

Interactive Qualifying Project: Launching the STEM@WTHS Project Center

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This report represents work of one or more WPI undergraduate students submitted to the faculty as evidence of a degree requirement. WPI routinely publishes these reports on its website without editorial or peer review.

Abstract

Due to the importance of STEM in academic and work environments, Worcester Polytechnic Institute (WPI) took the initiative of establishing a new WPI project center that focuses on STEM-related educational and teaching opportunities (such as MQPs, IQPs, seminars, and other educational experiences) embedded in Worcester Technical High School (WTHS). Pre-service teachers in the WPI Teacher Preparation Program will complete their teaching experience practicum through this off-campus project center. The center will be managed by the WPI STEM Education Center, which is looking to have a long-lasting impact on our community by enhancing the quality of education provided to K-12 students through a STEM-focused curriculum and hands-on experiences. The IQP team responsible for this project researched STEM education, interviewed relevant stakeholders, and hosted a workshop with WTHS to discuss the utilization, communication, and visibility of the center in both communities. Some potential projects discussed for the new project center include completing TPP practicums, STEM-related presentations, and MQP/IQPs. The goal of this IQP was to launch this project center with a finalized non-binding partnership between WPI and WTHS by providing recommendations for the shared vision and future management of the center based on our findings.

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We would like to express our sincere gratitude to the STEM Education Center, Worcester Technical High School Faculty and Administration, as well as Worcester Polytechnic Institute Faculty and Students for their invaluable support and contributions towards the successful launch of this project center. We are particularly grateful to our project advisors, Kathy Chen and Noemi Robertson, for their dedication and commitment to our success. Their expertise, feedback, and mentorship have been instrumental in shaping the direction and scope of this project, and we are fortunate to have had the opportunity to work with such exceptional educators.

Authorship

By adopting a flat hierarchical structure and dividing the workload evenly, we all played similar roles in contributing to the success of the project. Specifically, we worked together on opening content chapters, the introduction chapter, the background chapters, and the interview/workshop questions.

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Raised in Warren, Rhode Island, Lorenzo was born of Brazilian and Scillian descent as a second-generation immigrant whose father was born in Belo Horizonte, Brazil. This in turn influenced the experience Lorenzo had growing up as the expectations of a foreign father were different than a traditional American parent. This forced him to exceed expectations higher than other children in his age group. He graduated from the New England independent preparatory school *Tabor Academy* located in Marion, MA in 2020. Throughout his high school career, Lorenzo's interests included working as an assistant in the school's Maker Lab which prompted his major in Electrical and Computer Engineering as well as making the varsity rowing team.

On this project, he primarily was the face of conversations with advisors as well as lead interviews with stakeholders and the workshop. He was the initial designer of the website, designing the layout and structure. In this report he wrote, Website Operation document, the Final Recommendations and Memorandum of Understanding along with Kaiwen.

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Kaiwen is a second-generation Chinese immigrant who was born in Framingham, MA and lived in Andover, MA for most of his life. He graduated from a suburban public school in 2020 with interests in playing both trumpet and piano, and he participated in the school's marching band. He has several years of experience working as a math tutor for middle school students. His experience with tutoring and public schools influenced his perception of an ideal STEM education and led to him joining an education-based IQP.

On this project, he recorded notes during interviews and most meetings, and helped condense interview and workshop results and feedback into digestible analyses. In this report,

he worked on writing the Methodology and Results sections. In addition, he wrote the Final Recommendations and Memorandum of Understanding along with Lorenzo.

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On this project, he usually outlined tasks' contents and visuals, such as those for the term presentations, the workshop, the website and the center's various suggested advertisements. He prepared the agendas and communicated with advisors while keeping the team on track. He frequently asked his teammates and advisors for feedback before committing to current drafts or decisions. In this report, he mainly focused on writing the Methodology and Results chapters and managed the overall cohesion between chapters.

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Will was born in Concord, MA. Throughout his childhood, he showed an interest in STEM fields. His favorite classes in school were those in math and science areas. He graduated from *Concord Carlisle Regional High School* in 2020. During his time there, he worked in the tech department of the school's radio station. He has always had an interest in helping others learn, in academic and non-academic contexts. He volunteered at a local summer camp for two years. This interest in learning is what led him to join an education-based IQP. It also gave him an educator-side perspective throughout the project.

On this project, he handled most communication between the team and outside parties. He also provided contributions to the website and acted as the primary editor for the report, interviews, workshop, and website.

Executive Summary

STEM educators play a critical role in shaping the next generation of innovators, problem solvers, and leaders. The WPI STEM Education Center seeks to provide opportunities for students considering a career in STEM education. To achieve this, the center houses the Teacher Preparation Program (TPP) for undergraduate WPI students seeking an initial teaching license in the state of Massachusetts. The TPP provides student teachers the opportunity to gain practical experience teaching (i.e., the teaching practicum) in a public school. One such school is Worcester Technical High School (WTHS). To enrich the TPP's teaching practicum and to provide our local community with more STEM-related opportunities, a project center has been established within WTHS.

This IQP report consists of the launching of a new project center, *STEM@WTHS Project Center*. It is managed by the WPI STEM Education Center and creates STEM-focused academic experiences embedded in WTHS, such as the TPP practicum. The following IQP objectives were established to provide the necessary recommendations for launching the project center:

1. Research successful teacher education programs.
2. Interview stakeholders involved in the project center from both schools, WTHS and WPI.
3. Create a shared vision and understanding of the project center between the two schools.
4. Formalize a list of recommendations for the operation of the project center.

To start, the team researched teacher education programs, the importance of STEM, and WPI's mission regarding project centers to inform the creation of interviews and a workshop with stakeholders from both parties (WPI and WTHS). The team interviewed staff from both schools, including WTHS teachers and administrators, WPI TPP students, and WPI faculty. Interviews were conducted in an open-ended, conversational manner. After collecting the data from interviews and research, it was decided that a design charrette (or workshop) would be helpful to further develop a shared vision between both parties by including the stakeholders previously interviewed. Visibility (advertisement) was also discussed at the workshop, with the website, physical fliers, and email announcements chosen as the most appropriate advertisements.

The recommended name is *STEM@WTHS Project Center* since it is concise yet it encompasses the focus on STEM and the partnership with WTHS. The recommended

projects are “Growing the STEM Teacher Pipeline”, “Integration between Academics and Shops at WTHS”, “The Psychology behind the Desire to Teach” and “Remodeling the WTHS Greenhouse”. The TPP practicum is now considered an off-campus IQP, so students are relieved from campus duties. Due to this center’s collaboration with WTHS, TPP seminars and practicums can be completed through *STEM@WTHS Project Center*, facilitating the current process; this is why the team took into consideration the past experiences of TPP students when conducting interviews. The team and stakeholders both agree that this project center has great potential to leave a stark impact on the Worcester community and beyond by integrating TPP into a high school and therefore providing young students with STEM experiences.

Table of Contents

Abstract	2
Acknowledgments	3
Authorship	4
Executive Summary	6
Table of Contents	8
Tables	9
Figures	9
Table 1: Acronyms used in this report	10
1. Introduction	11
2. Background	12
2.1 Growing Teacher Shortage: Impact on US Schools	12
2.2 STEM Teachers	12
2.3 Recruitment and Retention Drops	13
2.4 Mental Health of Teachers	13
2.5 Ways to Support Teachers' Preparation	14
2.6 Inequities and Biases	15
2.7 Student-Teacher Relationships	15
2.8 Importance of Experienced Teachers to New Teachers	16
2.9 Professional Development	16
2.10 WPI and the WPI Plan	16
2.11 WPI Global and Local Project Centers	17
2.12 Mission & Vision of WPI STEM Education Center and the TPP	17
2.13 Previous IQP	18
3. Methodology	19
3.1 Interviews	19
3.1.1 Relevant Stakeholders at WPI	20
3.1.2 Relevant Stakeholders at WTHS	21
3.2 Workshop for Shared Vision	21
3.2.1 Project Center Utilization	22
3.2.2 Project Request Process	22
3.2.3 Project Center Visibility	22
4. Results	24
4.1 Interview Results	24
4.1.1 WPI Interviews	24
4.1.2 WTHS Interviews	26
4.2 Workshop Analysis	27
4.2.1 Project Center Utilization	28
4.2.2 Project Request Form and Process	29
4.2.3 Project Center Visibility	30

4.3 Website	31
4.4 Additional Deliverables	34
4.4.1 Flier	34
4.4.2 Announcement	36
4.4.3 Final Recommendations	37
4.4.4 Memorandum of Understanding	37
5. Conclusion & Recommendations	38
Bibliography	40
Appendices	44
Appendix A Interview questions with Physics Teacher, WTHS	44
Appendix B Interview Questions with Director, Human Subjects Research and Academic Programs, WPI	45
Appendix C Interview Questions with Principal & Director of Career and Technical Education (joint interview)	46
Appendix D Interview with Director, IPP & Career and Partnership Specialist, IPP (joint interview)	48
Appendix E Interview with Director, Teacher Preparation Program, WPI	49
Appendix F Interviews with WPI TPP Students who did their practicum at WTHS	50
Appendix G Interview with Professor and Director, Worcester Community Project Center (WCPC), WPI	51
Appendix H Memorandum of Understanding	52
Appendix I Recommendations for Website Management	55
Appendix J Flier	59
Appendix K Email Announcement	60
Appendix L: Website Form	61

Tables

Table 1: Relevant acronyms	10
Table 2: Graph detailing health problems surveyed among teachers	14

Figures

Figure 1: Workshop Roadmap Slides	27
Figure 2: Process of Project Form	29
Figure 3: Website Homepage	31
Figure 4: Website Projects Page	32
Figure 5: Project Form Section 1	33
Figure 6: Project Form Section 2	33
Figure 7: Website Form Section 3	34
Figure 8: Flier	35
Figure 9: Email Announcement	36

Table 1: Acronyms used in this report

Acronym	Definition
WPI	Worcester Polytechnic Institute
WTHS	Worcester Technical High School
CRT	Culturally Responsive Teaching
STEM	Science, Technology, Engineering, Mathematics
IQP	Interactive Qualifying Project
MQP	Major Qualifying Project
TPP	Teacher Preparation Program
MOU	Memorandum of Understanding
IPP	Innovations Pathways Program

1. Introduction

As technology and science become unavoidable factors in our daily lives, STEM education is more important than ever. Teachers are a critical part of students' development into productive and successful individuals. However, educators across the United States are leaving the profession and fewer teachers than ever are earning teaching licenses. A multitude of factors contribute to this shortage, including the recent COVID-19 pandemic, strict and limited recruitment, and public perception of the profession. This shortage is even more severe for STEM educators. (Feder, 2022).

In response to this challenge, WPI has initiated a plan to establish a new project center that focuses on STEM-related educational and teaching opportunities embedded in WTHS. With WPI's commitment to the United Nations 17 Sustainable Development Goals, our project seeks to engage with Goal #4: Quality Education.

The goal of this IQP team is to launch the project center, which will allow student teachers in the WPI TPP to work closely and frequently with the high school, empowering and better preparing them for a professional career in education and encouraging WTHS students to learn more about STEM. With a project center embedded in WTHS, greater cooperation and communications are possible than before. This project center will be able to house the TPP, as well as give the option to conduct other STEM-related MQPs, IQPs, and smaller projects. TPP students will also benefit from the project center, allowing them to be relieved from on-campus responsibilities and gain the opportunities to have more practical experiences in a real classroom.

In order to launch the center, the IQP team conducted research on STEM education, project centers, and teaching by interviewing relevant stakeholders, such as teachers, TPP students, project center directors, and the WTHS principal. The team aimed to form a shared vision between WPI and WTHS based on their research and interviews, explore other possible projects beyond the TPP, and provide well-informed recommendations to facilitate the project center's future management and success.

By successfully launching this project center with a finalized partnership between WPI and WTHS, there is an aspiration to contribute to the education of future generations and provide a unique opportunity for WPI students to gain valuable experiences in the field of STEM education.

2. Background

In this chapter we establish the necessary context of the factors we will take into consideration when analyzing our primary data (interviews and workshop) in order to launch the new project center with an evidence-based approach. This background information considers the current teacher shortage in the US and its consequent factors, such as the importance of STEM pedagogy, ways to support teacher preparation, and relevant information regarding our clients.

2.1 Growing Teacher Shortage: Impact on US Schools

According to the American Association of Colleges for Teacher Education, from 2008 to 2019 the number of people completing a traditional teacher education program decreased by over one-third (Chirichella, 2022). In addition, 88% of all school districts in America reported a shortage of educators in 2021. Both teacher recruitment and retention are falling, and these problems were only exacerbated by the COVID-19 pandemic. This shortage can be attributed to multiple factors, leading to both experienced and new teachers leaving the profession. The most important factors were increased accountability and paperwork, poor student and parent attitudes, unresponsive administrations, and the perceived low status of the profession, including salary considerations (Tye, 2002).

A study published in early 2019 reported that teachers with less experience or certifications are more likely to quit. Other factors found to be correlated with the likelihood of quitting the profession included poor organizational commitment and stress (Mack, 2019).

2.2 STEM Teachers

Amidst this shortage, STEM teachers have been in especially high demand. Physics is a subject with 27,000 teachers in US high schools, and arguably, the number of physics teachers should ideally be 42,000-50,000. In all STEM fields, 100,000 teachers in high school and 150,000 teachers in middle school are needed (Feder, 2022). In addition, the number of certificates awarded for teaching STEM is decreasing while tuition and state requirements increase.

At the Colorado School of Mines, results from surveys and focus groups indicated that half of college physics majors expressed some form of interest in teaching in high school (Feder, 2022). Many college students are willing to teach and see the profession as rewarding; however, the barrier to entry for STEM degree teaching is incredibly high.

2.3 Recruitment and Retention Drops

Due to the decrease in student enrollments that happened mostly because of the pandemic, 40% of the country's largest schools had to implement staff and budget cuts (Makori, 2022). Just in Massachusetts, the enrollment in "public schools has fallen nearly 4%" (Hilliard, 2022), but even if no teachers leave certain schools, there can still be a deterioration in the quality of education due to factors such as salary reductions and lack of resources.

Amidst the pandemic, "Worcester School Committee approved \$15.5 million in budget cuts" (Hanson, 2020). For example, this included diminishing the use of essentials such as HVAC systems and decreasing the number of bus rides.

According to Boston University Wheelock College of Education, teacher turnover was at least 15% higher from 2020 to 2022 compared to 2019 (Jung, 2022). This change in turnover increases overall teacher diversity in Massachusetts (WEPC Faculty, 2022). This factor can affect student-teacher interactions and school management, as to be discussed in section 2.6.

2.4 Mental Health of Teachers

A large correlating factor among the many educators who decide to leave the profession is lack of experience or certifications. A study of educators in Florida conducted in 1999 found a significantly greater level of teacher attrition among uncertified teachers than certified teachers. Related studies conducted in other states show similar statistics. In addition, less experienced or certified educators are more likely to leave the profession altogether while other more experienced educators tend to simply transfer to another facility (Billingsley, 2004).

Occupational stress, including poor job satisfaction, plays a major role in teacher attrition rates, as reported by a significant number of studies. For instance, a study (Mack, 2019) notes that higher perceived stress is correlated with intent to leave the profession (Table 2). It is highly important that teachers early in their careers receive support as they gain the necessary experience to work in this profession. A study conducted on an educator mentoring program for special needs education found a significant correlation between teachers' plans to remain in education, which is especially significant considering that special needs education is the area most lacking among educators (Whitaker, 2000).

Table 2: Health problems surveyed among teachers (Mack, 2019)

	Remain (0% not likely to quit) N = 949	Intend to leave (100% likely to quit) N = 198	Statistical comparison p value	Cohen's d
Perceived stress mean (St. Dev)	16.20 (7.0)	23.13 (7.8)	$p < 0.001$	$d = 0.935$
SF-36 mental quality of life mean (St. Dev)	46.01 (11.8)	34.00 (14.2)	$p < 0.001$	$d = 0.920$
SF-36 physical quality of life mean (St. Dev)	50.38 (9.4)	49.73 (10.1)	NS	
Major depression %	10.2%	47.7%	$p < 0.001$	
Anxiety disorder %	11.5%	38.0%	$p < 0.001$	
Panic disorder %	6.0%	17.9%	$p < 0.001$	
Somatization %	24.9%	60.9%	$p < 0.001$	

Many teachers also feel that their role tends to extend beyond that of an educator and feel overloaded by administration and parents. A 1995 study of special education teachers concluded that only half of all special education educators surveyed felt their workload was manageable (Morvant, 1995). Clearly defined responsibilities, adequate time for paperwork, and lesson plan creation are all correlated with teachers planning to remain in the profession.

2.5 Ways to Support Teachers' Preparation

When researching factors that could support a teacher in the long term, we tried not to limit our understanding of which factors could be significant. For example, we found that teachers often seek to learn more about their interests and do not necessarily follow a strict syllabus or work schedule. They might achieve this by taking courses outside of their institution while preparing to become a teacher or taking time off to take courses while teaching. "Teachers' subject matter understanding and their pedagogical orientations and decisions critically influence the quality of their teaching" (National Academies of Sciences, Engineering, and Medicine, 2001). Moreover, encouraging teachers to take these courses immediately after graduating can be beneficial: "one factor stands out: Teacher preparation that focuses more on the work of the classroom and provides opportunities for teachers to study what they will be doing produces teachers who are more effective during their first year of teaching" (Boyd, 2008).

An indication of successful class comprehension is the syllabus, which should include effective communication of the content and its level of clarity and accessibility. According to

Harvard researchers, a good syllabus should have assignments that focus on the same goal as the overall course, allowing students to feel that the course strategies have been designed to help them reach their goals, rather than merely being busywork (Harvard researchers, n.d).

2.6 Inequities and Biases

There are many inequalities and biases inside the classroom that many teachers are not trained for. For example, according to research, even black teachers subconsciously have 30-40% higher expectations of black male students (Gershenson, 2016). Teachers are an essential part of people's lives, so having biases like this one can gravely affect the education of many. Helping students beyond the classroom and bonding with them has shown an improvement when these issues are present in their environment.

To help them, making use of Culturally Responsive Teaching (CRT) can be beneficial. CRT entails viewing a student's identity and culture as assets in an academic setting and not as factors that segregate them from their classmates, teachers, and syllabus (Massachusetts Department of Elementary and Secondary Education, 2021). "Teaching methods that connect with students' real lives and interests and promote understanding of other cultures are associated with better academic outcomes" and an increase of "positive racial socialization" (Byrd, 2016).

It was found that teachers from diverse backgrounds can inspire students from nondominant groups, yet white teachers, when properly trained, can also be as effective regarding culturally responsive pedagogy (Nevarez, 2019).

2.7 Student-Teacher Relationships

Developing relationships between the teacher and students on an individual level can be beneficial both in the students' ability to learn and in the teacher's ability to teach, as well as their mental well-being. Students perform better when teachers express high expectations, care, interest, and understanding of their students (Johnson, Wildy, & Shand). Successful student-teacher relationships make it easier for teachers to know how to make the learning meaningful and relevant, while also giving them a greater feeling of accomplishment in their work. Many teachers reported difficulty in developing these relationships, often leading them to feelings of frustration and anger. However, understanding these feelings, as well as the reasons the students are being difficult, can lead to a smoother development of relationships and better overall mental health (Spilt, Koomen, & Thijs. 2011).

The early formation of student-teacher relationships, such as understanding the student's culture, their point of view, being culturally responsive (as discussed in the previous section), and being flexible with them has been shown to improve the teacher's mentorship skills (Schweinberg, 2015).

2.8 Importance of Experienced Teachers to New Teachers

Programs where first-year teachers are mentored by more experienced teachers, sometimes called teacher induction programs, only work sometimes. In order for them to work, both the mentor and the new teacher have to be engaged in making it work. Each has to be willing to listen to the other. Studies on teacher induction focused more on how well teachers felt they were doing, and how important they felt the induction program was, without looking at how it impacted student performance (Wang, Odell, & Schwille 2008).

2.9 Professional Development

If a teacher has self-efficacy, they are able to reflect on and adjust their teaching style to fit the needs of their students and unsurprisingly, their students perform better in academics. Researchers also found a link between self-reflective teachers and those with a better ability to accommodate the diverse needs of their students. They also found that teachers with self-efficacy make students more engaged. Studies also have shown that they experience less burnout and stress, as well as more job satisfaction and commitment (Zee & Koomen, 2011).

2.10 WPI and the WPI Plan

WPI is a higher education institution in Worcester, MA founded in 1865 with a focus on engineering and technologies. With over 5,000 undergraduate students, WPI offers various majors in humanities, engineering, computer science, and other unique fields. It is renowned for its Global Project Experience and Project-Based Curriculum, which focuses on positive community impact. WPI's unique curriculum divides the school year into four seven-week quarters. The WPI Plan, introduced in 1970, aims to apply university-level learning to real-world problem-solving. The plan is based on six principles: Pursuing Your Passion, Learning how to learn, Project-Based Learning, Global Immersion, Beyond the Classroom, and Personal.

2.11 WPI Global and Local Project Centers

WPI's two degree-required projects, the MQP and IQP, are the height of an undergraduate student's experience. Both global and local projects take place for students depending on where they wish to work. These projects are advised by a WPI project center and sponsored by an outside group that's not necessarily affiliated with WPI. These projects vary in task based on the project center and sponsor hosting it. There are global project centers located in different countries such as England, China, Japan, and Italy, while some of the local project centers are based directly in Worcester, Massachusetts. For example, the STEM Education Project Center is one of them. On-campus projects are typically done in 3 terms of 1/3 units, while taking 2 other courses each term. Off-campus IQPs are done in a single term of 3/3 units, with no other classes.

2.12 Mission & Vision of WPI STEM Education Center and the TPP

The WPI STEM Education Center is a unit within WPI that, through the new *STEM@WTHS Project Center*, houses the TPP, which enables undergraduates to complete the teaching practicum required for initial licensure by the State of Massachusetts. WPI undergraduate students getting a Bachelor of Science can apply for the program in their first or second year. After being accepted, TPP students take multiple courses on teaching and gain teaching-like experiences. During their junior year, they complete student-teaching for a full semester in a middle or high school classroom under a mentor teacher. The student-teacher starts with classroom observations and then quickly starts leading lessons in the classroom independently. Some WPI students complete their teaching practicum at WTHS.

A TPP IQP is different from other IQPs in that it's done over 2 terms encompassing 2/3 units, requiring an additional WPI course each term for a WPI student to be considered full-time.

The main goal of the TPP is to prepare undergraduate students (earning a Bachelor of Science) to be endorsed for an initial teaching license at the secondary level in the state of Massachusetts. The program fosters teachers to help their students solve STEM-related challenges and "overcome the future challenges of the American education system" (WPI staff, n.d.).

2.13 Previous IQP

This project is a continuation of a project completed in 2020 titled: “Establishing a Partnership: STEM Education Center and Worcester Technical High School.” This project aimed to establish a relationship between the WPI STEM Education Center and WTHS, creating a TPP presence within the high school itself. They conducted interviews with STEM Education Center staff and WTHS teachers and administration. Upon completion, their project delivered a draft MOU which has been used as an initial guideline for the partnership, a project center definition, and preliminary recommendations for projects that can be completed at the site.

3. Methodology

Upon commencing data analysis, the team initially intended to employ tools such as SWOT analysis to classify the data found during the interviews and workshop into strengths and weaknesses. However, upon closer examination, we realized that our findings were highly subjective and did not align with the conventional framework of categorization. Given the contrasting nature of both parties, where one action could benefit one side but not the other, the situation was further complicated. We decided to utilize our insights to produce well-considered recommendations and articulated them in our conclusion. This approach enabled us to provide actionable recommendations that effectively address the challenges identified in our research while accounting for the nuanced perspectives of different stakeholders.

3.1 Interviews

We identified the needs of the stakeholders of the project center by conducting interviews with them. This allowed us to gain their individual perspectives and find out what the common wants, needs, and potential constraints were. We interviewed the stakeholders listed in chapters 3.1.1 and 3.1.2 based on their experience and potential involvement with the project center. The interviews were formulated based on our research and goals. They were conducted in a conversational manner with questions given beforehand to guide the discussion more efficiently. The interviews were also used to identify any other individuals who may be helpful in gaining a greater understanding of the needs of the project center. In addition, project center visibility is an important factor to consider since we wanted to find out how to get students and faculty interested in the center's future projects. Therefore, in an effort to find what could differentiate this project center from the STEM Education Project Center or other Worcester-based project centers, stakeholders were asked about their thoughts on establishing clear visibility for the center and what advertising channels they find most appropriate.

Questions can be found in Appendices A-G, and included the following themes:

- Past experiences and perception of WPI and WTHS
- Importance of teaching and what could be done to improve the experience for student teachers
- Advantages and disadvantages of the collaboration and project centers in Worcester vs global centers

- Future project ideas and general suggestions for the project center
- Visibility strategies for TPP and the project center
- Suggestions for other people to interview

Interviews were recorded to ensure the accuracy of our analysis. We asked for permission from each interviewee to record the session. Because the interviews were programmatic in nature, rather than personal or potentially containing sensitive information, a Human Subjects Internal Review Board (IRB) request was not submitted. Best practices for interviews were still conducted, for example, the recordings were deleted after the analysis. The findings of these interviews were used to inform the creation of a workshop between the two schools to develop a shared vision between WTHS and WPI.

3.1.1 Relevant Stakeholders at WPI

Director, Human Subjects Research and Academic Programs

Part of this stakeholder's job is working with the academic side of IQPs, which is why we wanted to interview them. Our questions were formulated to ask about what makes a strong or weak IQP, not only for the betterment of our IQP but also for future IQPs that the project center may house.

Director, Teacher Preparation Program

The director of the TPP works with current and potential TPP students and manages its marketing and visibility, so we asked them about advertising the center. We also wanted to ask about the differences that an off-campus project center would have compared to an on-campus IQP.

Professor and Director, Worcester Community Project Center

They work with a different project center in Worcester, so we wanted to make sure there was no overlap or confusion between this new project center and theirs. We also asked about what makes their center effective in the Worcester community.

TPP Students with WTHS Teaching Practicum

They were asked about many aspects of their experience within the TPP. We mainly focused on how they learned about the existence of the TPP and their thoughts on the practicum taking place at WTHS through the new off-campus project center.

3.1.2 Relevant Stakeholders at WTHS

Physics Teacher

They have worked with many WPI teacher prep students doing their practicums. We asked about the perception of WPI by WTHS staff and students, their experience with other teacher preparation programs, and how WPI TPP students perform in comparison. Finally, we talked about their expectations for the project center.

Joint interview: Principal & Director of Career and Technical Education

We wanted to learn how WTHS functions to find the best ways to form this partnership and hear their expectations for this project center. Due to WTHS's status as a vocational technical high school, we inquired about the dynamics of shops and academic classes, and in what ways this center's activities could interact with them. We also asked about their wants, their needs, the logistics of this partnership, and the kinds of projects they would like to see.

Joint interview: Director, Innovations Pathways Program & Career and Partnership Specialist, Innovations Pathways Program

The Pathways Innovation Program (IPP) is an afternoon program designed for six comprehensive high schools, where students can apply during their ninth grade and participate until they graduate. The program offers technical education opportunities mainly in STEM. It takes place between November and March since students are usually less busy during the afternoon due to the general absence of sports in Winter. These stakeholders were interviewed to gain an understanding of their logistics and to open the way for potential projects between the IPP and the new project center.

3.2 Workshop for Shared Vision

The shared vision consists of WPI and WTHS collaborating on projects that mutually benefit them while simultaneously aligning expectations regarding mutual projects' scope

and goals. Establishing this vision will minimize conflict by creating a sense of community between the two parties.

In order to facilitate a collaborative effort between both institutions, it was important to have a clear understanding of their shared goals and challenges. One effective method for achieving this is through the use of a design charrette, or workshop (Todd and Lindsey, 2021). A design charrette is a conference-styled conversation that is designed to bring together relevant stakeholders to identify commonalities and problems as well as discuss relevant information.

The previous team that worked on this project center focused on establishing a relationship between the two parties. Our team wanted to set up the structure necessary for both parties to voice their opinions in order to maintain the shared vision. To do this, after interviewing each stakeholder, we hosted a workshop where we met with as many of them as could attend to discuss the project center. The conversation was guided by the IQP team; it was divided into three main topics:

3.2.1 Project Center Utilization

We explained which types of projects the center will house: Large projects, where WPI students may complete IQP/MQP within the center with WTHS, Teacher Prep Program practicums (where WPI students within the TPP participate in a real classroom setting) and small one-time events where WTHS staff can request WPI students for smaller projects and presentations. After that, we asked for potential ideas that fit these categories. Then we discussed the role of both institutions whenever a new project is executed.

3.2.2 Project Request Process

We realized that it was necessary for the project center to have a method to receive communications about project proposals, especially from WTHS. This communication had to encompass all potential projects in the future: MQPs, IQPs, and smaller projects and seminars. Potential future projects and the best way to communicate them with the project center were discussed.

3.2.3 Project Center Visibility

We explained how this project center and its activities will be communicated in the future to the WPI community. From there, we wanted to learn how WTHS plans on

communicating the same information to their community and how the project center can contribute. So, we listened to stakeholders' opinions regarding advertising and through which channels.

4. Results

At the beginning of this IQP, we were only going to provide recommendations, the Memorandum of Understanding, and some advertisements for the center. But due to our discussions with the stakeholders, we also found what changes we needed to implement to the aforementioned deliverables and that we need to make a website and focus on the communication between both parties and what types of channels of advertisements we should consider.

4.1 Interview Results

We aimed to identify the unique insights and information that each stakeholder, based on their respective roles, could offer to our research while keeping in sight the development of a shared vision, in which both institutions mutually benefit.

4.1.1 WPI Interviews

Director, Human Subjects Research and Academic Programs

We discussed their role in the academic side of IQPs and similar projects, and how from those experiences they found that a successful project fulfills learning outcomes effectively. They emphasized that the success of WPI off-campus project centers depends on the relationship between WPI faculty and site sponsors, and that marketing is crucial. They highlighted the use of social media and other methods to advertise project centers to students and suggested contacting the Director of the Worcester Community Project Center for potential collaborations.

Director, Teacher Preparation Program

They discussed their role in visibility and marketing of the TPP. Their experience as a former teacher in the Worcester Public School District enables them to handle the recruitment and placement of student teachers by networking with the community. Matching student teachers with mentor teachers is one of the most important parts of their job, and they see potential in the collaboration between TPP and WTHS through the project center. They appreciate embedding the TPP practicum into the project center since it can benefit both parties by relieving student teachers from most on-campus obligations.

They stated that *eProjects* is the primary means for students to apply to TPP, but tabling, campus digital screens, information sessions, and direct contact are also important to

consider when advertising the project center. Regarding publicity, they believe that the TPP could benefit from plentiful visibility, and they suggest that one way to do this could be to make it a minor with 5-6 classes; however, that is not within the scope of this IQP.

Finally, they suggested some potential projects to consider for the project center:

- Aligning CS/Robotics shops with WPI majors.
- Exploring all shops and links with WPI departments.
- The psychology behind the desire to teach.

Professor and Director, Worcester Community Project Center (WCPC)

They primarily discussed their role in managing a Worcester-based WPI project center. Their partnerships with other organizations and respective IQPs usually depend on the number of interested students and their demographics. They felt that the teaching practicum is very different from global and local IQPs. They said that if the project center started doing education-focused IQPs, it would not cause any confusion with the WCPC they direct, which was a potential concern. They remarked that the benefits of WPI students enrolling in off-campus IQPs in Worcester included affordability, proximity to family/school, diverse selection, and a better understanding of the Worcester community. Some challenges include team dynamics, sponsor expectations, and students' understanding that off-campus Worcester IQPs are considered a full in-person class component, and not to be attended part-time. Finally, they said they were open to partnerships between both project centers. Additionally, they find D-term to be a good term for IQPs.

WPI TPP Students who did their practicum at WTHS

One TPP student participated in the TPP because they were interested in math. They do not remember how they found out about the program, but they were pleased with their placement at WTHS. Their recommendations for other TPP students include getting familiar with the school, meeting with their mentor early and often, creating lesson plans, learning student names early, motivating student participation, and having mentors who are actively involved by regularly checking in. Lastly, they suggest that WPI students conduct activities with shops related to their majors at WTHS.

The other student interviewed participated in the TPP because they had a long-standing interest in teaching and wanted to make science engaging for children. They discovered the TPP through the WPI website and were content with their placement at

WTHS. To feel more comfortable in a new teaching environment, they suggest working closely with the students, creating lesson plans, paying close attention to classroom management, and engaging in hands-on projects as much as possible. Their practicum experience was particularly challenging, and they recommend underloading the number of WPI courses, especially later when the teaching practicum requires more responsibilities from student teachers.

4.1.2 WTHS Interviews

Physics Teacher

They shared their positive experiences with the WPI Teacher Prep Program over a period of seven years. They recommended that WPI students better understand that typical high schoolers may have less interest in academics than they expect. They had experience with other teacher preparation programs and found that they were more in-depth and required more time than the WPI TPP. Thus to better prepare WPI Teacher Prep students, they suggested working with individuals on their struggle areas and having stricter schedules with lesson plans. They proposed that the project center could host activities adjacent to existing programs such as tutoring. Overall, they are happy about this partnership. They believe that the general perception of WPI at WTHS is that, while their students were fascinated by WPI, they see it as unattainable and disconnected from the community. They suggested using Twitter as the best media to communicate with students.

Joint interview: Principal & Director of Career and Technical Education

They expressed their desire to see more than just TPP at the project center, so they suggested a project about linking traditional academic learning with the tech shop and practical skills. They had no concerns about WPI students working at WTHS, and both believed that the longer someone stays, the better integrated they become with the teachers. They recommended involving academic and vocational department heads in future projects to finalize a clear vision and purpose for the partnership. Finally, they mentioned that they found weekly tutoring to be unsuccessful because students lose interest quickly, so instead it might be better to focus on topic-specific tutoring sessions, presentations, seminars and workshops.

Joint interview: Director, IPP & Career and Partnership Specialist, IPP

They discussed how the IPP could potentially collaborate with WPI to offer internships, host presentations/seminars, and outreach activities. Specific collaboration ideas (not necessarily IPP related) were discussed, including mentoring for senior students' capstone classes, aligning IPP pathways with mentoring/tutoring, offering technical teacher licensure in more shops, and having students assist in the creation of new IQPs for the center. (reference chapter 3.1.2 for more information about the IPP).

They emphasized the importance of concise, smaller, and interactive lessons to catch students' attention quickly. They believe that faculty and students would respond well to guest speakers but noted that the speakers should remember that the students are younger.

They noted that the project center based in their school will inevitably have scheduling disadvantages. Nevertheless, they are excited about the collaboration and hope to tap into the center's shared resources.

4.2 Workshop Analysis

We divided the workshop into three main sections: Project Utilization, Project Request Process, and Project Center Visibility. We also discussed potential names briefly. This structure was displayed to workshop attendees on the slide shown in Figure 1. Below are our results divided into these sections and consequent themes. They were formulated by taking into consideration the main takeaways from the interviews.



Figure 1: Workshop slides: roadmap shown to stakeholders

4.2.1 Project Center Utilization

The main idea for this section of the workshop was to ask for project ideas for the project center to start with. The project ideas discussed were not finalized and many details about said project are to be determined. The strongest of these ideas regarding potential **MQPs and IQPs** were:

- Growing the STEM teacher pipeline: this concept involves enhancing the accessibility and timeliness of information about teaching as possible STEM careers. This could entail identifying promising candidates through an analysis of academic and technical credentials, as well as developing strategies for integrating pertinent knowledge into the educational curriculum at earlier stages of a student's education. This also entails addressing common misconceptions and outlining key steps for future teachers to consider a career in STEM education.
- Integration between academics and tech shops at WTHS: WTHS is exploring the possibility of enhancing the integration between academic programs and shops; they are interested in facilitating this in collaboration with the project center.
- The psychology behind the desire to teach: this project would be about investigating potential factors and commonalities between students that find teaching desirable at WTHS and the TPP to inspire future teachers.
- Greenhouse: WTHS is looking to remodel its greenhouse, where a potential MQP or IQP could explore and/or execute a plan to give the defunct greenhouse new functions in potential collaboration with a WTHS capstone project.

Regarding the TPP, we discussed the benefits of it becoming a part of the project center. Some benefits are that student teachers are relieved of on-campus responsibilities while teaching. This leaves more time for commuting, lesson planning, grading, and meeting with their mentors. Lesson planning was discussed in depth during both the interviews and workshops. Students who taught at WTHS before their practicum found it very challenging to create concise lesson plans that utilized class time effectively. Recent efforts are allowing student teachers to improve and are leaving them more time for lesson planning and grading. Consistent mentoring was identified as an additional beneficial support. Currently, the TPP is looking to shift more of its courses to be completed during a student's practicum at a school instead of during the student's school year. These benefits will allow the TPP to feel just like any other off-campus IQP, letting student teachers be more engaged in their practicum.

Everyone seemed to like the idea of having ongoing activities that further connect both of our communities through STEM as smaller projects or one-time events. They might include but are not limited to: seminars, presentations, workshops, and hands-on projects.

4.2.2 Project Request Form and Process

Some very valuable feedback was collected regarding the template of the website's project request form, initially shown at the workshop. It was targeted toward WTHS faculty and had three options: 'Project suggestion', 'Request for a WPI student' (as a TA or for a presentation), and "Other." Figure 2 shows the very first draft of the form discussed during the workshop.

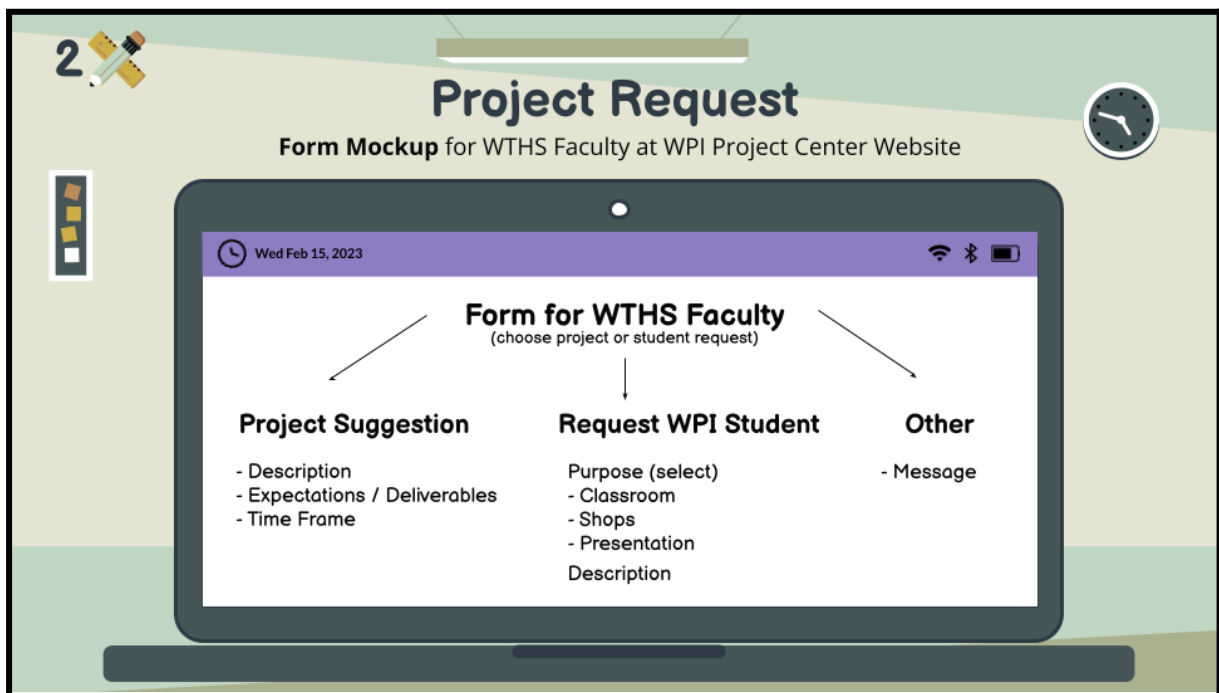


Figure 2: Workshop slide: project request form template

After revising this draft, it was concluded that both students and faculty at WPI were also part of the target audience for requesting projects and therefore that it wasn't necessary to explicitly have a section for requesting students. Instead, you can now request a large or small project and "other", which is for feedback or general messages. This way, the STEM Education Center management decides each request's validity, category, and time frame based on the user's idea and its scope. Since both institutions have conflicting breaks and holidays, calendars were added to the website to assist with the timing for executing projects.

4.2.3 Project Center Visibility

There was no need to mention WPI channels of advertisements during the workshop since it was not relevant to WTHS stakeholders and it's already known to those from WPI. Therefore, it was important to discuss the channels WTHS uses in order to know which types of advertisements to consider making for them. WTHS works on "levels," meaning they have daily news for students through Instagram and clubs, and announcements for teachers from either the principal or department heads. With this in consideration, it was decided to make fliers (that include a QR code that directs the user to the website, refer to Appendix J) and email announcements (refer to Appendix K).

The topic of the center's name was briefly discussed. For most of the IQP, it had the placeholder name of "Worcester Tech Teaching Project Center." The term "STEM Education" was proposed by some to be a more comprehensive alternative to "teaching" as it encompasses a wider range of concepts and may more appropriately represent the project center's main propositions, but including "education" would make it too similar to the existing STEM Education Project Center. In the final recommendations (in Chapter 5), a new name for the project center is proposed: "*STEM@WTHS Project Center*". Since the center focuses on STEM-related activities and is embedded at WTHS, the name got widespread acceptance from our advisors and the STEM Education Center, primarily due to its brevity and directness.

4.3 Website

Based on the interviews and the workshop, it became clear that there should be a central portal with all the resources, information, and necessary communication channels for the project center. Therefore, we included the following tabs: landing/home page (Figure 3), projects (Figure 4), Teacher Prep, calendars, and contact.

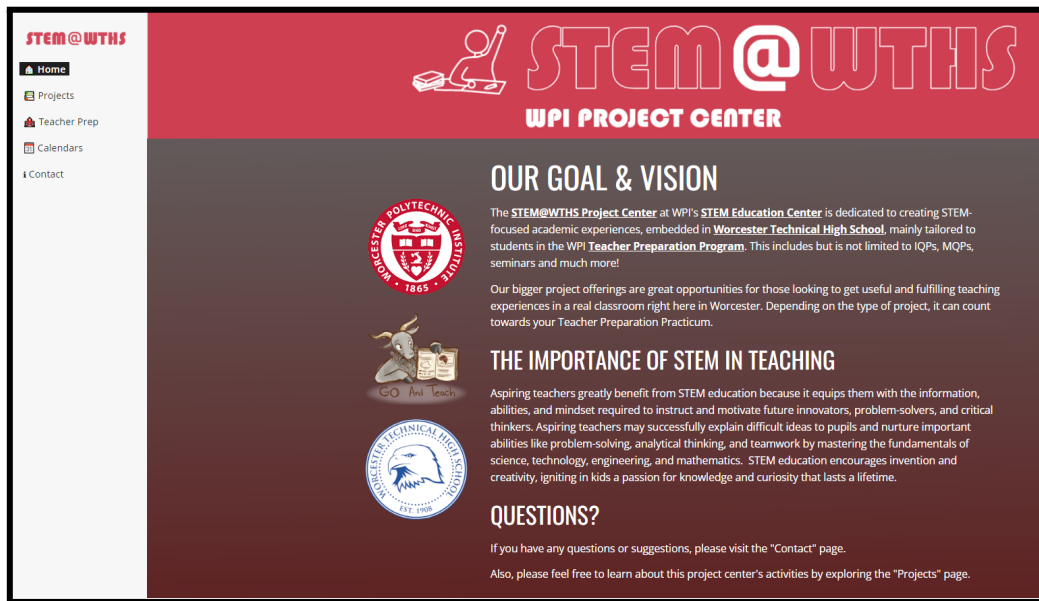


Figure 3: Website homepage describing the mission of the project center

The website was created using Google Sites for its simplicity. We modeled it after other project centers' website designs. Its URL is: sites.google.com/view/stem-at-wths.

The landing page or 'Home' summarizes the project center's goals, features maps of the WPI STEM Education Center and WTHS campus, and showcases relevant pictures of past projects. The 'Projects' tab showcases past, present and greenlit future projects with descriptions, images, and relevant details. The 'Calendars' page displays both institutions' current calendars for efficient project planning.

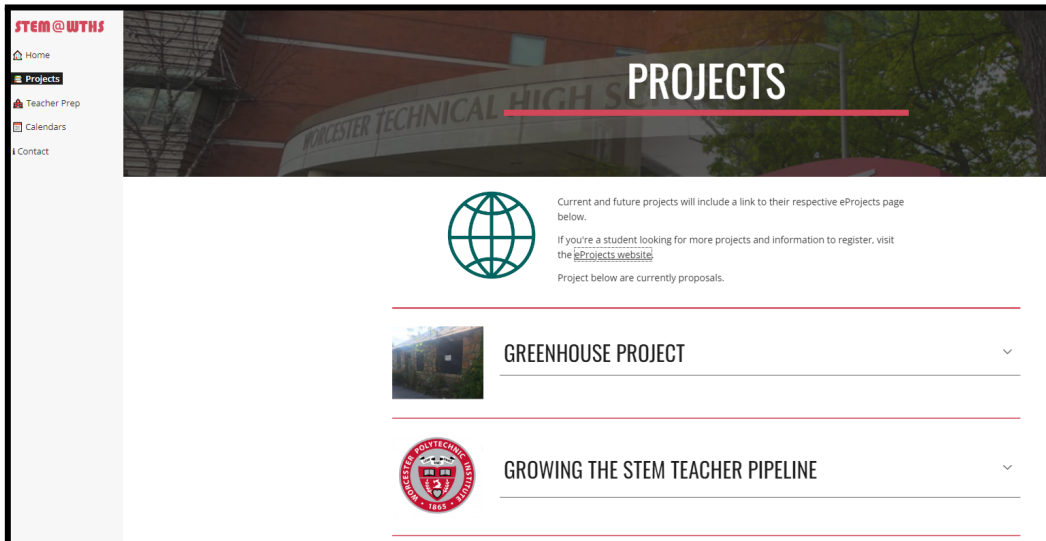


Figure 4: Website projects page, currently showing potential projects

In the ‘Teacher Prep’ tab, we briefly explained the TPP’s role in the project center and what it entails; we also added a hyperlink to the main WPI TPP webpage for further details. The ‘Contact’ page features images and emails for the project center management team (i.e., the STEM Education Center) and a Google Form, shown in Figure 5, that allows users to communicate feedback, questions, or new project ideas; there’s an option to choose between large and small project requests on the page shown in Figure 7 or to write messages on the page shown in Figure 6. The reason for this third option is so that users can send an email-style message to the entire management at once. The recommended website maintenance can be found in Appendix I.

Section 1 of 3

Project Request Form

When making your project suggestion, please keep in mind that this center focuses on **STEM-related academic experiences** embedded in Worcester Technical High School.

Email *

Valid email address

This form is collecting email addresses. [Change settings](#)

Name *

Short-answer text

Email *

Short-answer text

Phone Number (not required)

Short-answer text

What is your request? If you have a question or feedback, select "Message" *

- Large Project (WPI will advise what type of project this can be, like IQP or MQP)
- Small Project: Request WPI Student for classroom, shops or presentations
- Message (questions or feedback)

Figure 5: Website Form section 1, embedded in the website's Contact page

Section 2 of 3

Message to Teaching Project Center

Please compose your message to the project center below.

Message *

Long-answer text

Figure 6: Website form section 2, embedded in Contact page

The image shows a web form titled "Section 3 of 3" for a "Project Proposal". The form is divided into several sections, each with a "Long-answer text" input field. The sections are:

- Description (optional)**: A text input field.
- Description of Project ***: A text input field with a red asterisk indicating it is required.
- Expectations of Project ***: A text input field with a red asterisk indicating it is required.
- Deliverables of Project ***: A text input field with a red asterisk indicating it is required.
- Time Frame of Project ***: A text input field with a red asterisk indicating it is required.
- Other Comments (consider constraints)**: A text input field.

Figure 7: Website form section 3, embedded in the website’s Contact page

4.4 Additional Deliverables

This chapter discusses various miscellaneous deliverables related to the project center, including advertisement for the center (a flier and a general announcement of its launch), final recommendations based on the research of the IQP, the Memorandum of Understanding, and the website.

4.4.1 Flier

Based on the workshop results and further discussions, we decided on what the flier should include: the goal/vision of the center, the collaboration between WPI, TPP, and WTHS, what types of projects it will have, a QR code to the website, and some phrase that targets those interested in education.

As shown in Figure 8, we put the title of the center at the top and made it as big as possible. In the middle, we stated the aforementioned collaboration, the goal, and the types of projects. To the right, we put the phrase “For those interested in education!” (with “education” in bold to capture the attention of that audience). And at the bottom, we put a collage of both institutions, the Teacher Prep logo, and the QR code for the website.

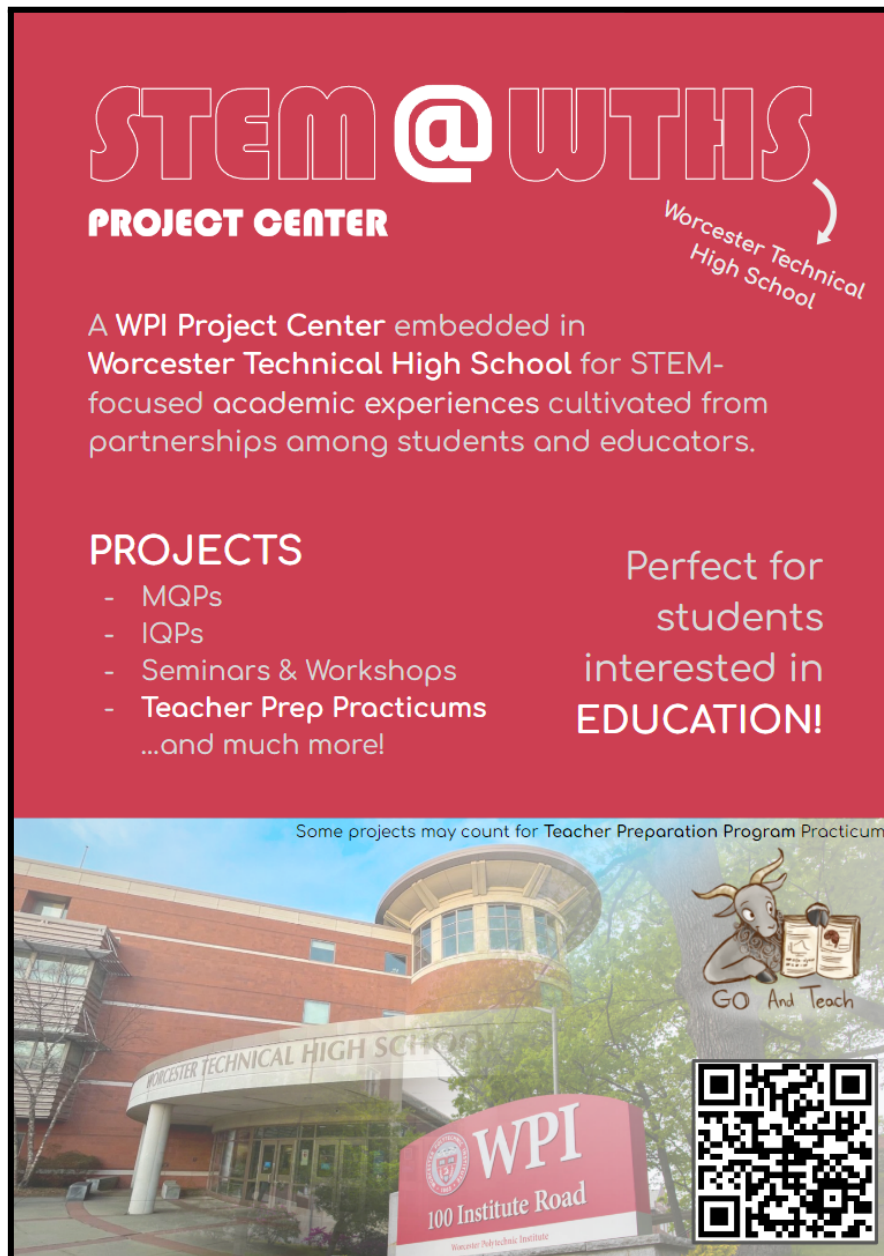


Figure 8: Flier to advertise project center around campus

4.4.2 Announcement

We made a general announcement of the project center so that it can be sent out to faculty and staff, shown in Figure 9. It has a general overview of what the center will do and the motivations for its creation.

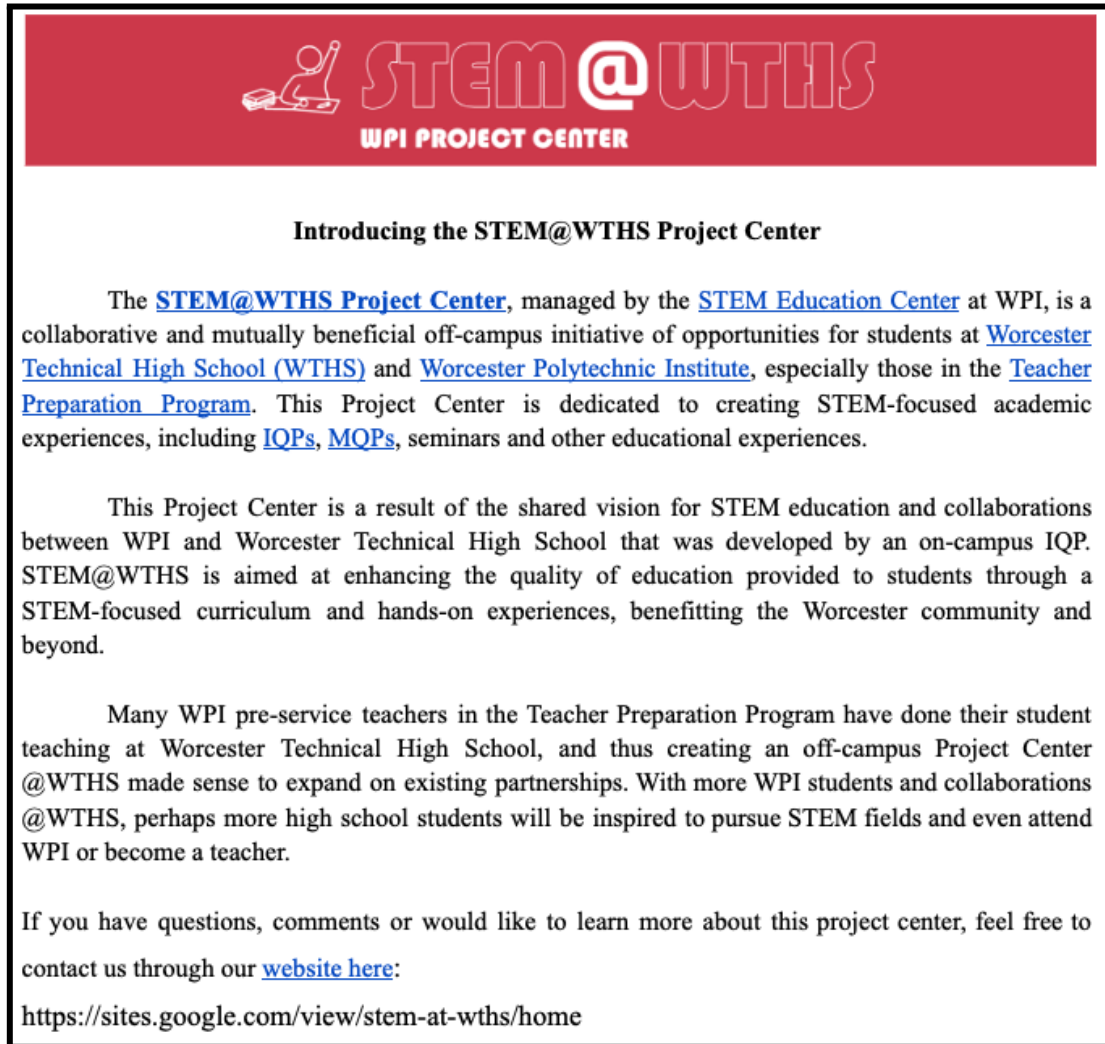


Figure 9: Email announcement about the project center directed to WPI faculty and students

Advertisements, such as the flier and email announcement, will be publicized to the WPI community by the project center's management. These two assets will be sent to WTHS so they can adjust their content, format, and scope according to the communication channels of their preference.

4.4.3 Final Recommendations

This is one of the most important deliverables in this project since it is a concise explanation of the most relevant information and our corresponding recommendations for those that will manage the project center after our IQP ends. In Chapter 5, we propose these recommendations for the establishment of the project center, and Appendix I provides guidance regarding the future management of the website.

4.4.4 Memorandum of Understanding

A Memorandum of Understanding (MOU) is a formal agreement between two parties that establishes a clear understanding of each of their roles, expectations, and responsibilities regarding the project center's management and operation while maintaining a clear focus on their mutual goal and shared vision (refer to Appendix H).

5. Conclusion & Recommendations

Based on the research conducted and data collected, our suggestions to the STEM Education Center take into account the feedback from past TPP students, the needs of all stakeholders, and the experiences of other project centers.

We recommend the name of this project center to be “*STEM@WTHS Project Center*” based on our interviews and the workshop. Should this name be changed, both sides would mutually agree on the name change and all infrastructure should be updated.

We advise the project center to be managed on the Worcester Polytechnic Institute side primarily by Kathy Chen, Noemi Robertson, and Jillian Bonaventura of the WPI STEM Education Center. Individuals outside of the project center can communicate with all staff through the form on the website’s Contact page (see Website Operations Document in Appendix I). We also recommend for the website to be used as the main hub of information for the project center so that all related information is easily found in one place. This includes having an archive of past projects and including any other future programs that the center may accommodate.

We advise the project center to be managed on the Worcester Technical High School side by an individual(s) that WTHS administration deems suitable for the role and will be decided on at a later point in time by their administration.

Within the project center, major projects will most likely be divided into IQP and MQP projects, where an IQP project is a seven-week project typically given to a team of WPI Juniors and an MQP project is a research capstone project typically given to a team of WPI Seniors. Major projects within the project center will likely be related to STEM education; however, projects do not necessarily have to be education related. Major project ideas to explore for the near future include researching a pipeline for STEM teachers, remodeling a defunct WTHS greenhouse, bridging the gap between shops and academics at WTHS, and the psychology behind the desire to teach. We also suggest offering smaller, one-time events such as presentations or seminars by WPI students hosted at WTHS. These events have the potential to establish the project center as a prominent entity at WTHS and improve the awareness of bigger projects by word of mouth.

Through the project request form on the project center website, there is also the opportunity for WTHS staff to request WPI students for one-time projects or events, such as small presentations, seminars, and workshops. WTHS and WPI staff will likely have some interaction with the project center through direct communication with the administration.

WPI students can sign up for major projects on the WPI system *eProjects*. We advise including a link to the project center's website in each project listed on *eProjects*. To join smaller one-time events, students could contact project center staff or the event's host.

Regarding visibility, we created email announcements directed at WPI faculty and students, and fliers to be put around campus. The project center management will use these or newer assets to advertise newly created projects when appropriate. Hopefully, these assets will be of value to the project center.

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Appendices

Appendix A Interview questions with Physics Teacher, WTHS

- Please tell us about your experiences with the WPI Teacher Prep Program.
- From your experiences, what might you recommend to better prepare the WPI students to teach at Worcester Tech HS (and other local schools)?
- In your opinion, what are the benefits of Teacher Prep students spending more time in a WTHS?
- Do you have any experience with other teacher preparation programs? What lessons have you learned from those experiences?
- What types of activities might you suggest to better prepare the WPI Teacher Prep students?
- The WPI project center at Worcester Tech High School could host other activities and projects. What ideas might you have?
- How do you think your students would respond to having WPI students at WTHS?
- How do you think teachers/staff would respond to having WPI students at WTHS?
- What is the general perception of WPI at WTHS?
- What is the perception of your students about WPI?
- How do you view this collaboration/partnership with WPI?
- What advantages/disadvantages do you see in a project center hosted within a high school?
- What kinds of things would you like to see in the project center we are launching?
- Is there anyone else that you think will be beneficial for us to contact regarding our project?
- We are planning to hold a workshop for all stakeholders in the project center to discuss coming to a shared vision and brainstorming possible collaborations. Would you like to participate?

Appendix B Interview Questions with Director, Human Subjects Research and Academic Programs, WPI

- Please let us know your role with IQPs.
- How long have you been at WPI?
- What do you think makes a project successful and effective at WPI?
- What are the important characteristics of a WPI off-campus Project Center?
 - Have any WPI Project Centers closed? (Why?)
 - What should we be considering with a new Project Center?
- What advantages and challenges do you foresee when setting up this project center in a high school?
- What are the common methods that project centers use to advertise themselves to students?
- Do you know if there are any MOUs between WPI and off-campus Project Centers?
 - If so, have you ever overseen an MOU from past projects?
 - If so, what trends did you find?
 - What factors do you think we should consider when forming ours? Is there a recipe for success/failure?
 - Do you think workshops with multiple stakeholders can be beneficial when forming our MOU?
- Is there anyone you think will be beneficial for us to contact regarding our project?
- We are planning to hold a workshop for all stakeholders in the project center to discuss coming to a shared vision and brainstorming possible collaborations. Would you like to participate?
 - We are thinking in Jan/Feb, and feel that an in-person session would be best to facilitate smooth communication.
 - Who else from WTHS should be involved with the workshop?
- Is there anyone else that you think may be relevant who we should contact?

Appendix C Interview Questions with Principal & Director of Career and Technical Education (joint interview)

- What is your experience with WPI
 - With the Teacher Prep Program?
- What are some potential challenges you see with a WPI project center within the high school?
- The WPI project center at Worcester Tech High School could host other activities and projects. What ideas might you have?
- How do you think your students would respond to having WPI students at WTHS?
- How do you think teachers/staff would respond to having WPI students at WTHS?
- What is the general perception of WPI at WTHS?
- What is the perception of your students about WPI?
- How do you view this collaboration/partnership with WPI?
- What advantages/disadvantages do you see in a project center hosted within a high school?
- What kinds of things would you like to see in the project center we are launching?
- How do you think a WPI project center at your school could benefit the school and your students?
 - After the launch of the project center, what programs or other collaborations would you want to see in addition to the Teacher Prep Program placements?
- When launching a project (project group, project, etc...) what strategies have you used to make that launch successful?
 - How do you envision the project center being announced/communicated to WTHS(staff, students, etc.)?
- From WTHS, who might be the contact person for future collaborations through the WPI Project Center?
- Is there anyone else that you think will be beneficial for us to contact regarding our project?
- We are planning to hold a workshop for all stakeholders in the project center to discuss coming to a shared vision and brainstorming possible collaborations. Would you like to participate?
 - We are thinking in Jan/Feb, and feel that an in-person session would be best to facilitate smooth communication.

- Who else from WTHS should be involved with the workshop?

**Appendix D Interview with Director, IPP & Career and Partnership Specialist, IPP
(joint interview)**

- Could you please tell us about the Innovations Pathways Program. (What is it, who is it for, what are the goals....)
- How could a collaboration with WPI assist your program and your students?
- Possible collaboration ideas?
- From your experiences and in your role, what do you think would help teacher prep students become more effective teachers?
- The WPI project center at Worcester Tech High School could host other activities and projects. What ideas might you have?
- How do you think your students would respond to having WPI students at WTHS?
- How do you think teachers/staff would respond to having WPI students at WTHS?
- What is the general perception of WPI at WTHS?
- What is the perception of your students about WPI?
- How do you view this collaboration/partnership with WPI?
- What advantages/disadvantages do you see in a project center based in a high school?
- We are planning to hold a workshop for all stakeholders in the project center to discuss coming to a shared vision and brainstorming possible collaborations. Would you like to participate?
 - We are thinking in Jan/Feb, and feel that an in-person session would be best to facilitate smooth communication.
 - Who else from WTHS should be involved with the workshop?
- Is there anyone else that you think will be beneficial for us to contact regarding our project?

Appendix E Interview with Director, Teacher Preparation Program, WPI

- Please tell us about your role as the Director of Teacher Prep at WPI?
- Why is the Teacher Prep practicum done as an IQP?
- In what ways do you feel that the teaching practicum IQP is different/similar to the global IQPs?
- What are some **benefits** to having the TPP IQP practicums run through an off-campus Project Center?
- What are some **drawbacks** to having the TPP IQP practicums run through an off-campus Project Center?
- Do you know of other teacher programs embedded in a high school?
- How does having the project center at Worcester Tech High School help the Teacher Prep Program?
- What would you like to see at this Project Center?
- What ideas do you have for other collaborations with Worcester Tech in addition to the Teacher Prep Program placements?
- What is the current process students need to go through to apply to TPP?
 - Primarily eProjects, direct contact, project fair, etc?
- What benefits do you see coming from a project center in a high school?
- What do you think of the TPP's current visibility?
 - What do you do to let potential applicants know the TPP exists?
- What are some common traits you've noticed in students who choose to become student teachers?
 - Major, clubs, interests, etc?
- We are planning to hold a workshop for all stakeholders in the project center to discuss coming to a shared vision and brainstorming possible collaborations. Would you like to participate?
 - We are thinking in Jan/Feb, and feel that an in-person session would be best to facilitate smooth communication.
 - Who else from WTHS should be involved with the workshop?
- Is there anyone else that you think may be relevant who we should contact?

Appendix F Interviews with WPI TPP Students who did their practicum at WTHS

- Why did you participate in the TPP?
- How did you find out about it?
- Were you happy with your placement at WTHS?
- How did you travel to W Tech HS every day during your Practicum?
- W Tech is a large, urban public high school with a highly diverse student population. Was the high school you attended similar to W Tech?
- How prepared did you feel in going to Worcester Tech at the beginning of your practicum?
- What would help TPP students prepare to student teach at a school? (i.e., not content or lesson-wise, but feeling comfortable at the school)
- How long did it take you to get to know and feel comfortable with the students? the faculty/staff?
- Are there any recommendations you have to help future TPP students feel prepared/comfortable to do their practicum? (e.g., more informal time at the school, tutoring)
- What was your experience spending most of the day at W Tech and then returning to WPI during your practicum?
- What are your thoughts about attending a TPP-specific course (or doing the Practicum Seminar) at W Tech HS (vs. at WPI)?
- Moving the TPP practicum to an off-campus IQP project center means that TPP students would have fewer responsibilities at WPI. Would this have impacted your practicum experience?
- Non-TPP WPI students may be doing IQPs or other projects through the Worcester Tech Project Center. Do you have ideas for possible projects?
- What other collaborations might you suggest between Worcester Tech and WPI?

Appendix G Interview with Professor and Director, Worcester Community Project Center (WCPC), WPI

- Do you, as the Director of the Worcester Community Project Center, have any experience working with Worcester Technical High School?
- If the Worcester Tech HS Teaching Project Center started doing other IQPs, would this cause confusion with your WCPC IQPs? Would there be other problems?
- What have been the benefits of WPI students doing an off-campus IQP in Worcester?
- What have been some of the challenges of having WPI students do an off-campus IQP in Worcester?
- Why do WPI students choose to do their IQP nearby in Worcester vs. other locations?
- In your experience, how do you best prepare students for a project based in Worcester?
- Are there any potential projects you see being included in this Teaching Project Center?
- Is there anyone else that you think may be relevant who we should contact?

Appendix H Memorandum of Understanding

Memorandum of Understanding

Memorandum of Understanding (the “Document”) made as of this 2nd day of May, 2023 (the “Execution Date”) between WPI STEM Education Center of 100 Institute Road, Worcester, MA 01609, and Worcester Technical High School (WTHS) of 1 Skyline Drive, Worcester, MA 01605.

(individually to “Partner” and collectively the “Partners”)

Background:

- a. The Partners wish to associate themselves in a partnership.
- b. The goal of the Partnership will be to establish and maintain a project center.
- c. The activities of the Partnership will be exemplified through the operation of the Project Center.
- d. A period of negotiation and exchange of information is needed to finalize agreements.

1. Non-Binding

This Document does not create a binding agreement between the Partners and will not be enforceable. Only the future partnership agreement, duly executed by the Partners, will be enforceable. The terms and conditions of any future partnership agreement will supersede any terms and conditions in this Document. The Partners are not prevented from entering into negotiations with other third parties with regard to the subject matter of this Document.

2. Composition of the Project Center

- a. The name of the Project Center will be: “***STEM@WTHS Project Center***”.
- b. There will not be a specified office or location to house the Project Center.
- c. The purpose of the Partnership will be: to create STEM education learning environments and STEM Teachers.

3. Duration and Termination

The partnership will continue after a yearly meeting takes place between the Partners and both are able to remain mutually beneficial post-discussion. Should the partnership no longer be mutually beneficial, the Partners have the right to close the partnership. The date for this meeting will be determined by the Partners on a year to year basis.

4. Description of Partnership

To create a sustainable and mutually beneficial partnership between WPI STEM Education Center and Worcester Technical High School for the development and improvement of Worcester Technical High School's academic classrooms and shops, and WPI's Teacher Preparation Program, MQP and IQPs, and seminars/events.

5. Expectations of WTHS

- a. Worcester Technical High School will supply one or more staff members to act as a liaison for communications between Worcester Technical High School and WPI STEM Education Center.
- b. It is requested that Worcester Technical High School upholds their end of an equal and fair partnership. Concerns are discussed with all parties in the partnership and are to be addressed in a professional manner. Clear communication is to be maintained at all times until the Closing Date.
- c. In relation to projects, programs, or events led by or in part by WPI, it is expected that WTHS works with and supports students and faculty from WPI.
- d. In relation to the WPI STEM Education Center Teacher Preparation Program, it is requested that WTHS supports engaging opportunities for teacher candidates and anyone participating in the TPP at WPI.

6. Expectations of WPI STEM Education Center

- a. WPI STEM Education Center will supply one or more staff members to act as a liaison for communications between the WPI STEM Education Center and Worcester Technical High School.
- b. It is requested that the WPI STEM Education Center upholds their end of an equal and fair partnership. Concerns are discussed with all parties in the partnership and are to be addressed in a professional manner. Clear communication is to be maintained at all times until the Closing Date.
- c. In relation to projects, programs, or events led by or in part by WTHS, it is expected that WPI works with and supports students and faculty from WTHS.
- d. It is expected that the WPI STEM Education Center will abide by the curriculum and vocational guidelines when instructing WTHS students on projects, programs, and events.

7. Management Titles

a. **Project Center WPI Director**

A representative from the STEM Education Center will be responsible for maintaining the partnership as well as the leadership of STEM Education Center involvement within the project center.

b. **Project Center WTHS Director**

A representative from WTHS will be responsible for maintaining the partnership as well as the leadership of WTHS involvement within the project center.

c. **Project Center WPI Faculty Advisors**

A member(s) of WPI Faculty will be involved in the completion of projects and events within the Project Center.

d. **Project Center WTHS Faculty Advisors**

A member(s) of WTHS Faculty will be involved in the completion of projects and events within the Project Center.

Signatures

This Document reflects the understanding between the Partners,
signed on _____ day of _____, _____.

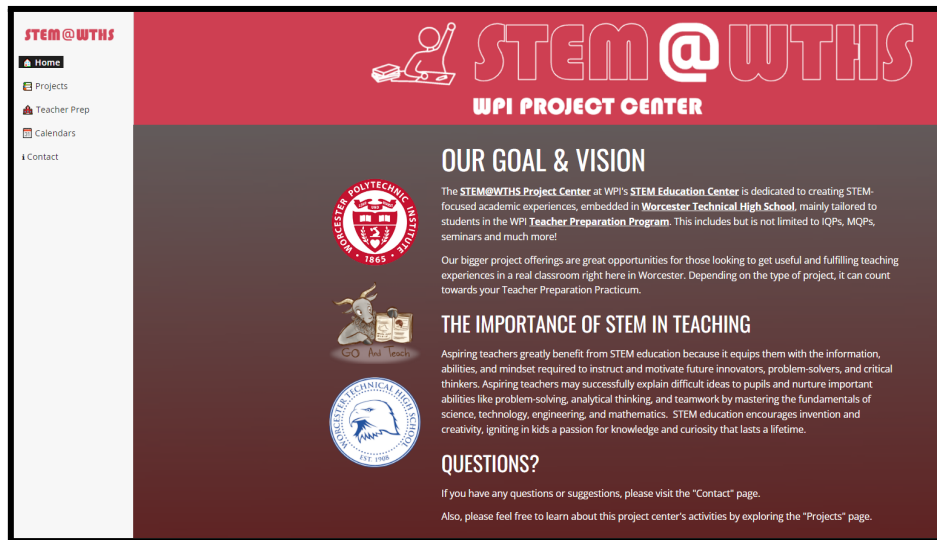
Per: _____
WPI STEM Education Center

Per: _____
Worcester Technical High School

Appendix I Recommendations for Website Management

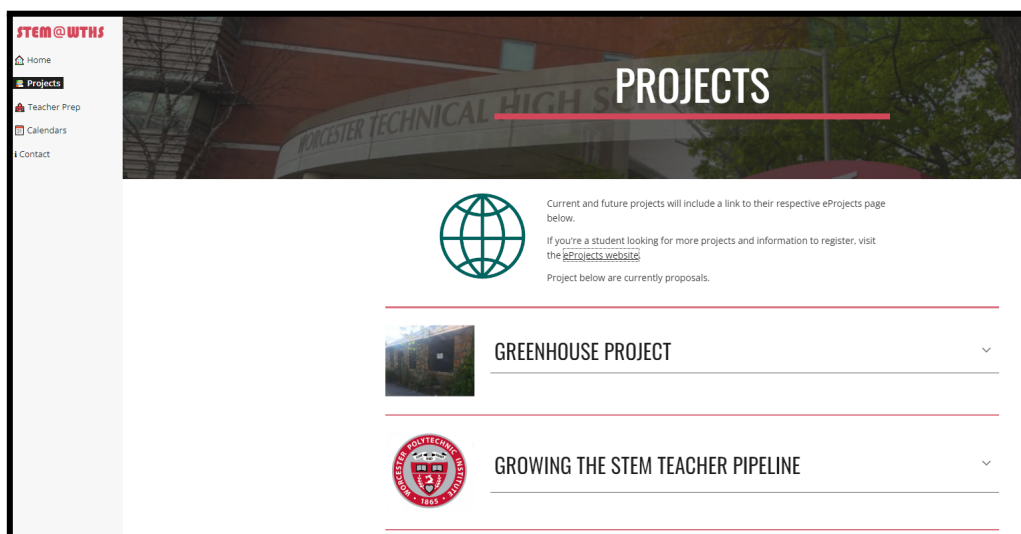
Home Page

The Home/Landing page will be the first thing visitors view when entering the website. It will provide the goals of the project center along with images from project work and embedded Google Maps locations of the WPI STEM Education Center and Worcester Technical High School. The exact content of this page is subject to change however the provided documentation will suffice for the launch of the project center.



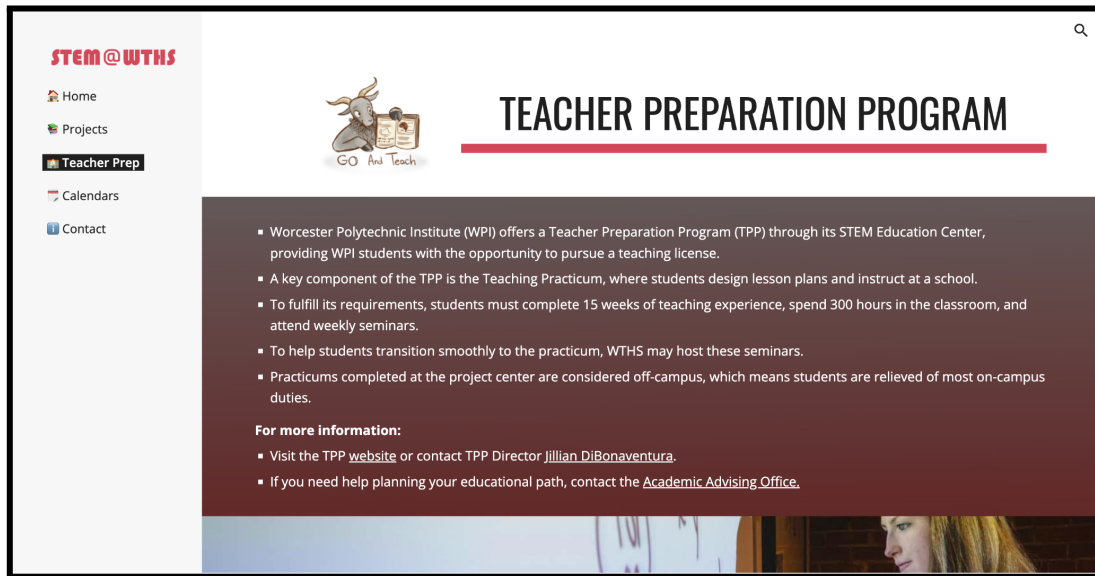
Projects Page

The Projects page will outline projects that have been active within the project center. This list of projects will contain summaries of the project work, when the project took place, and who completed it. This list will be modified when any new project is started. The projects to be included on this page will primarily be WPI MQP and IQPs. The *eProjects* description of these projects will be used for the summaries.



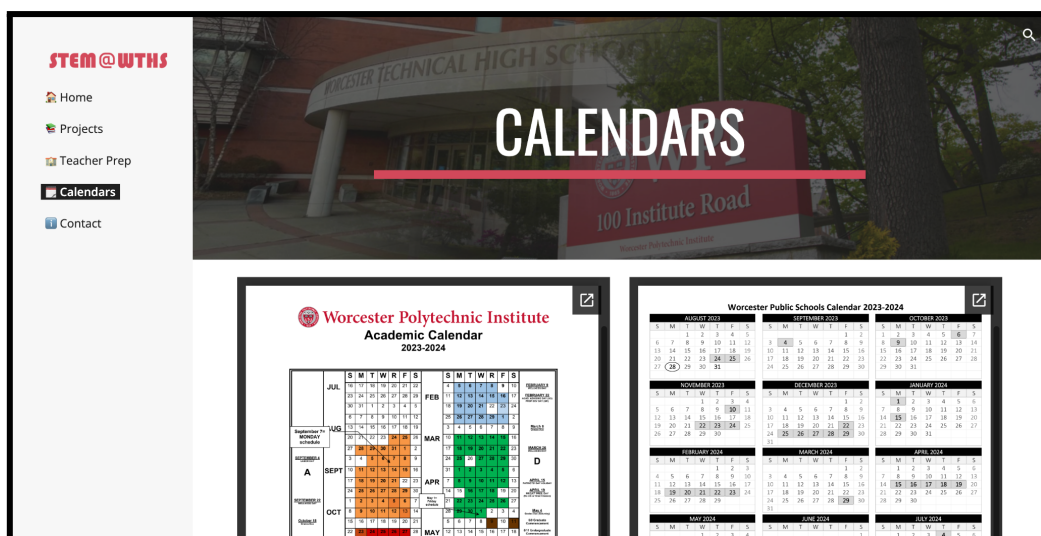
Teacher Preparation Program Page

This page is used to describe the STEM Education Center and WPI Teacher Prep Program, allowing WPI students to learn about the program. Additional details involving the WPI Teacher Preparation Program will be handled by the Director of the Teacher Preparation Program, currently Jillian DiBonaventura.



Calendars Page

The Calendar Page will be updated yearly to show both the Worcester Polytechnic Institute and Worcester Technical High School current calendars as PDF documents. This will allow project organizers to easily see each other's start and end dates for each term and holiday/vacation schedules.



Contact Page

The Contact page includes contact information for the heads of the project center. It also contains a Google form embedded to allow users to reach out to the project center. This form was designed for three types of users: WPI students and WTHS staff with questions, WPI/WTHS staff with a large project suggestion (MQP/IQP), or WPI/WTHS staff with a small project suggestion.

Section 1 of 3

Project Request Form

When making your project suggestion, please keep in mind that this center focuses on STEM-related academic experiences embedded in Worcester Technical High School.

Email *

Valid email address

This form is collecting email addresses. [Change settings](#)

Name *

Short-answer text

Email *

Short-answer text

Phone Number (not required)

Short-answer text

What is your request? If you have a question or feedback, select "Message" *

Large Project (WPI will advise what type of project this can be, like IQP or MQP)

Small Project: Request WPI Student for classroom, shops or presentations

Message (questions or feedback)

Section 2 of 3

Message to Teaching Project Center

Please compose your message to the project center below.

Message *

Long-answer text

Section 3 of 3

Project Proposal

Description (optional)

Description of Project *

Long-answer text

Expectations of Project *

Long-answer text

Deliverables of Project *

Long-answer text

Time Frame of Project *

Long-answer text

Other Comments (consider constraints)

Long-answer text

The form has users input their name, email address, optional phone number, and purpose of the inquiry: “Large Project” request, “Small Project” request, or “Other”. The message feature is used to ask simple questions, while the project requests feature uses the same format; however, they allow project center staff to easily see what type of event or project the user suggests. This allows staff a quick and simple understanding of what, when, and how a person wants to run a project.

Operation and Management

The content of this webpage will only need to change in cases of: staff changes to the project center, changes to the fundamental ideals of the project center, new projects being added, and desire for Google Form question changes. The website will be managed by a delegate at the WPI STEM Education Center.

STEM @ WTHS

PROJECT CENTER

Worcester Technical
High School

A WPI Project Center embedded in Worcester Technical High School for STEM-focused academic experiences cultivated from partnerships among students and educators.

PROJECTS

- MQPs
 - IQPs
 - Seminars & Workshops
 - Teacher Prep Practicums
- ...and much more!

Perfect for
students
interested in
EDUCATION!

Some projects may count for Teacher Preparation Program Practicum



Title font used: Bauhaus 93. General text font used: Comfortaa. Color hex code: #d03c54

Appendix K Email Announcement



Introducing the STEM@WTHS Project Center

The [STEM@WTHS Project Center](#), managed by the [STEM Education Center](#) at WPI, is a collaborative and mutually beneficial off-campus initiative of opportunities for students at [Worcester Technical High School \(WTHS\)](#) and [Worcester Polytechnic Institute](#), especially those in the [Teacher Preparation Program](#). This Project Center is dedicated to creating STEM-focused academic experiences, including [IQPs](#), [MQPs](#), seminars and other educational experiences.

This Project Center is a result of the shared vision for STEM education and collaborations between WPI and Worcester Technical High School that was developed by an on-campus IQP. STEM@WTHS is aimed at enhancing the quality of education provided to students through a STEM-focused curriculum and hands-on experiences, benefitting the Worcester community and beyond.

Many WPI pre-service teachers in the Teacher Preparation Program have done their student teaching at Worcester Technical High School, and thus creating an off-campus Project Center @WTHS made sense to expand on existing partnerships. With more WPI students and collaborations @WTHS, perhaps more high school students will be inspired to pursue STEM fields and even attend WPI or become a teacher.

If you have questions, comments or would like to learn more about this project center, feel free to contact us through our [website here](#):

<https://sites.google.com/view/stem-at-wths/home>

Appendix L: Website Form

Section 1 of 3

Project Request Form

When making your project suggestion, please keep in mind that this center focuses on STEM-related academic experiences embedded in Worcester Technical High School.

Email *

Valid email address

This form is collecting email addresses. [Change settings](#)

Name *

Short-answer text

Email *

Short-answer text

Phone Number (not required)

Short-answer text

What is your request? If you have a question or feedback, select "Message" *

Large Project (WPI will advise what type of project this can be, like IQP or MQP)

Small Project: Request WPI Student for classroom, shops or presentations

Message (questions or feedback)

Selecting "Message" goes to Section 2 below.

Selecting "Large Project" or "Small Project" goes to Section 3 below.

Section 2 of 3

Message to Teaching Project Center



Please compose your message to the project center below.

Message *

Long-answer text

Section 3 of 3

Project Proposal



Description (optional)

Description of Project *

Long-answer text

Expectations of Project *



Long-answer text

Deliverables of Project *

Long-answer text

Time Frame of Project *

Long-answer text

Other Comments (consider constraints)

Long-answer text