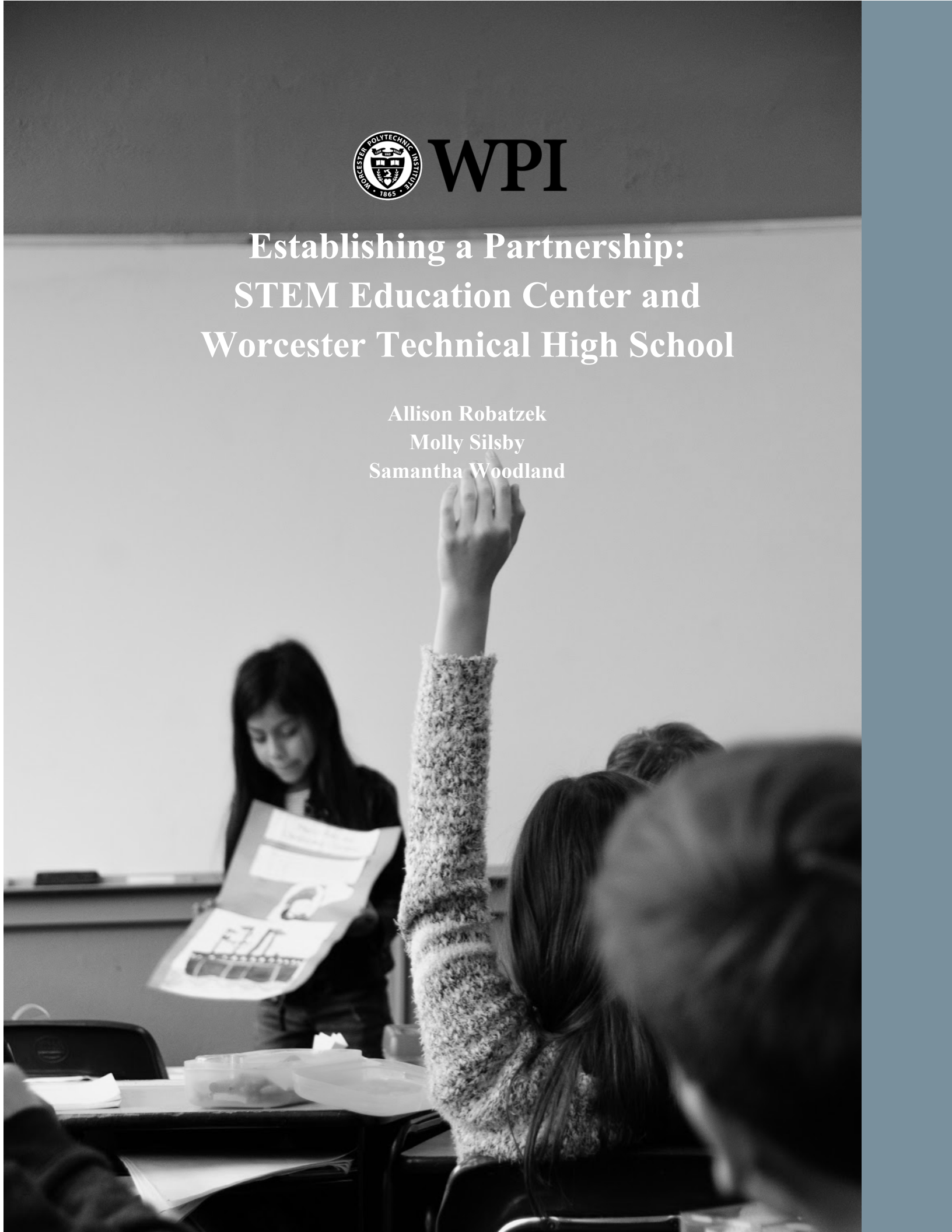




**WPI**

# Establishing a Partnership: STEM Education Center and Worcester Technical High School

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# Establishing a Partnership: STEM Education Center and Worcester Technical High School

An Interactive Qualifying Project  
Submitted to the Faculty of  
WORCESTER POLYTECHNIC INSTITUTE  
In Partial Fulfilment of the Requirements for the  
Degree of Bachelor of Science

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Date: 13 May 2020

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*This report represents work of WPI undergraduate students submitted to the faculty as evidence of a degree requirement. WPI routinely publishes these reports on its web site without editorial or peer review. For more information about the projects program at WPI, see <http://www.wpi.edu/Academic/Projects>.*

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## Abstract

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Currently, STEM education is not accessible to all learners. The WPI STEM Education Center works to promote relevant, inclusive STEM education for all students and their communities. Our goal was to establish a relationship between the STEM Education Center and Worcester Technical High School in order to create a unique WPI project center existing within the high school. After interviewing members of both stakeholders, we developed a Memorandum of Understanding, project recommendations, and site recommendations to advance the project center.

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## Acknowledgments

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Our team would like to take a moment to thank all of the people who made this project a possibility including helping with all of the different stages from development to the finished product. The following people are:

- **Our sponsors, Kathy Chen and Shari Weaver** with the STEM Education Center, for their excitement and readiness to give us guidance, support, and advice on this project.
- **Our faculty advisors, Professor Doiron and Professor Stafford**, for their constant guidance and support throughout the entire journey of this project.
- **Our other stakeholder, Worcester Technical High School** for their input and willingness to help and give feedback on our agreement.
- **The Worcester Technical High School teachers**, who provided us with their invaluable feedback and advice in our interviews.
- **Worcester Polytechnic Institute** for being flexible and still providing us an amazing opportunity to complete our IQP project, despite not being in Namibia.

We would also like to thank our team's **families and friends** for their support, love, care, and support towards this project. This project would not have been possible without it.

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## Authorship

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**Allison Robatzek** - During our interviews with stakeholders, Allison served as the main interviewer and led the conversations. In the data collection stage, she contributed to transcribing the interviews for our analysis. In the report, Allison served as one of the primary authors for the Background and Methodology chapters. She also served as the primary author for the Findings chapter and the Memorandum of Understanding. Throughout the whole report, Allison contributed to edits and revisions.

**Molly Silsby** - Molly served as creative director for the entirety of the project, contributing to the formatting of all the deliverables, presentations, and the report. She also served as the main secretary, taking notes from all meetings and interviews the team conducted. Within the report, she was one of the primary authors of the Background and Methodology chapters. She also served as the primary author of the Project Recommendations deliverable. Molly was the primary author of the executive summary and served as the primary editor for the report.

**Samantha Woodland** - Samantha served as the qualitative analysis expert for the project, performing the thematic coding for the analysis of the interview transcripts. She served as the primary author of the Site Recommendations deliverable. Within the report, Samantha served as one of the primary authors of the Background and Methodology chapters. She was also the primary author of the Abstract, Introduction and Conclusions and Recommendations chapters. Samantha contributed to edits and revisions throughout the entire report.

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## Executive Summary

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Around the world, but especially within the United States, there is a shortage of qualified science, technology, engineering, and mathematics (STEM) educators (Goldhaber, D., Krieg, J., Theobald, R., & Brown, N., 2014). This is largely due to the teaching barriers caused by the lack of information on STEM education and financial reasons of providing resources in order to effectively teach STEM. This has led to the ineffective recruitment of new STEM teachers and poor retention of current educators. Often, there is also little opportunity for professional development for current STEM educators to improve their skills and stay current in the field (Hutchison, L. F, 2012). This has reduced the quality of STEM education that students across the nation have received.

At Worcester Polytechnic Institute, an accredited research university in Worcester, Massachusetts, the STEM Education Center was created in order to help overcome these barriers and issues in STEM education. On campus, they provide opportunities for professional development for current STEM educators, community outreach to promote effective STEM education and a Teacher Preparation Program for students looking to gain their teaching licenses. Currently, one of the schools that the STEM Education Center sends its students to complete their practicums is Worcester Technical High School (WTHS), an academic and vocational school within the Worcester Public School system. Because of the similar focus on student achievement and the promotion of STEM education in both WPI and WTHS, an opportunity arose to further develop this current relationship into an established partnership. This led our sponsors, the STEM Education Center, to propose this idea of establishing a formalized partnership with Worcester Technical High School in order to potentially create a project center within the school.

In order to achieve the goal of creating this project center embedded within a school, our team outlined four main objectives that needed to be completed:

1. Identify the wants and needs from both stakeholders
2. Analyze the data
3. Create the deliverables
4. Evaluate the effectiveness of the deliverables

To gather the data we needed in order to determine what should be included within this partnership, our team conducted a series of interviews with both stakeholders, WPI and WTHS.

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For WPI, we kept our interviews to the staff of the STEM Education Center as they were the driving force behind this partnership. For WTHS, we interviewed various members of the staff including members of the administration team and teachers from both the vocational and academic sides of the school. We kept all interviews open-ended and conversation-like as this partnership was for them and we did not want to interfere with strict questions. We recorded each interview and transcribed them in order to collect qualitative data. Using the transcripts, we organized the data through thematic coding. We coded by taking the topics that came about through the interviews and organizing them into themes. We then organized those themes into larger categories and calculated the percentages of times each category was mentioned. This way, our team could see which categories are most important to the stakeholders in order to frame our partnership creation. The most popular categories we found were: logistics, student benefit, and project ideas.

Throughout our team's interviews and data analysis, we also determined the scope of our deliverables which would be in the form of a Memorandum of Understanding, a project center definition, and a set of recommendations for projects that can be completed at this site. Our first deliverable was a Memorandum of Understanding (MOU), which was used to set boundaries for the formalized partnership. We used the data that was thematically coded from the interview transcripts with both WPI and WTHS and put together a series of clauses outlining the basic requirements of this established partnership, such as expectations of students and faculty of WTHS and from WPI. The MOU also established the different positions needed in order to create this project center and set specific definitions and expectations for each role. This MOU lays the foundation for this partnership and was largely generalized. The specific recommendations for creating the projects to be done at this site were categorized as a separate deliverable. Because this MOU defined what the partnership would look like, it was important that it was accepted by both parties involved. In order to ensure this, the team sent the MOU draft to multiple members of both WPI and WTHS to get feedback and make changes until there was no new feedback given. At that point, both parties were satisfied with the document and no new changes were made.

Our second deliverable was a project center definition. Our team discovered that the current goal of creating a project center within a high school did not match with current models of what a project center is. There were two main options: making the center, on-campus or off-campus. As keeping the center as an on-campus project center gave the STEM Education center more control

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over the selection process and possibilities, the team decided to classify this project center as on-campus.

Our third deliverable was to create a series of project recommendations for different project types and examples that WPI students could work on while at this project center. These recommendations were split up into three main areas: Teaching Practicums, Pre-Practicums, and Interactive Qualifying Projects (IQP). The Teaching Practicum is already well-established and follows Massachusetts guidelines so our recommendation was to send more Teaching Practicum students through WTHS. For students seeking to receive their licensure, a series of Pre-Practicum requirements must be completed first. These requirements mostly surround meeting a certain number of hours working directly with K-12<sup>th</sup> grade students as well as classroom experiences and through our interviews, we determined it would be possible to complete these requirements at WTHS as well. Our team also determined that IQPs could be completed at the WTHS project center focusing on STEM education within the school.

Because our project focused mainly on establishing the relationship, we also included Site Recommendations, which outline the next steps that need to be done to further set up the pilot program of projects to be completed at the Worcester Technical High School project center. These steps included setting up the logistics for a pilot program, creating better advertising for the project center through the eProjects website as well as a personalized website outlining the partnership, moving the center to an off-campus project center, and establishing a method of feedback for both parties.

For our final recommendations, we included possibilities for the expansion of this program in the future as well as the potential impact this project center could have on the Worcester community. The potential expansion our team discovered surrounded expanding the projects that can be done at this project center through the addition of Major Qualifying Projects as well as Graduate level projects. We also found room for potential integration of project work into WTHS' curriculum. The future impact we saw the creation of this project center having is expanding the definition of what a project center is and the opportunities of projects that could be completed at one for WPI. We also found that this project has the potential to be replicated by using this model of creating a partnership and MOU and applying it to other schools in the Worcester Public School system. Finally, we found that creating this partnership truly benefits the Worcester community as



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a whole. By using the strengths of both schools—college and high school—we can work to create a better STEM education for all of Worcester’s students.

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## Abbreviations and Acronyms

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<b>Acronym</b>	<b>Definition</b>
GPS	Global Problems Seminar
HUA	Humanities and Arts
IQP	Interactive Qualifying Project
MOU	Memorandum of Understanding
MQP	Major Qualifying Project
PBL	Project-based learning
STEM	Science, Technology, Engineering, and Mathematics
WPI	Worcester Polytechnic Institute
WTHS	Worcester Technical High School

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## Chapter 1: Introduction

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As the new decade begins, it has become increasingly apparent that a well-rounded STEM education is necessary to be successful in this day and age. This can begin as early as preschool for many students. However, across the United States, school systems face a critical shortage of qualified STEM educators, which has the potential to have a negative economic impact on our society (Goldhaber, D., Krieg, J., Theobald, R., & Brown, N., 2014). Several factors contribute to this shortage including, situational and financial barriers to the teaching workforce, ineffective recruitment, poor retention of qualified teachers, and insufficient professional development for current STEM educators (Hutchison, L. F, 2012). In addition to a shortage of qualified teachers, there is a lack of resources needed to support high-caliber STEM education that also plays a role in the inequality between schools across the country. Another issue facing STEM education is the absence of diversity in the workforce. Representation plays an important part in shaping a student's education (Basile, V., & Murray, K, 2015). A student's ability to learn can be impacted if they cannot relate to their teachers and see them as role models due to a lack of representation.

The goal of the STEM Education Center at Worcester Polytechnic Institute (WPI) is to combat these issues through the advancement and promotion of inclusive STEM education in schools and communities. They are committed to bolstering the current teaching workforce by providing a path to the classroom for current WPI students that wish to become licensed STEM teachers. These students can earn their bachelor's degree through the Teacher Preparation Program at the STEM Education Center. The center also provides opportunities for graduate programs for educators. Another main focus of the STEM Education Center is professional development which is available for STEM education teachers so those teachers can foster their skills to be able to provide relevant learning experiences for their students. The STEM Education Center also does community outreach within WPI and the Worcester community through advising and sponsoring on-campus IQPs and consulting on WPI STEM-related research and projects.

WPI's unique curriculum, called the WPI Plan, allows for connection to communities both locally and around the globe through WPI project centers. The creation of a project center within a local Worcester public high school, specifically Worcester Technical High School (WTHS), is an innovative way for the STEM Education Center to directly impact STEM Education in the Worcester community. This could provide Worcester Technical High School with an ability to

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offer their students exposure to higher education and enriching project-based learning experiences through collaborations with college students while in high school. The goal for our project is to establish a sustainable, equally beneficial partnership between the STEM Education Center at WPI and Worcester Technical High School. To this end, we will interview representatives from STEM Education Center and Worcester Technical High School to ascertain their needs and wants from this relationship. The data we collect will be used to create the foundation for a successful partnership between the two institutions.

In this report, we present a background chapter that examines the WPI Plan and its project centers both in a local and global context, the WPI STEM Education Center, STEM education in urban public school systems and specifically in Worcester Technical High School (WTHS) and existing partnerships between colleges and high schools. Following the background chapter, our methodology section outlines our team's objectives and our methods that shaped the completion of our project. In our findings chapter, we discuss our data gathered through interviews with the STEM Education Center, Worcester Technical High School, and members of WPI administration. Our final deliverables are an MOU between the WPI STEM Education Center and Worcester Technical High School (WTHS), project recommendations that outline multiple types of projects that could be completed at the project center as well as specific examples, and site recommendations that will be passed to the next IQP team working on this project center.

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## Chapter 2: Background

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Located in central Massachusetts is a private research university, Worcester Polytechnic Institute (WPI). WPI, which focuses heavily on science and technology-based majors, has a unique Project-Based Learning curriculum. This flexible curriculum allows WPI students to have the opportunity to complete projects off-campus, working with real established organizations instead of typical classroom assignments. These partnerships with different organizations are located all across the globe in the form of Project Centers, covering six different continents.

However, WPI students do not need to travel far to apply their technical and project-based skill set to the real world. Locally, in Massachusetts, there is a large need for developing STEM educator skills and STEM programs in public school systems. K-12<sup>th</sup> grade students could benefit immensely from working directly with college students for multiple reasons including tutoring opportunities and seeing college representation. Also for college students seeking to obtain a teaching license in the Commonwealth of Massachusetts, a teaching practicum in a classroom setting is required. Thus, in local communities in which colleges are located, there exists a unique opportunity for a partnership between the college and high school to benefit both institutions and student bodies. In Worcester, MA, where Worcester Polytechnic Institute is located, there is a multitude of local high schools with a project-based learning curriculum similar to that of WPI's that would serve well for an established partnership.

In this chapter, we begin with a discussion about Worcester Polytechnic Institute, its project-based curriculum, and an overview of its most significant projects. We also discuss the establishment of project centers. Next, this leads to an explanation of WPI's current public high school outreach programs and the need for effective teaching. Following that, Worcester Technical High school, a local 9-12th grade school in the Worcester Public School system is introduced. Finally, we cover topics of partnerships between colleges and high schools and the positive effect it can have on students.

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### 2.1 Worcester Polytechnic Institute (WPI)

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Located in Worcester, Massachusetts, Worcester Polytechnic Institute is a research-orientated private university. Home to nearly 5,000 undergraduate students and around another 1,000 more graduate students, WPI's campus is full of life. While the typical majors surround



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engineering, applied sciences, and technical arts, WPI’s curriculum expands beyond just STEM. Seeking to create a flexible scheduling approach, typically uncommon for STEM majors, and a global perspective for students, WPI is committed to making sure students are providing solutions to “important and socially relevant problems in diverse fields,” (About WPI, 2020). WPI is also known for its project-based hands-on learning approach, which focuses on the concept of Theory and Practice to achieve success. This section focuses on the background of Worcester Polytechnic Institute and its Project-Based curriculum and project centers.

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### *2.1.1 The WPI Plan*

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Worcester Polytechnic Institute is used to being at the forefront of innovation, whether it from becoming the first nationally-ranked science and engineering school to have a test-optional admission policy or having a substantial number of student patents, with 42 students filing for patents and five licensing their patents in the 2017-2018 academic year alone (WPI, 2019). The WPI Plan is no different. Roughly 50 years ago, in 1970, the institution introduced this unique curriculum plan. The goal for the development of this plan stemmed from the school’s desire to apply its education and curriculum to solve real problems challenging communities. The plan’s main focus was a shift away from lecture-style learning and into project-based learning (PBL). This way, WPI students can use their knowledge and skills in a practical setting to solve actual problems facing the world, not just ones in a textbook. Students would leave WPI ready to face the challenges and demands of the workforce and their careers having already been exposed to many of them while an undergraduate student. Through these projects, the plan also seeks to develop student’s world views, interpersonal and communication skills, and professional abilities (Creating, 2020). The start of the WPI Plan outlined a curriculum involving two major projects to be completed while enrolled, regardless of what a student’s major is. Today, the WPI Plan has been expanded beyond just PBL and sectioned into six main elements: pursue your passion, global immersion, project-based learning, learn how to learn, beyond the classroom, and personal impact (WPI Plan, 2020).

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### *2.1.2 Project-Based Learning*

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Currently, WPI offers four main projects—one for each year of a traditional college track. A student’s first year in college is met with the optional Great Problems Seminar (GPS), in which

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students work on interdisciplinary teams to provide technology-based solutions to problems globally. While students still live on campus to complete this project, many projects partner with outside local organizations to give students an early introduction to professional partnerships. Following GPS, typically in a student's sophomore year, an Inquiry Seminar or Practicum is completed. This is the capstone project of the Humanities and Arts (HUA) requirement of WPI's curriculum. This seminar or practicum is focused on a Humanities or Arts topic of a student's choosing and is largely self-driven. It is also an option to complete the Humanities and Arts project off-campus in various locations ranging from Argentina to Japan to Morocco. The Interactive Qualifying Project (IQP) is typically completed in a student's junior year. For this project, students work in interdisciplinary teams to create feasible solutions that intertwine science and society. This project gives students the opportunity to apply their knowledge of technology to benefit society (Interactive Qualifying, 2020). It is optional for students to leave campus in order to complete this project and through the Global Projects Program, there are currently over 30 project centers abroad students can visit all across the world, including Melbourne, Australia, and Windhoek, Namibia. The Major Qualifying Project (MQP) is a senior-level project that seeks to apply a student's major-specific knowledge to a professional-level design or research project of their choosing (Major Qualifying, 1987). Students also work in teams of 2-4 and partner with a professor to advise the project. MQP also provides an opportunity for a global experience as many projects can be completed either abroad or with an off-campus sponsor. However, wherever a student completes their projects, on-campus or off, WPI is committed to giving each student a global experience working with professionals and gaining valuable skills to apply to their career after college.

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### *2.1.3 Global Projects Program and Project Centers*

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One of the areas of the WPI Plan, Global Immersion, is accomplished through the establishment of project centers. These centers, located all across the globe, establish a formalized location where students can go to complete their project-based learning. Similar to a study abroad program, in which students will live in the community the project center is in and fully immerse themselves, but unlike a typical study abroad program, WPI's Global Projects Program allows students to work on a project instead of taking classes. It is also built into the school's curriculum with every student being required to complete an IQP and MQP project.

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Whether the center is for MQP, IQP, or Humanities and Arts, these centers have become a staple in WPI culture. This is because each project completed at the center has a lasting impact on the community in which the center is in. By partnering with sponsors local to that community, WPI students are able to gain professional skills and experience working on a team for a sponsor. Students often help to create solutions to problems that sponsors do not have the time or resources to address. Many of these solutions are actually being implemented, expanding WPI's reach across the entire globe (Project-Based, 2020).

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#### *2.1.4 Global Impact of Project Centers*

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These project centers also create lasting global relationships between WPI and the project center community. For example, the IQP project center in London, England was established in 1987. Since its establishment, WPI students have completed over 450 projects with over 100 different organizations in the Greater London Area (London Project Center, 2020). This IQP project center is still available for students to apply for the 2020-21 academic year. The relationship and reach that WPI is able to have in a community far away from its own is partly due to the project center establishment and partnerships it creates.

WPI currently has centers in over thirty countries across six continents and is always actively adding new project centers to its Global Project Program. Within the last three years, WPI has added many new centers including ones in Prague, Czech Republic, Kyebi, Ghana, The United Arab Emirates, and Reykjavik, Iceland (Project Center Directory, 2020). However, to achieve Global Immersion and lasting impact, the project centers do not have to be international. In fact, WPI currently has sixteen domestic sites and seven within the Commonwealth of Massachusetts. These local sites provide WPI with an opportunity to apply its project-based curriculum to enrich its own community.

For example, in Nantucket, MA, a project center created in 2008, students work directly with organizations on the island. Project center director, Dominic Golding stated, "Often the students serve as a catalyst to enable them to do things they wouldn't be able to do otherwise." Previous IQP projects have worked with the Maria Mitchell Association to create a stronger digital marketing campaign for their various educational buildings as well as creating a feasible parking sticker system, valet services, and plans for a parking garage in order to improve traffic on the island. In speaking about this long-standing partnership between WPI students and the island

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organizations, Nantucket assistant Town Manager, Gregg Tivnan, said “We wouldn’t have been able to jumpstart these projects without the students’ input. Their projects have always been excellent, relevant, and very well-received,” (Global Impact, 2019).

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### *2.1.5 Local Project Centers*

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WPI is also seeking to expand its network within its own community of Worcester, Massachusetts. While there is an already established project center for Worcester, the center currently switches local sponsors year to year, depending on what the community needs (Worcester Community, 2020). In contrast, the Farm Stay Project Center in Paxton, Massachusetts, a short 10 miles from Worcester, is located in a specific yurt village. Year to year, WPI students complete their IQP projects with the same specific sponsor working on different projects centered on improving the farm’s community outreach programs for disadvantaged children (Farm Stay, 2020).

WPI also has a variety of on-campus projects centers, in which students can complete their IQP projects without having to travel off-campus at all. Currently, there are four on-campus IQP project centers, each is focused on different topic areas. The four project centers are Sustaining WPI, Sustainable Energy, Sustainable Food Systems, and the STEM Education Center (On Campus, 2020). These project centers still seek to give students a meaningful IQP experience focused on WPI’s own community.

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## *2.2 STEM Education Center*

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The creation of a center for Science, Technology, Engineering, and Math (STEM) education at Worcester Polytechnic Institute (WPI) was announced in 2011 with the goal of improving the ability of primary and secondary school teachers to educate young students in STEM fields. WPI is widely known as an institution dedicated to innovation in education as well as engaging students of all ages in STEM fields. Over the years, WPI has developed a number of programs for K-12 teachers in order to assist them in providing enriching STEM education for their students as well as pre-collegiate programs for students interested in STEM fields. The STEM Education Center builds on this success by serving as a central location for these programs in addition to offering degree programs for current students to receive licensure to teach and

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practicing teachers to receive graduate degrees. The STEM Education Center also integrates WPI's existing research on teaching and learning.

### *2.2.1 Undergraduate STEM Teacher Development*

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The students of today are the innovators of tomorrow. Teachers are tasked with the integral role of shaping our students' futures by guiding them and providing a high-quality education that allows them to become positive contributors to society. When classrooms are understaffed or led by unqualified educators, education for students suffers and our society is then impacted down the road. Qualified STEM teachers are pivotal to the provision of high-quality STEM education for students. The United States is currently facing a national shortage of qualified STEM educators which has an economic impact due to the fact that STEM fields strengthen the economy through the creation of new jobs and boosting productivity (Goldhaber, D., Krieg, J., Theobald, R., & Brown, N., 2014). There are several factors that contribute to this national shortage, including ineffective recruitment of STEM teachers, inability to retain qualified educators, and a lack of professional development as new innovations in STEM fields continue to occur (Hutchison, L. F, 2012). Many college graduates and career professionals have the desire to enter the teaching workforce but face barriers due to being uninformed about the process of becoming a teacher or financial reasons (Goldhaber, D., Krieg, J., Theobald, R., & Brown, N., 2014). Once a teacher enters the workforce, a pattern has emerged showing that less effective teachers are more likely to leave teaching than more effective teachers. Because of the shortage of high-quality STEM teachers, there are more teachers leaving the profession than entering (Hutchison, L. F, 2012).

The STEM Education Center confronts access barriers to teaching through the Teacher Preparation Program which allows undergraduate students with technical majors to earn a Massachusetts Initial Teaching License along with a Bachelor's Degree. The Teacher Preparation program also allows undergraduate students to gain the skills needed to teach STEM subjects by giving them actual experience in classrooms. WPI also offers graduate degrees specifically for educators teaching math or physics. Master's degrees are increasingly popular in Massachusetts because teachers are required to obtain a professional license five years after obtaining their initial license. Finally, WPI's Learning Sciences and Technologies Program offers masters and doctorate degrees to graduate students who are interested in researching and improving education through technology.

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### *2.2.2 Professional Development for K-12 Educators*

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As a student develops, it's up to their teachers to prepare them to enter either a post-secondary education program or the workforce. A teacher has the critical role of guiding a student, providing them with critical skills and content knowledge to live and succeed as a contributing member of society. Teachers also shape a student's aspirations and motivations as well as development, which can impact their professional ambitions. A high-quality teacher can encourage a student's aspirations and open doors that may not have been an option before. A high-quality STEM teacher can inspire interest and ambition to enter a STEM field, opening doors to a career in STEM. Research has shown that student-teacher relationships are impacted by the value of a student's identification with a teacher of their own race/ethnicity or gender giving the teacher the ability to make a greater impact on the student (Basile, V., & Murray, K, 2015). Research has also shown that STEM teachers are more likely to identify as male with a majority also identifying as white (Basile, V., & Murray, K, 2015). Increasing diversity among K-12 STEM Educators will inspire minority students to pursue STEM majors and careers.

The STEM Education Center is committed to offering professional development for K-12 educators in a variety of different ways. They develop and conduct in-school workshops in order to address the specific needs of each school they are contacted by. They also offer professional workshops at WPI in areas such as Coding and Computational Thinking, STEM/STEAM Projects, Problem-Based Curriculum, Electrical Engineering, and more. Strategic STEM Integration is a two-year program designed to help administrators and leaders in education develop a STEM program specifically for their school or district. The program works by working with a team from a school or district, engaging them through an exploration of what successful STEM programs look like, guiding them as they create a plan based on several STEM Integration Models and eventually assisting them as they implement their plan in their own school or district. WPI is also the Massachusetts Affiliate University for Project Lead The Way (PLTW), a non-profit organization that provides learning experiences to students and teachers. WPI offers summer courses where educators learn to teach PLTW courses through PLTW Core Training. Through all of these various programs and workshops, the STEM Education Center at WPI encourages the professional development of teachers in the surrounding Worcester community as well as across the state of Massachusetts.

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### 2.2.3 Community Outreach

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Across America, underserved and minority communities struggle with economic access and stability. Education is an important tool in breaking barriers and achieving economic stability. Today, a valuable education depends on math and science education within schools, which can be lacking or underdeveloped in underserved communities (Hinnant-Crawford, B, 2016). STEM education has an impact on STEM-literacy within a population. STEM education also leads to increased STEM majors at universities and future careers in STEM. STEM education and literacy also has an economic impact. STEM fields are more likely to pay higher salaries and are less likely to be affected by recessions and employment spikes (Hinnant-Crawford, B, 2016). Therefore, it can be said that STEM education should be available to all students across the nation, regardless of economic background, race/ethnicity, or gender.

The STEM Education Center is dedicated to broadening participation in STEM and increasing access to STEM education. Through multiple ways, the STEM Education Center is carrying out community outreach to give the Worcester area better access to STEM education. Starting with the WPI community, the STEM Education Center acts as a consultant and collaborates on research or projects done by WPI faculty or students involving STEM education. The STEM Education Center also sponsors IQPs that investigate socially relevant problems in an educational setting in partnership with nonprofits, educators, and researchers across the Worcester community and globally. The STEM Education Center also provides the connection with Worcester Public Schools in order for undergraduate students in the Teacher Preparation Program to complete their required practicum requirement, which often doubles as the IQP requirement for their Bachelor's degree. The STEM Education Center is also responsible for leading the Central MA STEM Network Ecosystem (CMSNE) which aims to develop and deliver STEM experiences to historically underrepresented and low-income students in Central Massachusetts. These experiences include classroom STEM experiences, STEM festivals, science fair project support, out-of-school STEM classes, and STEM workshops.

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## 2.3 Urban Public School Systems

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Education in urban and high-poverty populations comes with differences and considerations that may not be as prominent in non-urban school systems. Certain components to

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a child's learning that need to be considered in urban communities are demographic aspects such as ethnicity and language (Foote, 2005). For example, some students may come from a home where English is their second language and Spanish is their first, while others may come from a home where English is their first language. There is also the consideration of the students' home life in terms of guardianship, financials, and resources. Each of these factors is unique to each student and will affect them each in their own way. It is important to observe and accommodate some of these needs in order to maximize the impact of the child's education (Jacob, 2007).

A push that school systems are beginning to make is to hire teachers who look like the students. In other words, when a school has more children of color they would hire a more diverse staff. Research was done by the IZA Institute of Labor Economics that shows there is an estimated 19-29% increase in the number of students who went on to college after being taught by teachers of color. Retention of students is higher when there is support in the classrooms and role models in the schools that the students can relate to (Gershenson, Hart, Lindsay, & Papageorge, 2017).

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### *2.3.1 STEM Education in Urban Schools*

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These challenges are just a few that any school will have to consider. But a more specific challenge that schools are beginning to face is that of STEM education and curriculums. STEM education has become a popular initiative in the Massachusetts school system. There are curriculum frameworks and implementation resources that are updated and published by the Massachusetts Department of Elementary and Secondary Education (Science, technology engineering, and mathematics (STEM), 2016), While this resource is great, there is still the issue of the schools having the proper tools to be able to carry out the curriculums. If a school is still working on improving conditions and resources for the students and families who need help, then the focus of a STEM curriculum may be put on the back-burner. But there are a few schools that have made great strides towards both causes.

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### *2.3.2 Worcester Technical High School*

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There are many schools whose focus lies in the future of the student whether that be a college or workforce career and are equipped with the resources to do so. One school, in particular, is the Worcester Technical High School (WTHS) located within the Worcester Public School system. WTHS is a unique school in that it is not quite a vocational style school, meaning the focus

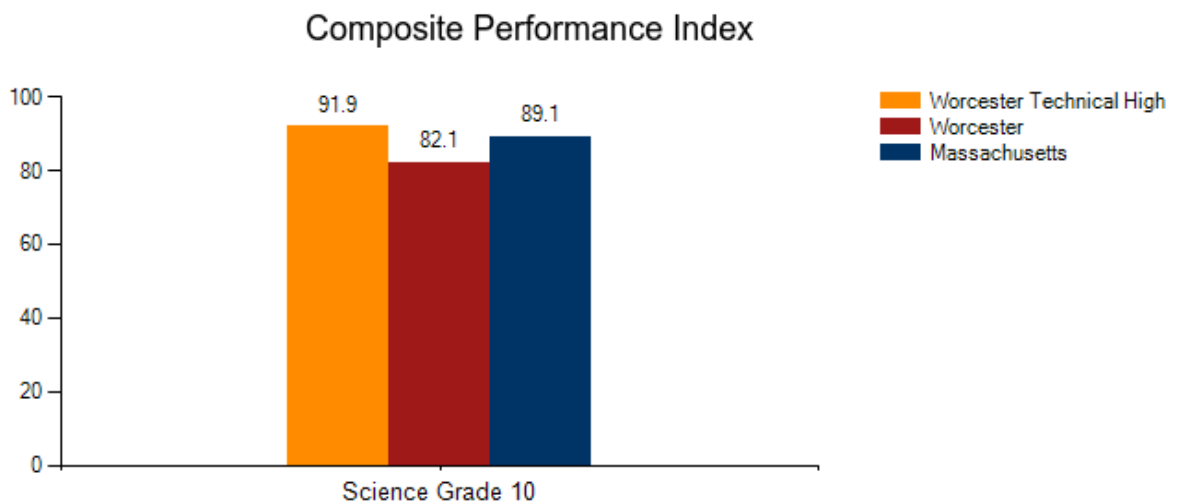


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is solely on trade, but also not quite a standard high school focused on academics. WTHS takes the benefits of both educations and creates something in the middle. Students still maintain their standard high school education but have the opportunity to be on an accelerated track and also to focus on one of 22 different technical areas. Design and Engineering, Health and Human Services, Construction Technology, and Information Technology and Business Services are just some of the technical areas that prepare students for both college and the workforce (Worcester Public Schools, 2020).

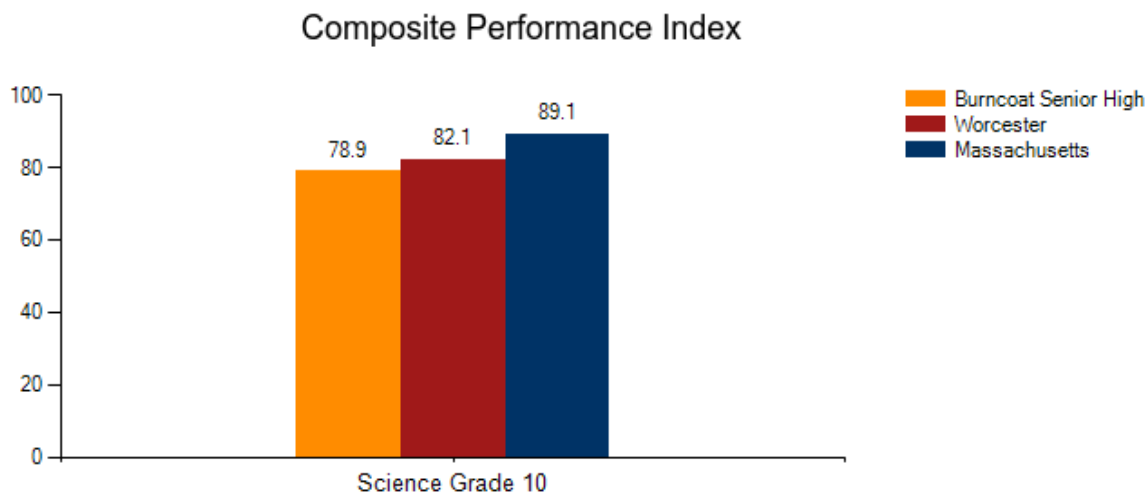
While WTHS has a focus on trades, it is still very comparable in demographics to the other Worcester Public Schools. All Worcester high schools have families with varying backgrounds and resources. But with the focus on trade and academics, Worcester Tech leads the district in graduation rates of about 98% of the graduating class (Worcester Public Schools, 2020). Not only that but the overall Composite Performance Index (CPI), or “a number from 1-100 that represents the extent to which students have attained or are progressing toward proficiency in a given subject” (DESD, 2019) for WTHS is higher not only from the district average but from the state average as well. For example, Figure 1 below shows the CPI of Worcester Technical High School while Figure 2 shows the CPI of Burncoat Senior High. As you can see, the trade and technical focus of WTHS shows benefits in not only retention but in test scores as well (DESD, 2019).

Figure 1. Composite Performance Index of Worcester Technical High School (DESD, 2019)



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Figure 2. Composite Performance Index of Burncoat Senior High (DESD, 2019)



A school like Worcester Technical High School is a great basis for project opportunities from outside influences. WTHS already has partnerships and programs with colleges such as Tufts University, Becker College, Quinsigamond Community College, and more. Partnership programs create a more valuable education among students at the high school level.

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#### 2.4 Partnerships between Colleges and High Schools

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Similarly to Worcester Technical High School, many public school systems partner with local colleges and universities in order to provide more opportunities for its students. These symbiotic partnerships can provide benefits for both institutions and both groups of students. This section focuses on two examples of partnerships between Master’s programs and local high schools and the benefits they provide to the community.

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##### *2.4.1 High Tech High Graduate School of Education (GSE)*

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In San Diego, California, unified school district, High Tech High created a program truly unique: it embedded a Graduate School of Education within its K-12 schools. High Tech High which is a series of tech-focused elementary, middle, and high schools in California, has a hands-on, applied, project-based learning curriculum—similar to that of WPI’s. The goal of this unique partnership in which HTH offers graduate-level teaching students a chance to complete a Masters of Education (M.Ed) within its school is to “aspire[s] to serve as a center of inquiry and progressive

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practice related to teaching, learning, and leading, and an example of transformative graduate education that has a direct impact on K-12 schools,” (Scholarship & Innovation, 2020). The GSE students provide resources and support to the faculty of the High Tech High schools in hopes that the students will benefit from interacting with the future teachers and the future teachers will gain classroom experience. The HTH GSE provides two degree programs, a Master’s degree in Education, and a two-year teacher credentialing. The GSE Dean, Stephen Hamilton states: “What makes graduate students’ experience transformational is our GSE’s embeddedness in a set of innovative K-12 schools, along with the modeling in the GSE of the pedagogical principles,” (Ryerse, 2016).

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#### *2.4.2 Clark University*

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More locally in Worcester, MA, Clark University is taking great strides with the creation of its Masters of Arts in Teaching (M.A.T) program. This program seeks to partner current Clark University students with a desire to teach with one of six partner public high schools within the Worcester Public School system (Partner Schools, 2020). The partner schools are all located in Worcester’s Main South neighborhood—a racially and linguistically diverse urban neighborhood and the same neighborhood Clark itself is located in. This partnership gives the university students real-world experience in teaching in urban settings as students benefit from effective teaching practices (Master’s in Teaching, 2020). It is currently the only teacher preparation and licensure program of its kind to receive Approval with Distinction by the Massachusetts Department of Elementary and Secondary Education. The Commissioner of Elementary and Secondary Education stated, “The sponsoring organization or program is operating at such a high level that it could serve as a model for other providers in the state and nation,” (Masters of Arts, 2020).

Clark University has also received national attention for its creation of the University Park Campus School (UPCS) through the University Park Partnership. This 7<sup>th</sup>-12<sup>th</sup> school was founded in 1997 in order to create better relations between Clark University and the Main South district. The high school, along with Clark’s Adam Institute for Urban Teaching and School Practice and the Worcester Education Partnership, seeks to create a better learning environment for urban high school-aged students through partnerships with the local university. The benefits from this partnership include curriculum development for UPCS, homework support and tutoring for the UPCS students, teacher training and enrichment through Clark University, real-life teaching

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experience for Clark students, and opportunities for the high school students to enroll in college-level courses (Neighborhood, 2020). This partnership was also praised by Lani Guinier, Harvard Law professor, civil rights theorist, and author of *The Tyranny of the Meritocracy*, in which she stated, “Since the partnership began, crime and transiency have gone down in the Main South neighborhood, and residential occupancy is up. Some families say they have moved in just so their children can attend University Park,” (Guinier, 2015). Clark University also offered free tuition to University Park graduates who passed Clark’s admission requirement. The school was immensely successful for students in the Main South neighborhood. In fact, in 2014, UPSCS had 100% of its graduating class admitted to higher education institutions, with 89% being four-year colleges and 11% being two-year community colleges (Guinier, 2015). This is an incredible accomplishment for any high school. However, it wasn’t only the neighborhood’s children that benefited from this partnership but the Clark University students, as well as the program, turned them into qualified young teachers, many of whom stayed in the UPSCS faculty. Almost all of the teachers working at UPCS graduated through Clark’s program (Partner Schools, 2020).

Both Clark University and HTH’s Graduate School of Education provide excellent examples of the benefits and potential positive outcomes that can arise when a college partners with local community high schools through an established program. As former UPCS principal, Ricci Hall said “We are a community, and we can always achieve more together,” (Guinier, 2015).

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## 2.5 Background Summary

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As the need for STEM educators grows, so does the need for the programs to support these educators. The STEM Education Center and WPI focus on training teachers so that in turn they are able to educate their students in the field of STEM. This center sends teacher-candidates to many local Worcester schools in order to complete the teaching practicum. One school in particular that focuses on STEM education is Worcester Technical High School. This vocational and traditional style school is a great example of the positive impact that STEM education can have on a learner. This school has some of the highest student achievement for the district. Institutions such as these will lead the way in educating youth in STEM fields. In our next chapter, we will discuss our methods on how we are able to link these elements together in a project center for WPI.

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## Chapter 3: Methodology

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Our team's goal was to establish a project center within Worcester Technical High School through a formalized relationship between the high school and Worcester Polytechnic Institute. This way, both schools can benefit from this community-based approach. For WPI, the project center could serve as a way for college students to complete their capstone projects required for graduation and the high school could improve its STEM education, as well as the functionality of the school. The goal is that this partnership could lead to improvements for both schools and create a better STEM education for all.

In order for our team to achieve this goal, we created a set of objectives for us to meet. This guided us to create the most beneficial formalized relationship as possible for both Worcester Tech and WPI. The objectives our team developed and focused on are as follows:

1. Identify wants and needs from both WPI and WTHS.
2. Analyze the data collected.
3. Create agreement and recommendations.
4. Evaluate the agreement.

In order to satisfy these objectives, our team needed to understand the needs of both stakeholders in this project: WPI and WTHS. To do this, our team talked to various people working for both WPI and the high school in order to gain an understanding of what they would want out of a partnership. We also familiarized ourselves with methods to analyze qualitative data so our team could effectively interpret the data collected from these conversations. We then compiled this information into a formal agreement which was reviewed by each of the stakeholders.

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### 3.1 Identify wants and needs from both WPI and WTHS

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To identify the wants and needs of both the stakeholders of this project, Worcester Polytechnic Institute and Worcester Technical High School, our team conducted a series of interviews with key employees from both groups. This way we gained a perspective on what each stakeholder needs from this partnership in order to improve their respective schools. The following subsections detail the process we followed for each step.

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### 3.1.1 Interview with Stem Education Center at WPI

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We first conducted interviews with WPI employees who work in the STEM Education Center. The goal for these extended interviews was to gain insight into what specifically WPI would need from this partnership in order to establish a project center as well as what kind of WPI curriculum-based projects could be completed if the project center were to be established. First, we started by identifying two people to interview, Kathy Chen, the director of the STEM Education Center and the current organizer of the on-campus IQP project center the Center hosts and Shari Weaver, who also works for the STEM Education Center. Since we were using these interviews to gain insight on what WPI would need to establish this project center and want for it to become in the future, these interviews were open-ended and conversation-like as opposed to a fully structured interview. The full interview guide our team followed can be found in Appendix A, however, a preview of some of the questions we asked for guiding topics are outlined in Table 1 below:

Table 1. Worcester Polytechnic Institute Interview Questions

What benefits will WPI students/faculty/staff gain?
What sort of projects do you believe will be completed at the new project center? (IQP, Teacher Practicums, MQP, etc)
How might this formalized relationship ease any current problems?

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### 3.1.2 Interview with WTHS

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Alongside our interviews with the STEM Education Center at WPI, the team conducted interviews with employees at Worcester Technical High School. Similarly to the WPI interviews, our interviews with the WTHS employees were conversational, and not fully structured interviews in order to gain a better understanding about what they would want from the partnership as a stakeholder instead of input from us. Our goal for these interviews was to fully define what WTHS

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would need in order to establish a partnership as well as ideas on what projects WPI students could assist the school in.

To start, we identified two individuals from Worcester Technical High school who showed interest in creating a formalized relationship between the college and high school. We talked to Patricia Suomala, who is the Director of Career and Technical Education at WTHS as well as Whitney Goodwin who is the Department Head of Coughlin Construction Academy for the high school. In interviewing these specific people we were looking to get the reasons in which WTHS would be interested in starting a partnership with WPI and what they need from the partnership in order to make it last through administration changes. Again, the full interview guide is located in Appendix A, however, a list of some of the guiding questions we asked the WTHS employees are provided in Table 2 below:

Table 2. Worcester Technical High School Interview Questions

What benefits will WTHS students/faculty/staff gain?
Are there any reservations you may have regarding the creation of the project center within WTHS?
How do you think this will impact the students in your school?
Could the projects needed to be completed by WPI students benefit the school?

We also gathered the names of various teachers within the high school from the first round of interviews for us to interview as well. The purpose of interviewing teachers in Worcester Tech was to gain a more rounded view of what this project center could look like and how is the best way to define it. Teachers have direct interactions with the high school students as well as with WPI Students completing a teaching practicum at their school so therefore they have a unique perspective of what this partnership between schools could do to benefit and improve the high school. We were able to interview four different teachers each from different subjects within the

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school, from both the academic side of the school as well as the vocational. These interviews were also kept open-ended and conversation-like and the guiding questions for Worcester Technical High School found in Table 2 as well as Appendix A were used.

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### 3.2 Analysis of Data

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As we interviewed representatives from the STEM Education Center and Worcester Technical High School, we recorded our conversations in order to be able to analyze the responses from interviewees. The qualitative data analysis technique we used is thematic coding, which is the categorization of qualitative data in order to find patterns to analyze and come to a conclusion (Clarke, V., & Braun, V, 1970).

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#### 3.2.1 Thematic Coding

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Thematic coding, also called thematic analysis, is a form of qualitative analysis that we utilized after the data collection phase of our project. It involves reading through text in order to create a framework of related ideas (Mountain, A., & Marshall, H, 2019). We went through the recordings of the interviews and evaluated the responses from the interviewees word by word. Different words were organized together thematically and coded so that we could categorize the wording of the responses in the interviews. Once categorization was complete, we analyzed and discovered the relevant objectives relating to our project in order to create the deliverables.

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### 3.3 Creation of Deliverables

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Our third objective was the development of the deliverables of our project. The first deliverable was a Memorandum of Understanding (MOU), an agreement between both the STEM Education Center and Worcester Technical High School outlining the responsibilities and expectations of both parties as they created the project center within Worcester Technical High School. The second deliverable was a clearly written definition of the project center and the third deliverable was a set of recommendations for projects that could potentially take place at the new project center as well as the next steps in creating the project center.



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### *3.3.1 Memorandum of Understanding (MOU)*

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An MOU is a document that outlines mutually agreed upon expectations and responsibilities between two parties as they work towards a common goal (Chandler, N, 2011). In our case, the two parties are the STEM Education Center at WPI and Worcester Technical High School and the common objective is the creation of the proposed project center within Worcester Technical High School. Our MOU is not legally binding, so it is not a contract, but it is a more formal agreement between the two stakeholders of the project that can be referred to as the project center is established. MOU's take time and energy to create because they require both parties to evaluate their own needs and wants and then come together to negotiate in order to conclude on common ambitions (Chandler, N, 2011). Learning the needs and wants of each party was completed in the first objective as we interviewed both parties. The common goals between each stakeholder were discerned while completing our second objective, qualitative analysis. This information collected from the first two objectives was used to guide the creation of our MOU.

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### *3.3.2 Project Center Definition*

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Our second deliverable was a clear definition of the proposed project center. To date, no WPI project center has ever been created in a high school, so this proposed project center is completely unique. Other project centers are located all around the world and partner with sponsors in their respective communities. Similar to the Worcester Community Project Center for IQPs, this project center is located in Worcester and will help make an impact on the community. However, this project center will be different in that the projects completed will take place in Worcester Technical High School and specifically the school. Since this project center is unlike any other, we used what we learned in our interviews and qualitative analysis to create a formal definition of the project center to aid in the creation of the project center in Worcester Technical High School.

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### *3.3.3 Project Recommendations*

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In our interviews with the STEM Education Center, one of our goals was to identify the types of projects that they envision being completed at the new project center, whether it will be IQPs, Teacher Practicums, MQPs, HUAs or even graduate-level projects. It was important to identify the scope of the proposed project center because it helped us to more clearly define project centers as well as aided us in establishing the boundaries of the relationship between the STEM

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Education Center and Worcester Technical High School. After we established the scope of the project, another goal of ours was to identify potential project ideas from both parties to serve as a starting point for the project center to begin completing projects.

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### 3.4 Evaluate the Agreement

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The team's final objective was to evaluate the agreement created in order to make sure it fully fits the needs of both stakeholders as they will be the ones utilizing this agreement. In order to evaluate the agreement, the team chose the method of sending the agreement to both stakeholders for feedback. The team continued rounds of feedback until data saturation was reached.

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#### *3.4.1 Feedback*

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Once written, it was important to gauge the effectiveness of the MOU. This would help to ensure the relationship's longevity and strength in the years to come, something that is important to both stakeholders. In order for our team to produce the most effective agreement, we heavily considered feedback from both Worcester Technical High School and the STEM Education Center at WPI. Their voice was used to not only help write the agreement but also create a partnership that will only strengthen the relationship between the two schools.

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#### *3.4.2 Data Analysis*

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Once we began gathering data through our interviews and conversations, we were able to compile it and create a comprehensive assessment of what the agreement should look like. For our team to refine the data to the most effective state we used an indicator called data saturation.

Data saturation, also known as the point where the research process presents no new information, is the method our team used to determine when the agreement is satisfactory to both stakeholders (Faulkner & Trotter, 2017). Through the previously mentioned process of sending the drafted agreement back and forth to both stakeholders, we were continuously in contact with WTHS and the STEM Education Center for their feedback and suggestions. Depending on the difference in needs from the STEM Education Center and Worcester Technical High School, the time to reach data saturation varied. The drafted MOU was sent back and forth until both

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stakeholders no longer have any suggested edits they wish to make. This was the stopping point for our MOU improvements and we were able to effectively conclude our work on the agreement.

### 3.5 Methodology Summary

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Our team outlined four main objectives in order to achieve our goal of establishing a relationship and creating a project center. We needed to first identify the wants and needs both WTHS and WPI were seeking in this relationship. We did this through interviews with both stakeholders that were conducted in a more informal and conversation like setting. From there we would analyze the data through thematic coding to identify the main themes our team should focus on. These themes would outline the information needed in our deliverables. The MOU contained general and shared themes, while the more specific themes were included in the recommendations. For the MOU it was important to consider feedback from the stakeholders to ensure a satisfactory document. We sent drafts and feedback back and forth until we reached a point of data saturation where no new suggestions were made. In the next chapter, we will discuss the specific findings that our team came across during the execution of our methodology.

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## Chapter 4: Findings

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As previously mentioned in the Methodology Chapter, the team set out to identify the needs and wants of the stakeholders, analyze these themes, and to define the relationship through our deliverables. We began the identification with a series of interviews of both stakeholders, followed by an analysis of these interviews. Our team was then able to determine the key aspects that would define our deliverables. The following section is organized to follow these objectives in the order that they were executed.

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### 4.1 Identifying the Needs

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To recognize the needs of our stakeholders, our team conducted a series of interviews. These interviews provided us with better insight into the proposed relationship. Our goal was not only to obtain and highlight the needs and wants of the two stakeholders but to also understand the limits and potential of this project center. We were able to speak with representatives individually from the STEM Education Center along with WTHS administration and WTHS faculty. The following three sections analyze and discuss the findings of the three representative interviews we conducted.

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#### *4.1.1 STEM Education Center*

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Our team spoke with two members of the STEM Education Center at WPI. We led our interview as an open-ended conversational interview so that we could get to understand each person and their thoughts more coherently. After explaining what our team was hoping to understand, we began by asking each of them what they wanted to see this relationship look like. Throughout this conversation, our team also learned more about the STEM Education Center and the types of work they do. Projects such as the teaching-practicums were stressed as something that had already been developed on the WPI side. However, the STEM Education Center is looking to branch out and partner with more schools to create more opportunities for the teacher-candidates.

Right away our team noted that the STEM Education Center was very adamant that the relationship is equally beneficial to the WPI and WTHS students. Soon we were able to discuss ideas for projects such as tutoring for the high school students along with thoughts of integrating

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the Practicum and Pre-Practicum requirements from the Teacher Preparation Program into the WTHS project center. The STEM Education Center was particularly interested in WTHS due to its heavy involvement with STEM education. There has been a great need lately for teachers who specifically can teach the main STEM topics. Having the ability to be involved in a technical school would greatly benefit the students in the Teacher Preparation Program.

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#### *4.1.2 Worcester Technical High School Administration*

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Similar to the interviews with the STEM Education Center, our team individually spoke with two WTHS administration members. Each representative was just as enthusiastic about this opportunity as the STEM Education Center. Once again we conducted these interviews in a more conversational style. We led these two interviews by explaining who we were and our team's focus. Once our introduction was established, we were able to start framing our conversations based on their responses and responses from earlier interviews.

In both interviews, we began by asking leading questions that would give us an idea of what the representatives saw this relationship as. From there we were able to ask more detailed questions based on their previous answers. For example, interdisciplinary work among the high school students was something the representatives were excited to see. From then we asked about what trades within the school have the ability to collaborate and what types of projects would interest the high school students. The information gathered from this would be reflected in our team's final deliverable of project recommendations.

Another interesting detail that came up during these interviews was the idea to speak with some of the students at WTHS. This would provide our team with even more data on how to make this relationship the most beneficial to the high school student population. We learned that motivation was also something worth noting about the high school students. As they already have their focus on curriculum standards, adding an additional and optional project may not be appealing. So it was suggested by the WTHS administration to create projects that would have an impact on the student and be engaging enough so as to not seem like additional work.

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#### *4.1.3 Worcester Technical High School Faculty*

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From the recommendation of the WTHS administration, our team had considered collecting data from the students at WTHS. However, due to the time constraints of this project

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and requirements from the Institutional Review Board at WPI, we thought it more prudent to speak only with teachers and faculty at WTHS. We reasoned that they would have a good understanding of the interests of their students and what engages them in their learning so that we could gain the necessary data without surveying or interviewing WTHS students.

Through the conversations with some of the faculty at WTHS, our team learned what the most current interests in terms of the offered trades are and what some current needs are within the learning environment. Some suggestions include but are not limited to college mentorships for interested high school students, collaborative projects between trades, and projects dealing with robotics. We also learned about the types of events and programs that the school once had to offer but due to various reasons no longer did. Events like a science fair and programs like a robotics tournament team were mentioned as something that students would still be interested in. All of these ideas and suggestions gave our team a much better idea for types of projects and specific project themes to recommend.

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## 4.2 Analyzing the Data

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In order to analyze the data our team had received from the interview transcripts, we used a method for qualitative data analysis called thematic coding. Our goal for the coding was to identify the most important themes that arose from the interviews by calculating how many times each theme was mentioned. The findings our team discovered throughout this process is outlined below.

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### *4.2.1 Thematic Coding Results*

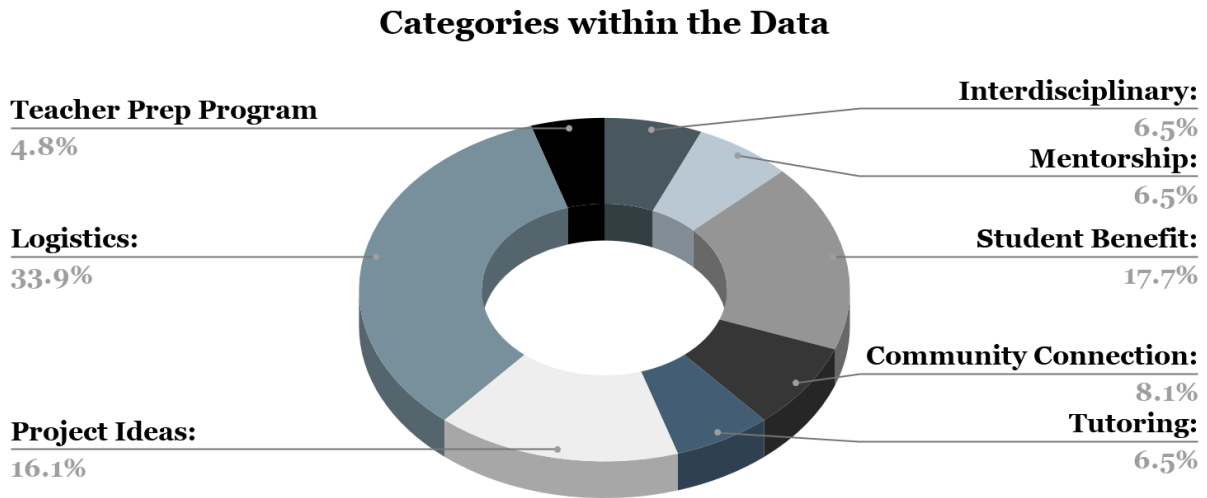
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After conducting the interviews with representatives from the STEM Education Center and WTHS, the team needed to further analyze the results. Through the previously mentioned method of thematic coding, we were able to pull the main themes from the interviews via their respective transcriptions. Each theme our team came across was put in a spreadsheet and organized to fit into different categories. From here, the categories became our focus and the importance of each category was determined by how many different themes from the transcriptions were able to be organized into that category. The table containing our organized themes and categories can be found in Appendix B. As a result of comparing frequency, the team was able to illustrate our analysis in the form of a pie chart as seen in Figure 3 below. The overarching categories that our

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team was able to identify from the data include “Teacher Preparation Program”, “Logistics”, “Project Ideas”, “Interdisciplinary Work”, “Mentorship”, “Student Benefit”, “Community Connection”, and “Tutoring”.

Figure 3: Categories within the Data



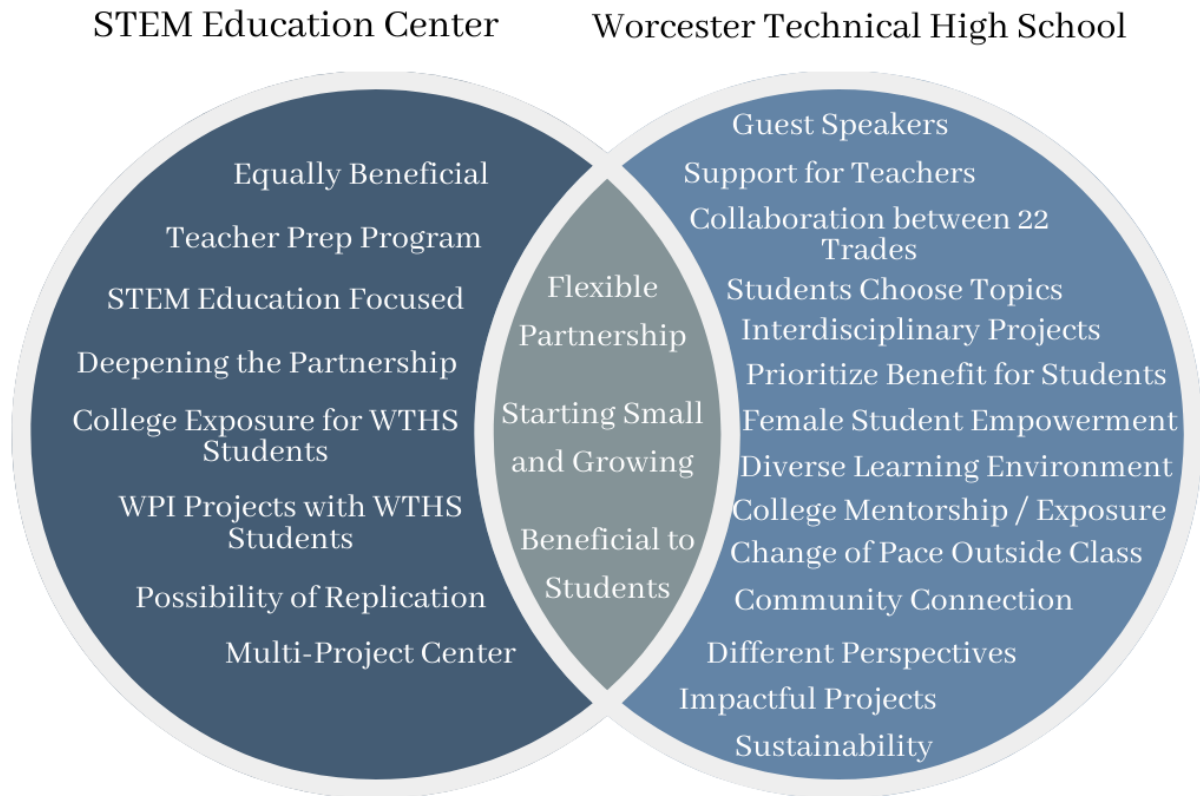
“Project Ideas” and “Student Benefit” came up in the data equally as often. Our team had noticed throughout the interviews this was something both stakeholders addressed. As shown, a majority of the themes identified fell under the category of “Logistics”. This includes aspects such as transportation, funding, and student-motivation that would need to be addressed when launching a program or project. All the themes that fit within the previously mentioned categories are later addressed by our team in our recommendations to the stakeholders and to the continuation of this project.

### 4.3 Defining the Deliverables

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Once all of our data from the interviews were analyzed, our team needed to decide what themes fit with the deliverables we had in mind. We also needed to think about the definition of our project center and what we meant by that.

Figure 4: Stakeholder Themes Venn Diagram



The Venn diagram, as seen in Figure 4, illustrates how our team categorized our focus themes. The left side represents the STEM Education Center while the right represents WTHS. The overlap in the middle is where our team saw similarities from the interviews of each stakeholder. From this Venn diagram our team was able to visualize what data fits each deliverable the best. We were also able to see the clear overlap that both stakeholders shared in thinking about this partnership.

#### *4.3.1 Findings for the Memorandum of Understanding*

As mentioned in detail in the Methodology Chapter, the Memorandum of Understanding (MOU) is what will formalize the partnership between the STEM Education Center and WTHS. Our team needed to decide what this partnership was going to look like to be able to piece together this document. After analyzing the interviews, our team determined the most important qualities that both stakeholders wanted to see from this relationship. When looking at the Venn diagram in Figure 4 you can see these qualities as the themes in the overlapping portion of the diagram.



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Aspects such as an equal partnership, flexibility, and benefit to the students foremost were all mentioned on separate occasions by both stakeholders. Our team also noticed that having this partnership start out smaller was also mentioned. The stakeholders saw this as a way to create a strong and grounded relationship that would then have the foundation to build upon.

Each of these common themes are highlighted in the MOU which can be found in Appendix C. There are a few other themes that each stakeholder emphasized in their interviews. From the STEM Education Center, the Teacher Preparation Program and from WTHS mentorship along with interdisciplinary work were the biggest themes. These are also noted in the MOU. Both of these ideas are also part of the recommendations our team is providing to the stakeholders.

Based on some of the themes, we composed a set of personalized clauses that would help further define this relationship. These clauses can be seen in full in Appendix C where the full MOU is. Two of the three main clauses discuss expectations from both WTHS and WPI. Expectations include flexibility, communication, and support for each other's programs. We really wanted to make sure that the respect was established in order for the relationship to start strong. The third clause we had included was one that would define the roles of each party's representatives. For example, we outline that each party needs to have a Director who will uphold and maintain the leadership of their respective organization. We have also defined some of the students who could be potentially involved in this relationship such as the teacher-candidates of the Teacher Preparation Program, IQP students from WPI, and the high school students at WTHS.

Something else that helped out the team with the MOU, was the feedback we received from the stakeholders. As this is their partnership we wanted them to be satisfied with the document. We sent the drafted MOU out to two representatives from each of the partners. All representatives gave us valuable feedback to which we made appropriate adjustments. Our goal was to continuously receive feedback until there was no new information and data saturation was achieved.

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#### *4.3.2 Defining a Project Center*

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Over the course of our interviews with the STEM Education Center and representatives from WTHS, we noticed that this idea for a project center did not seem to fit any previously created mold of “on-campus” or “off-campus”. We worked to come up with a definite classification that seemed to account for everything mentioned by both stakeholders. Initially, both our team and the

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STEM Education Center felt as though this would be considered an “off-campus” project center as the majority of the work would be done off-campus.

In need of further clarification, our team reached out to members of the WPI administration to discuss both what to classify this project center and how to make this an official center. We were able to speak with one person who was more familiar with the “on-campus” process for a project center along with one person who spoke more on the “off-campus”.

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#### *4.3.3 Interviews With WPI Administration*

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During the conversation about “off-campus” project centers, our team learned that it would require the center we are developing to be part of the Global Projects Program. This would entail the one prior term course of ID2050 in preparation for the seven weeks of project work in the term to follow. The application process would also be the same as all other projects in the Global Projects Program in the newly adapted ranking system.

For the “on-campus” project centers, our team learned that there is overall a better sense of control in managing it. The directors will have more say on the types of projects and the people who will get to be a part of them. Some centers even require a more interview-like process to assign WPI students to a project. There is also the potential to have projects that are longer than the seven-week style.

Our team took all the advice and knowledge from these conversations and began thinking of where this project center would fit best. We determined that as this is a new and creative concept for a project center that having the ability to change and fill its own mold was crucial, therefore the more control over the center the better. Our team also knew of projects, for example, the teacher practicums, that would be 15 weeks in length. This very clearly did not satisfy the “off-campus” model. In the end, we determined that the best classification in the meantime would be that of “on-campus”. Our team discussed this with representatives from the STEM Education Center as they would also be the director of this new center. They agreed with our thinking and figured it would be a good starting point that would allow for enough expansion to later be considered “off-campus”.

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#### *4.3.4 Findings for Recommendations Deliverable*

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Throughout our interviews, our goal was to glean inspiration from our interviewees. We wanted them to discuss all that they wanted to see come from the partnership between WPI and WTHS. To this end, we asked many open-ended questions and asked them to imagine what this project center could look like in the future. As shown in the Venn Diagram in Figure 4, the MOU was developed from the overlapping themes between WPI and WTHS. Our recommendations were developed from themes gathered from either side of the Venn Diagram in Figure 4, or the themes that were found from the data collected from interviews with WPI or WTHS but not necessarily both. Our team developed two sets of recommendations. The first, the site recommendations, are recommendations for the advancement of the project center. The second, the potential project recommendations, are potential project ideas that we believe could be accomplished at this new project center.

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#### *4.3.5 Shaping the Future of the Site*

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Our Site Recommendations are ways in which we believe the project center should be advanced. They were developed from data collected when speaking to the STEM Education Center administration and WTHS faculty and administration. Our IQP project covers the establishment of the partnership between WPI and WTHS but does not go into definitively defining the logistics and how the project center will eventually be run. Therefore, our site recommendations go over how we believe the directors of the project center could best approach getting the project center up and running. To this end, we have included recommendations based on themes from our data such as “Possible Replication” and “Multi-Project Center”. Our recommendations also draw heavily from the “Logistics” category from our data themes, found in Appendix B. The document covers best practices when moving forward with the project center and includes eventual expansion of the project center into other types of projects, including MQPs, HUAs, and graduate projects. Currently, the project center will be on-campus, but we also recommend that eventually this project center could be moved off-campus if the STEM Education Center chooses to do so, once the project center is firmly established.

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#### 4.3.6 Project Ideas

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Our Project Recommendations are potential projects that our team believes has the potential to be completed at this project center. When creating these project recommendations, we drew heavily from the “Project Ideas” category identified within our data. These include Teacher Practicum projects, Pre-Practicum projects, and IQP projects. The different projects were suggested during our interviews with both the STEM Education Center and WTHS. These are project ideas, not fully fleshed out projects, but merely intended to serve as a starting point as the project center moves forward. Many of our WTHS faculty interviewees came from different departments so we asked them to discuss some projects that they would like to see in their classrooms. We also asked them to discuss some projects they believed that their students would be interested in completing outside of school. Because incorporating a project into WTHS’ academic requirements would require school board permissions, we needed to think about projects that would engage students outside of their normal lessons and that they actually would want to complete. We found from the data that WTHS students are more likely to be interested in projects that they are able to choose and have a say in. We also found that projects with a community connection that allows a student to make a difference in their community is likely to be more engaging. Using this information, and other specific ideas, such as Saturday Buyback, Science Fairs, and Tutoring, we developed our project recommendations.

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#### 4.4 Summary of the Findings

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Through interviews, our team gathered our data from representatives of WPI and WTHS. Our interviews were intended to serve as conversations instead of formal interviews so as to allow the representatives to elaborate and give us their thoughts and ideas. Our interviews were recorded and the transcripts of each call served as our raw data for our project. This data was qualitatively analyzed using thematic coding, giving our team the themes to base our final deliverables on. By classifying the themes within different categories, we were able to discern specific topics to be included within our MOU and recommendations. The MOU was developed based on overlapping themes identified from interviews with representatives of both stakeholders, while our site and project recommendations were developed from all themes we identified from the data, but weren’t necessarily mentioned by both stakeholders. This allowed our deliverables to cover all themes

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within all categories identified from our data. In the next chapter, we further discuss the results and conclusions of our findings.

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## Chapter 5: Conclusions and Recommendations

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The purpose of our project was to investigate and establish a relationship between the WPI STEM Education Center and WTHS for the purpose of creating a WPI project center embedded within WTHS. To this end, a series of deliverables were produced to achieve this goal: MOU that defines the partnership between the WPI STEM Education Center and WTHS, a set of potential project recommendations for the new project center and a set of site recommendations intended to help progress the project center. These deliverables will be given to our sponsors at the STEM Education Center as well as the administration at WTHS in order to establish the project center.

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### 5.1 Importance of Flexibility

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From the beginning of our interviews, we realized the importance of flexibility going forward with the project center within WTHS. Interviews with both WPI and WTHS yielded common themes including the need for a flexible partnership, which made it clear to us that this would be an important factor moving forward. As the partnership progresses and projects begin in conjunction with WTHS, flaws with logistics may arise and flexibility will be important in order to figure out what works and does not work within the project center. With the completion of our project comes the establishment of the partnership between the STEM Education Center and WTHS. Logistics for the project center have not yet been established as our project comes to an end, but instead will be left to the next IQP team that continues the work on the project center within WTHS as well as the directors of the project center, meaning flexibility on both sides is of the utmost importance as these details are completed.

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### 5.2 Memorandum of Understanding

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Our first deliverable, the MOU, represents the new partnership between the WPI STEM Education Center and WTHS. The MOU formalizes the expectations that each stakeholder will abide by so that the new project center will succeed. The purpose and mission statement as written in the MOU reads:

“To create a lasting and growing partnership between the WPI STEM Education Center and the Worcester Technical High School for the development and growth of the students from each institution.”

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Our document is not legally binding and as such, is not enforceable. The MOU simply provides a written set of expectations that both parties will agree to as they move forward with the creation of the project center within WTHS. The full MOU document can be found in Appendix C. The following are expectations set out for Worcester Technical High School:

1. It is requested that Worcester Technical High School upholds their end of an equal and fair partnership, brings any concerns to all parties in the partnership, maintains clear communication, and addresses any concerns in a professional manner with full cooperation.
2. In relation to projects, programs, or events led by or in part by Worcester Polytechnic Institute, Memorandum of Understanding Page 3 of 4 it is expected that Worcester Technical High School works with and supports students and faculty from Worcester Polytechnic Institute.
3. In relation to the WPI STEM Education Teacher Preparation Program, it is requested that Worcester Technical High School supports and creates engaging opportunities for teacher candidates and anyone participating in the Teacher Preparation Program at WPI.
4. It is also asked that Worcester Technical High School representatives provide partnership leaders with timely and constructive feedback and suggestions to further develop and enhance this relationship.

The following are expectations set out for the STEM Education Center at WPI:

1. It is requested that the STEM Education Center upholds their end of an equal and fair partnership, brings any concerns to all parties in the partnership, maintains clear communication, and addresses any concerns in a professional manner with full cooperation.
2. In relation to projects, programs, or events led by or in part by Worcester Technical High School, it is expected that Worcester Polytechnic Institute works with and supports students and faculty from Worcester Technical High School.
3. It is expected that the STEM Education Center will abide by the curriculum and vocational guidelines when instructing Worcester Technical High School students on projects, programs, and events.

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4. It is expected that the STEM Education Center representatives provide appropriate support (case dependent) in a classroom or shop setting at Worcester Technical High School.
  5. It is also asked that STEM Education Center representatives provide partnership leaders with timely and constructive feedback and suggestions to further develop and enhance this relationship.

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### 5.3 Potential Project Recommendations

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The purpose of our potential project recommendations is to suggest areas where WPI students could work on projects at WTHS as well as inspire ideas for additional projects to be completed at the project center. Our project recommendations outline the types of projects as well as specific examples regarding each type of project. They are intended to provide the STEM Education Center with a starting point with the project center as well as display all the potential that this project center has with regards to the impact that students from WPI and WTHS could have within the project center. All of our project recommendations were created to uphold the mission statement and guidelines described in the MOU and approved by both the WPI STEM Education Center and WTHS. The completed document, Project Recommendations, is located in Appendix D.

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#### *5.3.1 Teaching Practicum Projects*

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Before the creation of this project center, WPI sent students within the Teacher Preparation Program to complete their Teaching Practicum within many Worcester Public High Schools including WTHS. Based on the team's interviews with various members of WTHS staff as well as WPI staff, this teaching practicum program is already well established and benefits both parties in the way the MOU states. Therefore, the team suggests that this partnership would only continue this successful relationship and WPI should keep sending student teachers to WTHS who will provide mentor teachers to train them.

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#### *5.3.2 Pre-Practicum Projects*

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WPI also supports undergraduate students aspiring to be teachers before their official Teaching Practicum. These Pre-Practicum experiences are fewer hours and require students to work directly with K-12th grade students. Because of this needed direct contact time for WPI



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students and the want from WTHS to have students work with college students, our team recommends that Pre-Practicum projects be completed at the WTHS/WPI Project Center. The team identified five different areas in which the partnership between WPI and WTHS could create a structure for Pre-Practicum students while providing the WTHS students with engaging learning material.

The first area identified that could be improved through the establishment of this partnership is interdisciplinary trade projects. The idea behind these projects would be that Pre-Practicum students could achieve hours working with students as well as experience managing students through acting as a project advisor for interdisciplinary student projects. The students would work in teams to complete a project that allows them to apply their trade to solve a real-world problem. Because these projects would need to be completed outside the curriculum required of a WTHS student, each project completed should be engaging for the WTHS students. Thus, our team recommends making the projects student-driven meaning that students largely determine what project they take on, with guidance from student-advisor and teacher. The main goal of these Interdisciplinary Trade Projects (ITP) would be to work with students of other trades on a real-world problem. This way each student could take what they are interested in doing, their trade, and through the process of managing a project could gain real-world skills. These projects would allow for teachers in training at WPI to practice their skills by acting as an advisor, overseeing a project. Second, because these projects are applying trade knowledge to the world of STEM and would require knowledge of multiple different topics within STEM, WTHS students could receive help on the topics they are struggling to understand from their student-advisors. The third benefit would be college perspective and mentoring. Through these partnerships, high school students would have the opportunity to work closely with college students. This would allow them to see how attending college could potentially help them reach their career goals as well as having mentorship from a college-level student. This could be transformative for students realizing they want to pursue college. The fourth benefit would be global and interdisciplinary project work. This type of project work benefits students as it gives them an opportunity to work on teamwork skills and working in a cross-discipline group. The final benefit of these projects that our team discovered was community outreach. By having these projects aim to solve real-world problems, students would be able to see how they can use their trade to benefit their own community. For WPI

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students, these projects would also give them project management skills as well as a community outlook.

In addition to the Interdisciplinary Trade Projects, through our interviews, our team discovered another way that WPI students could provide help to the teachers and students of WTHS would be through after school tutoring. It was discovered from talking with the teachers at WTHS that students could always benefit from more one-on-one tutoring on specific material they are struggling with and we found the best way to accomplish this would be through an after school tutoring program. This could provide Pre-Practicum students with a specific way to meet their required hours while tutoring students in the area they intend to get their license in. This will also help WPI students to gain direct experience teaching and having to cater to classroom material in order to teach it to different students. This program will also give WTHS students a chance to not only receive help on their homework or learning but also form a way for them to meet and interact with current college students. College mentorship for the high school students was also mentioned in our interviews and this after school tutoring with college and high school students working directly together gives them a chance to interact with each other and truly learn from one another. However, as the after school time frame for Worcester Tech is still within the class time frame for WPI students, Pre-Practicum students would have to make sure that their class schedule does not conflict with this program.

The third opportunity for Pre-Practicum WPI students was the Saturday Buy-Back program. This program, which allows students to come in on Saturdays to make up for missed material and school days to avoid having to stay back a year. This unique program presents an opportunity where WPI students could benefit the high school. By having WPI Pre-Practicum students come in and help out the WTHS teachers during these Saturday sessions it could take away added stress for WTHS having to come in on a weekend and keep on top of their workload. This would also help WPI students achieve the necessary hours to complete their Pre-Practicum requirements while giving them valuable experience working with students who need extra help on classroom material. Also, the Saturday time frame ensures that the program would not conflict with classes for the WPI student and so is easier to complete during the school year. However, given that Saturday Buy-Backs are based on funding for WTHS, these projects would have to be on an availability basis and not guaranteed year to year.

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The fourth area we identified was organizing small visits to WPI. This could be done potentially using the vans that WTHS has set aside and bringing small groups, separated by trade, into the college. This would allow for the WTHS students to gain exposure to what a college campus looks like and the different opportunities that college can provide. These visits do not have to be often. They can also show WTHS students how WPI and other colleges like it can serve as the next step to advance their knowledge specifically within their trade. It could also provide WPI students working on their Pre-Practicum real experience bringing students on field trips.

The fifth and final area was the school science fair. From our interviews, it was discovered that the teachers often do not have the extra time in their busy schedules to facilitate science fair projects despite the fact that the students often enjoyed participating in them. Thus, an idea our team had was to allow Pre-Practicum students to complete their required hours through facilitating an intra-school science fair. This way the high school students could have the experience of working to complete a science fair type project that helps foster their project management and problem-solving skills. The WPI students would gain experience working directly with high school-aged students as well as management skills necessary for teachers. The science fair could be kept small and within the school or even the possibility of being entered in the science fair held at WPI every year.

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### *5.3.3 IQP Projects*

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In addition to the Pre-Practicum and practicum work, this partnership includes establishing this center with IQP projects independent of teacher training. These projects will center around one-time establishment projects aimed to complete the requirements of an IQP for WPI's curriculum and to solve a problem for WTHS. The idea would be that these projects could be completed over multiple terms with WPI students working directly in the high school for less time per week or for a full 7-week term, visiting the school more often in the week. Our team suggests three different potential areas for IQP projects, including designing labs for the Science Department of WTHS, the creation of a tutoring lab, and the establishment of a robotics club and competition. The full scope of IQP projects that could be completed at the high school are not limited to just the ones listed below and these projects can also be adapted and changed to fully fit the needs of the current context.

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The first idea our team recommends surrounds designing a potential lab for the Science Department at WTHS. WPI students could assess the current materials that the high school has, as well as plan for any materials needed and come up with an educational and engaging lab(s) that the students could complete. This could be completed in Chemistry, Biology, or Physics academic classrooms. WPI students could analyze what labs would assist WTHS students in understanding the topics in their curriculums. This could seek to apply WPI students' STEM-based knowledge to a classroom setting with an engaging project students can complete. IQP students could gather information about best lab practices for this age group of students as well as an idea for how to acquire the materials and effectively execute the lab activity. They would also need to seek feedback on the effectiveness of the lab lesson.

A second major area that an IQP team could help with is tutoring. Throughout many of the interviews with WTHS and the STEM Education Center, the idea of providing extra support for the high school students outside of the classroom arose. Many teachers stated they did not currently have the extra time available needed to set up a tutoring program. Our team saw this as an opportunity for a future IQP project to take place within WTHS. By using WPI's STEM-based knowledge, the idea is that an IQP team could design a plan for a STEM Tutoring Lab including determining a physical location, schedule, and general plan for this tutoring lab. Because IQP students would seek to complete this process of establishing a sustainable tutoring lab, it would allow for the students to get the extra help with what they need while taking a project off of the busy WTHS teacher's hands.

The third topic that came from our interviews was the idea of having WTHS learn classroom material in a different way in the form of an exciting after school Robotics Club. The benefit of establishing a Robotics Club at the school is that students can learn the concepts of basic programming, mechanics, and math through the building of a robot. This IQP would have WPI students take their STEM knowledge and apply it to the creation of a Robotics Club and intra-school competition. The details of what kind of robot with students of this skill level would be able to create, what new knowledge do they need to learn, where would the materials for the robot come from, would all be questions the IQP team would have to solve. This will hopefully allow WTHS students to engage in classroom material through a new and exciting way by building a robot of their choice and then potentially competing with their creation.

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## 5.4 Site Recommendations

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Alongside the Project Recommendations which outline specific project ideas, the team also created a set of site recommendations. The purpose of this set of recommendations is to lay out the specific details our team thought needed to occur in order to ensure the future of this project center. They also give advice on specific logistic issues that our team discovered needed to be addressed in the future. These were intended to provide guidance to both the STEM Education Center on what else to focus on for creating this center and any future IQP teams who plan to work on a continuation of our project. The Site Recommendations document that was sent to our sponsors is located in Appendix E.

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### *5.4.1 Pilot Groups*

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There is no precedent for a team of students completing their IQP to do so within WTHS. It is the recommendation of our team that a pilot group completing their IQP do so at the project center in order to explore this new partnership slowly to start and to also set a precedent for future IQP groups. This will allow for both sides to get a sense of what this partnership will actually look like in the future regarding IQP projects and work out logistics and potential problems as the project center moves forward. Our team also recommends that IQP projects completed at the project center be over the course of multiple terms in order to better fit the schedule of WTHS students and establish a better connection with WTHS students.

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### *5.4.2 Advertisement*

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Since most students at WPI plan to go abroad for their IQPs, finding students to complete their IQPs on campus may be difficult. Out of the students that do decide to stay on campus, it may be challenging to find those students that have an interest in STEM education and wish to complete their IQP at WTHS. Those students that are in the Teacher Preparation Program often use their Teaching Practicum to double count as their IQP so they will already have a connection with the WTHS project center through the STEM Education Center, but other students outside the Teacher Preparation Program will not. Our team recommends that potential project opportunities be put on the eProjects site in order for the project center to be more accessible for the students that do have an interest in the potential projects at the project center.

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The eProjects website at WPI is an excellent way for faculty and students to connect and complete projects, but it is not accessible to the outside world. It would be beneficial for information about the project center to be accessible to the public so that both the STEM Education Center and WTHS can showcase their innovative partnership to the world. Parents of WTHS students will be able to find information about the program that their children are participating in. Projects could be displayed in order to promote the project center and the potential impact on the Worcester community. Therefore our team suggests that a website could be built for the new project center for further promotion outside WPI.

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#### *5.4.3 Off-Campus Project Center*

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With the conclusion of our project, we are leaving the project center as an on-campus program with all the benefits that being on-campus provides such as flexibility and the retention of control by the STEM Education Center. The project center will be able to provide the three-term IQP projects that work best with WTHS student schedules while also including the Teacher Preparation Program in the same project center as IQP projects. While there are no current plans to include the project center in the GPP due to the project center not meeting the criteria, we believe that this remains a possibility at some point in the future and should remain a viable option for a future IQP team to explore, if the STEM Education Center so desires.

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#### *5.4.4 Method of Feedback*

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As the project center goes forward and projects begin at WTHS, it's important to have a method for both sides to give and receive feedback in order to improve. Therefore, our team recommends that moving forward, there should be a way for WTHS to give WPI feedback and vice versa. Without feedback, there can be no improvement and without improvement, the project center cannot hope to be successful. The project center must work with the needs of the students and teachers at WTHS as well as the needs of the students at WPI. With a way to give feedback, potential issues can be worked out and the project center can continue successfully.

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### 5.5 Future Expansion

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The aforementioned projects for this unique project center only touch the surface on the potential impact the project center could have on both WPI and WTHS. Serving as both a way for

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WPI to give back to its Worcester community and for WTHS’s students to gain collegiate exposure and a new perspective on learning, this center creates many opportunities for expansion throughout the coming years. Starting initially with Teaching Practicum, Pre-Practicum, and IQP projects, and after a pilot program, this center can expand to better fit both WPI and WTHS needs. Outlined below are some of the potential pathways for expansion of the program in future years that our team has discussed.

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#### *5.5.1 Potential for MQP Projects*

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In the initial round of data collected from the team, only IQP, Teaching Practicum and Pre-Practicum related projects were discussed. However, this does not exclude the potential for this site to host future Major Qualifying Projects (MQP). With further research, this center could become a hub for MQP students looking to complete their senior year project off-campus and with a sponsor. This is because of the overlap between WTHS’s focus on the trades and WPI’s STEM-based focus. WPI could benefit from this expansion because it would open up more opportunities for senior college students to apply their major based knowledge to the Worcester community. WTHS would benefit from having experienced college students to help work on a project that they determine they need within the high school.

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#### *5.5.2 Graduate Teaching Program*

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Along with opening this site up to future students for MQP, this site could be used to host other types of students and programs as well. With the establishment of this center as a hub for Teaching Practicum and Pre-Practicum WPI students, it opens the way to the potential creation of a graduate teaching program at WPI where students can earn their Master’s Degree of Education—all while working at WTHS. This new program would benefit WTHS as they would gain more experienced level student teachers helping out in their classrooms all with a focus in STEM education, as those are the programs WPI certifies students in. It would also expose future educators from WPI to the Worcester Public School System and show the difference that STEM educators can have in a public school setting. This opportunity has the potential to further establish WPI’s reputation not just for STEM-related careers but for STEM education as well.

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### *5.5.3 Integration into WTHS Curriculum*

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Even without adding different types of projects to this center, there is still room for expansion. The majority of projects completed at this project center involving the students would be extra work outside of the classroom. An important step to further expand this program after a few years of the pilot program could be to integrate this PBL approach working directly with college students from WPI into the WTHS curriculum. This could give more leeway in terms of project development for the students. This would also allow them more time and resources to focus on projects and would give WPI practicum students more experience teaching within a curriculum.

### *5.5.4 Replication into Other Worcester Schools*

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In the future, if this model of integrating WPI into a local high school proves successful in terms of creating meaningful connections to college and a better understanding of content for the high school students and project opportunities for WPI students, this could be replicated in other local schools. The Worcester community is home to a multitude of different schools along with Worcester Tech. Similarly to how the teaching practicum students can be placed in a variety of schools throughout the Worcester Public School System and surrounding schools, this project center could also be replicated in many schools. This way WPI would foster a deeper connection of mutual benefit with its Worcester community and the Worcester Public schools could benefit from having college exposure for its students as well as continuous practicums, IQPs, MQPs, or graduate level projects taking place to help improve their schools. If this partnership is successful within just one school, the impact it could have in the Worcester community being implemented in many schools is substantial.

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## 5.6 Conclusion

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The scope of our project was to establish a deeper relationship between the WPI STEM Education Center and WTHS in order to form a new WPI project center within WTHS. This new project center will be completely unlike any project center WPI has had in its long history of project centers both locally and around the globe in that it will eventually have students completing STEM education IQPs but also Teaching Practicums and Pre-Practicum projects for the Teacher Preparation Program. Our team has outlined several potential project recommendations which we hope will inspire future projects at this new project center as well as site recommendations that we



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believe will help this project center progress further until it's a success. In the future, we see the potential for other projects such as MQPs and graduate work to be completed at this center, as well as the potential for WPI projects to be integrated with the WTHS curriculum and replication within other Worcester schools. Our team hopes that this project center will benefit the Worcester community as a whole and promote STEM education for all of its students.

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## Appendices

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### Appendix A: Interview Guide

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These should be used as more of a conversation guide and not drilling them with questions. It is more to help us phrase our thoughts more coherently

#### Informed Consent:

We plan on recording all conversations with both the STEM Education Center and Worcester Technical High School as well as creating a transcript of each conversation. These recordings and transcripts will be saved in a password-protected folder. We will be analyzing the transcripts of the conversations in order to develop the final deliverables. We may publish the names/titles of the individuals we interview in our final report. We may also quote them in our final report, in which we will send an email with the exact quote we plan to use for approval.

1. Do you consent to having this conversation recorded and saved for our data collection purposes?
2. Do you consent to having your name/title published in our final report?
3. Do you consent to being quoted in our final report?

#### Introduction to the Project:

Our project is the creation of a WPI project center within Worcester Technical High School for students to complete their Interactive Qualifying Projects, Teacher Practicums, and other projects at the project center. To do this, we are interviewing representatives from both the STEM Education Center at WPI and Worcester Technical High School to investigate the needs and wants of both parties in this proposed relationship between the two. Our final deliverables will be an MOU, a definition of the project center, and a list of project recommendations.

#### BOTH:

1. What do you imagine this relationship to be?
2. What opportunities do you feel will come of the relationship?
3. Is there a “need” or “want” that you are seeking to be filled?
4. What are the overall benefits?

#### STEM Education Center:

1. What benefits will WPI students/faculty/staff gain?
2. What sort of projects do you believe will be completed at the new project center? (IQP, Teacher Practicums, MQP, etc)
3. How might this formalized relationship ease any current problems?

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Worcester Technical High School:

1. What benefits will WTHS students/faculty/staff gain?
2. Are there any reservations you may have regarding the creation of the project center within WTHS?
3. How do you think this will impact the students in your school?
4. Could the projects needed to be completed by WPI students benefit the school?
5. Are there any teachers that you think would be willing to interview with us as well?

Appendix B: Thematic Coding Themes from Interview Transcripts

Thematic Coding Results:

Interdisciplinary:	Mentorship:	Student Benefit:	Community Connection:
Interdisciplinary:	college exposure	beneficial to students	impactful projects
Mechanical / automotive	college mentorship	equally beneficial	lasting effects for WPI and WTHS
22 trade collaboration	industry mentors	field trips to WPI	partnerships with other colleges
chapter 74	exposure to college	female motivation	guest speakers
		diverse learning environment	connection to community
		different perspectives	
		support for teachers	
		WPI help with labs	
		change of pace outside class	
		student choice in projects	
		prioritize benefit for students	

Tutoring:	Project Ideas:	Logistics:	Teacher Prep Program
Tutoring	saturday buyback	transportation	interest in education
academic tutoring	stem teaching / learning lab	incentivizing students	teacher prep program
MCAS tutoring	WPI projects with hs students	motivation issues	practicum = 2 terms
after school help	Robotics / Arduino	funding	
	science fairs	student engagement	
	WPI sponsored projects	open-ended projects	
	anatomage table project	framework / guidance	
	programming project	superintendent signature	
	GPS program at WTHS	CORI Checks	
	STEM curriculum for 5 year olds	clear expectations	
		Curriculum changes	
		flexible partnership	
		start small and grow	
		OneDrive	
		start small, scale up / replicate	
		multiple projects	
		flexibility	
		pilot program	
		5-10 WTHS students	
		juniors and seniors	
		3 term IQPs	



<b>Interdisciplinary:</b>	6%
<b>Mentorship:</b>	6%
<b>Student Benefit:</b>	18%
<b>Community Connection:</b>	8%
<b>Tutoring:</b>	6%
<b>Project Ideas:</b>	16%
<b>Logistics:</b>	34%
<b>Teacher Prep Program</b>	5%

Themes:

Themes for WPI	Themes for WTHS	Common Themes	Things to Consider
Teacher Prep	Interdisciplinary	Beneficial to Students	transportation
interest in education	College Mentorship	starting small and growing	incentives for hs students
deepening partnership	Motivation for Female students	flexible partnership	motivation might be an issue
tutoring	Field Trips to WPI		funding issues for some projects
college exposure	Mechanical / Automotive Collaboration		student engagement is key
practicum = two terms	Impactful Projects		open-ended project
equally beneficial	Lasting Effects for WPI and WTHS		framework / guidance
multiple projects at once	Industry Mentors		final MOU signed by superintendent
saturday buyback	Diverse Learning Environment		CORI Checks
stem teaching / learning lab	Robotics / Arduino projects		clear expectations for HS students
OneDrive	partnerships with other colleges		curriculum changes need school board
start small, scale up / replicate	Tutoring in academic sciences		
WPI projects with WTHS students	MCAS tutoring		
pre-practicum work	Different perspectives		
flexibility	science fairs		
	support for teachers		
	WPI sponsored projects		
	WPI help with labs		
	Exposure to college		
	guest speakers		
	after school help		
	change of pace outside class		
	connection to community		
	student choice in projects		
	all 22 trades can collaborate		
	Anatomage table project		
	programming project		
	OneDrive		
	benefit for students is priority		
	GPS program at WTHS		
	STEM Curriculum for 5 year olds		
	pilot program (1 group of students)		
	5-10 WTHS students (at first)		
	juniors and seniors to start		
	space at WTHS students		
	3 term IQPs would be better		
	Chapter 74		

For Worcester Technical High School:

Themes for WTHS	Common Themes	Project Ideas	Logistics
Prioritize Benefit for Students	Beneficial to Students	Mechanical / Automotive Collaboration	OneDrive
Collaboration between 22 Trades	starting small and growing	Robotics / Arduino projects	pilot program (1 group of students)
Impactful Projects	flexible partnership	Tutoring in academic sciences	5-10 WTHS students (at first)
Interdisciplinary Projects		MCAS tutoring	juniors and seniors to start
Students Choose Project Topics		science fairs	space at WTHS students
Support for Teachers		WPI help with labs	3 term IQPs would be better
Diverse Learning Environment		Field Trips to WPI	
Change of Pace outside Class		WPI sponsored projects	
Different Perspectives		STEM Curriculum for 5 year olds	
College Mentorship / Exposure		Anatomage table project	
Community Connection		programming project	
Guest Speakers		GPS program at WTHS	
Motivation for Female Students		after school help	
Lasting Effects for WPI and WTHS		Chapter 74	

For Worcester Polytechnic Institute:

Themes for WPI	Common Themes	Projects	Logistics
Teacher Prep Program	Beneficial to Students	Tutoring / Mentoring	OneDrive
STEM Education Focused	Starting Small and Growing	Saturday Buyback	
Deepening the Partnership	Flexible Partnership	STEM Teaching / Learning Lab	
Equally Beneficial		Pre-Practicum Work	
College Exposure for WTHS Students		Two Term Practicum	
Possibility of Replication			
Multi-Project Center			
WPI Projects with WTHS Students			

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## Appendix C: Memorandum of Understanding

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### MEMORANDUM OF UNDERSTANDING

**THIS MEMORANDUM OF UNDERSTANDING** (the "Document") made as of this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_ (the "Execution Date"),

**BETWEEN:**

WPI STEM Education Center of 100 Institute Road, Worcester, MA 01609, and  
Worcester Technical High School of 1 Skyline Drive, Worcester, MA 01605

(individually the "Partner" and collectively the "Partners")

**BACKGROUND:**

- A. The Partners wish to associate themselves in business as a partnership.
- B. A period of negotiation and exchange of information is needed in order to finalize terms.

This Document will establish the basic terms to be included in a future partnership agreement ("the Partnership Agreement") between the Partners. The terms contained in this Document are not comprehensive and it is expected that additional terms may be added, and existing terms may be changed or deleted. The basic terms are as follows:

**Non-Binding**

- 1. 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 contained 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.

**Formation**

- 2. By this Document the Partners signal their intention to enter into a general partnership (the "Partnership") in accordance with the laws of the Commonwealth of Massachusetts subject to negotiation of the terms of a partnership agreement. The rights and obligations of the Partners will be as as stated in the applicable legislation of the Commonwealth of Massachusetts (the "Act") except as otherwise provided in the future partnership agreement.

3. The firm name of the Partnership will be: STEM Education Center-Worcester Technical High School.
4. The principal office of the business of the Partnership will be located at Worcester, MA or such other place as the Partners may from time to time designate.
5. The purpose of the Partnership will be: Education.

**Closing Date**

6. The partnership agreement will be completed on or about the 13th day of May, 2025 (the "Closing Date"). All obligations as indicated in any future agreement will be completed and met by the Closing Date.

**Representations**

7. The Partners each represent and warrant that the qualifications, skills and experience which they will each bring to the Partnership are truly and accurately reflected in any descriptions of the same given to any of the other Partners. The Partners further represent and warrant that they are each in a position to make any agreed capital contribution to the Partnership on, or in advance of, the Closing Date. If the representations of one of more of the Partners are untrue upon the Closing Date, then any remaining Partners may terminate the partnership agreement without penalty.

**Additional Clauses:**

8. **Description of Partnership**

To create a sustainable and growing partnership between the WPI STEM Education Center and the Worcester Technical High School for the development and improvement of each other's academic and technical/vocational programs.

9. **Expectations of Worcester Technical High School**

It is asked that all representatives from Worcester Technical High School abide by the following set of expectations.

1. It is requested that Worcester Technical High School upholds their end of an equal and fair partnership, brings any concerns to all parties in the partnership, maintains clear communication, and addresses any concerns in a professional manner with full cooperation.
2. In relation to projects, programs, or events led by or in part by Worcester Polytechnic Institute,

it is expected that Worcester Technical High School works with and supports students and faculty from Worcester Polytechnic Institute.

3. In relation to the WPI STEM Education Teacher Preparation Program, it is requested that Worcester Technical High School supports and creates engaging opportunities for teacher-candidates and anyone participating in the Teacher Preparation Program at WPI.

4. It is also asked that Worcester Technical High School representatives provide partnership leaders with timely and constructive feedback and suggestions to further develop and enhance this relationship.

**10. Expectations of the WPI STEM Education Center**

It is asked that all representatives from the STEM Education Center abide by the following set of expectations.

1. It is requested that the STEM Education Center upholds their end of an equal and fair partnership, brings any concerns to all parties in the partnership, maintains clear communication, and addresses any concerns in a professional manner with full cooperation.

2. In relation to projects, programs, or events led by or in part by Worcester Technical High School, it is expected that Worcester Polytechnic Institute works with and supports students and faculty from Worcester Technical High School.

3. It is expected that the STEM Education Center will abide by the curriculum and vocational guidelines when instructing Worcester Technical High School students on projects, programs, and events.

4. It is expected that the STEM Education Center representatives provide appropriate support (case dependent) in a classroom or shop setting at Worcester Technical High School.

5. It is also asked that the STEM Education Center representatives provide partnership leaders with timely and constructive feedback and suggestions to further develop and enhance this relationship.

**11. Roles and Definitions**

The following roles and descriptions are expected to be satisfied by the indicated parties. Adjustments and changes can be made pending all parties are in agreement.

**WPI STEM Education Director**

A representative from the STEM Education Center who will uphold and maintain the leadership of the STEM Education Center in this relationship.

**Worcester Technical High School Director**

A representative from Worcester Technical High School who will uphold and maintain the leadership of Worcester Technical High School in this relationship.

**Faculty Advisors**

Faculty advisors are both Worcester Polytechnic Institute and Worcester Technical High School staff who will oversee projects led by or involving their respective students.

**Supervising Practitioner**

Supervising practitioners are teachers or faculty from Worcester Technical High School who will take part in the Teacher Preparation Program. The supervising practitioners are paired with a teacher-candidate who is from the STEM Education Center and will work with them to complete their current requirements.

**Students**

*Teacher-Candidate*

These are students from Worcester Polytechnic Institute who are participating in the Teacher Preparation Program through the STEM Education Center. These students may participate in tasks such as but not limited to tutoring, aiding a classroom teacher, or fulfilling their teaching practicum requirement.

*IQP Student*

These are students who are representative of the STEM Education Center and of Worcester Polytechnic Institute. They will work on a project or program where the benefit is to further develop and strengthen the relationship between the schools. There will be groups of these IQP students who will work on a range of projects at the request of Worcester Polytechnic Institute at varying times throughout Worcester Polytechnic Institute's academic year.

*High School Student*

These are students who are enrolled in Worcester Technical High School. These students will be able to participate and interact with programs and projects laid out by this partnership. In addition, Worcester Technical High School students are expected to abide by the Worcester Public School's handbook and Worcester Technical High School's handbook supplement.

This Document accurately reflects the understanding between the Partners, signed on this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

Per: \_\_\_\_\_ (Seal)  
WPI STEM Education Center (Partner)

Per: \_\_\_\_\_ (Seal)  
Worcester Technical High School (Partner)



## **Project Recommendations for WPI and WTHS Project Center**

**Date Created:**

05/13/2020

**Created for:**

STEM Education Center  
Worcester Polytechnic Institute  
Worcester Technical High School

**Created by:**

Allison Robotzek  
Molly Silsby  
Samantha Woodland

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### Abbreviations and Definitions

<b>Term</b>	<b>Definition</b>
WTHS	Worcester Technical High School
WPI	Worcester Polytechnic Institute
IQP	Interactive Qualifying Project
MQP	Major Qualifying Project
PBL	Project-Based Learning
MOU	Memorandum of Understanding
GPP	Global Projects Program
Chapter 74-Approved Program	Programs that meet the definition of vocational technical education contained in Massachusetts General Law Chapter 74
Teaching Practicum	15 week student teaching experience in a local school required by the Teacher Preparation Program at WPI
Project Center	Location where students can go to complete project-based-learning projects at Worcester Polytechnic Institute

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### **Purpose of Partnership**

As stated in the Memorandum of Understanding (MOU) that was established for this project center, the purpose and mission statement for this collaboration is “To create a lasting and growing partnership between the WPI STEM Education Center and the Worcester Technical High School for the development and growth of the students from each institution”. The creation of these potential project recommendations will all tie back to this mission statement and each project completed will uphold the guidelines set out in the MOU that was approved by both parties: Worcester Polytechnic Institute (WPI) and Worcester Technical High School (WTHS).

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## **1.1 Teaching Practicum Projects**

Before the creation of this project center, WPI was sending its students seeking to obtain their teaching licenses to a variety of Worcester Public High Schools including WTHS. Based on the team's interviews with various members of WTHS staff as well as WPI staff, this teaching practicum program is already well established and benefits both parties in the way the MOU states. Therefore, the team suggests that this partnership would only continue this successful relationship and WPI should keep sending student teachers to WTHS who will provide mentor teachers to train them.

## **1.2 Pre-Practicum WPI Projects**

WPI also supports WPI students aspiring to be teachers before their official Teaching Practicum. These pre-practicum experiences are less hours and require WPI students to work directly with K-12th grade students. Because of this needed direct contact time for WPI students and the want from WTHS to have students work with college students, these pre-practicum projects can be completed at the WTHS/WPI Project Center. The main goal would be for WPI students to come to WTHS once or twice a week for an extended period of time to give high school students a multitude of different outside-the-classroom experiences in order to further enhance their understanding of classroom material. The team has currently outlined five different areas that the partnership between WPI and WTHS could create this structure for pre-practicum students while providing the WTHS students with engaging learning material.

### **1.2.1 Interdisciplinary Trade Projects**

The first area identified that could be improved through the establishment of this partnership is the creation of interdisciplinary trade projects. The idea behind these projects would be that pre-practicum students could achieve hours working with students as well as experience managing students through acting as a project advisor for student projects. The student's would work in teams to complete a project that allows them to apply their trade to solve a real-world problem. Because these projects would be completed outside the curriculum required of a WTHS student, each project completed would need to be engaging for high school students. Thus, our team recommends making the projects student-driven. This means that students largely determine what project they take on, with guidance from student-advisor and teacher, so it is of interest to

them. The main goal of these Interdisciplinary Trade Projects (ITP) would be to apply a student's specific chosen trade to the world of STEM. This way each student could take what they are interested in doing, their trade, and through the process of managing a project could gain real world skills. The team outlined the benefits for completing these projects in Figure 1 below:

Figure 1: Benefits of Interdisciplinary Trade Projects

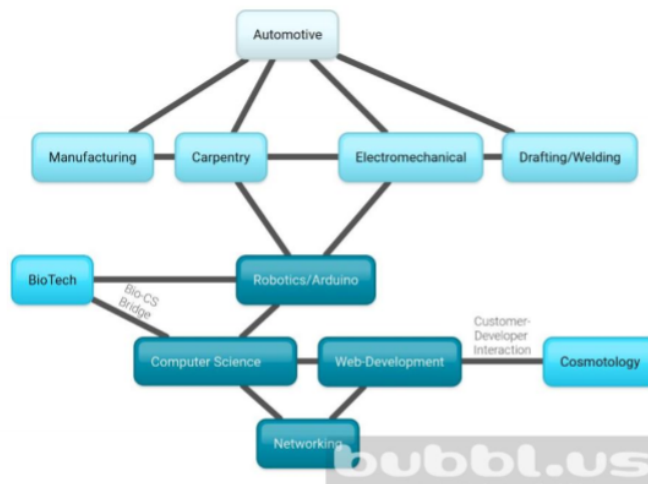


First, they would allow for teachers in training at WPI to practice their skills by acting as an advisor, overseeing a project. The second benefit would be tutoring. Because these projects are applying trade knowledge to the world of STEM and would require knowledge of multiple different topics within STEM, WTHS students could receive help on the topics they are struggling to understand from their student-advisors. The third benefit would be college perspective and mentoring. Through these partnerships, the high school students would have the opportunity to work closely with the college students. This would allow them to see how attending college could potentially help them reach their career goals as well as having mentorship from a college level student. This could be transformative for students realizing they want to pursue college. The fourth benefit would be global and interdisciplinary project work. This type of project work benefits students as it gives them an opportunity to work on teamwork skills and working in a cross discipline group. The final benefit of these projects that our team discovered was community outreach. By having these projects aim to solve real world problems, students would be able to see how they can use their trade to benefit their own community. For WPI students, these projects would also give them project management skills as well as a community outlook.

### 1.2.1.1 Trade Partnerships

The projects could also be enhanced through trade partnerships. Students could form teams working together with another trade or multiple trades within the high school. This way that each student could gain experience working in a cross-discipline team, something common in today's workforce. Our team has identified some of the different examples of potential partnerships between trades whose curriculums could work together fairly easily. This can be seen in Figure 2 below:

Figure 2: Trade Connections in WTHS



For the Automotive trade, it could be partnered with Manufacturing, Carpentry, Electromechanical, or Drafting and Welding as many of their curriculums rely on each other already to complete projects. As for the Biotechnology trade, through the Biology and CS bridge could partner with Computer Science to complete and expose students to Bioinformatics and Computational Biology. We also identified that the Robotics/Arduino could work with Electromechanical, Carpentry, Biotechnology or Computer Science as all share overlap in curriculum. Cosmetology could also be partnered with Web Development. This could be done through the creation of websites and branding for cosmetology students. This would give the Web Development students direct experience in customer developer interaction. These specific trade

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partnerships are just ideas that our team saw throughout the interviews and the possibilities of these partnerships are not limited to these specifically.

#### *1.2.1.2 Chapter 74*

The aim of these projects would work towards the guideline outlined for Vocational Technical Education Frameworks for each trade. Specifically, these frameworks lay out Strands which relate to the skills students need to have gained through the program. Across all trades, Strand 4 which is Employability and Career Readiness Knowledge and Skills and Strand 5 which is Management and Entrepreneurship Knowledge and Skills are similar. These refer to the skills students graduating from Vocational Schools need to have laid out by the Massachusetts Department of Elementary and Secondary Education. Therefore, these projects would help the high school students focus on that set of skills. By having to work across disciplines in teams on a project of their own design, the concepts of project management and entrepreneurship can be taught. These projects also connect their trade education and knowledge to a real-world project experience or problem to solve. This way WTHS students are working towards career readiness and employability. It is important that these projects connect to these frameworks in order to ensure that the WTHS students are learning valuable skills.

#### *1.2.2 After School Tutoring*

In addition to the Interdisciplinary Trade Projects, through our interviews, our team discovered another way that WPI students could provide help to the teachers and students of WTHS. This would be through after school tutoring. It was discovered from talking with the teachers at WTHS that students could always benefit from more one-on-one tutoring on specific material they are struggling with and we found the best way to accomplish this would be through an after school tutoring program. This could provide pre-practicum students with a specific way to meet their required hours while tutoring students in the area they intend to get their license in. This will also help WPI students to gain direct experience teaching and having to cater classroom material in order to teach it to different students. This program will also give WTHS students a chance to not only receive help on their homework or learning but also form a way for them to meet and interact with current college students. College mentorship for the high school students was also mentioned in our interviews and this after school tutoring with college and high school students working directly together gives them a chance to interact with each other and truly learn

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from one another. However, as the after-school time frame for Worcester Tech is still within the class time frame for WPI students, pre-practicum students would have to make sure that their class schedule does not conflict with this program.

#### 1.2.3 Saturday Buy-Back Projects

Another opportunity for pre-practicum WPI students that came out of the team's interviews was the Saturday Buy-Back program. This program, which allows students to come in on Saturdays to make up for missed material and school days to avoid having to stay back a year. This unique program presents an opportunity where WPI students could benefit the high school. By having WPI pre-practicum students come in and help out the WTHS teachers during these Saturday sessions it could take away added stress for WTHS having to come in on a weekend and keep on top of their workload. This would also help WPI students achieve the necessary hours to complete their pre-practicum requirements while giving them valuable experience working with students who need extra help on classroom material. Also, the Saturday time frame ensures that the program would not conflict with classes for the WPI student and so is easier to complete during the school year. However, given that Saturday Buy-Backs are based on funding for WTHS, these projects would have to be on an availability basis and not a guarantee year to year.

#### 1.2.4 WPI Visit

Also based on the team's interviews, we would recommend organizing small visits to WPI. This could be done potentially using the vans that WTHS has set aside and bringing small groups, separated by trade, into the college. This would allow for the WTHS students to gain exposure to what a college campus looks like and the different opportunities that college can provide. These visits do not have to be often. They can also show WTHS students how WPI and other colleges like it can serve as the next step to advance their knowledge specifically within their trade. It could also provide WPI students working on their pre-practicum real experience bringing students on field trips.

#### 1.2.5 Science Fair

From our interviews, it was also discovered that the teachers often do not have the extra time in their busy schedules to facilitate science fair projects despite the fact that the students often enjoyed participating in them. Thus, an idea our team had was to allow pre-practicum students to complete their required hours through facilitating an intra-school science fair. This way the high

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school students could have the experience of working to complete a science fair type project that helps foster their project management and problem-solving skills. The WPI students would gain experience working directly with high school aged students as well as management skills necessary for teachers. The science fair could be kept small and within the school or even the possibility of being entered in the science fair held at WPI every year.

### **1.3 IQP Projects**

In addition to the pre-practicum and practicum, this partnership leads to establishing this center with IQP projects independent of teacher training. These projects will center around one-time establishment projects aimed to complete the requirements of an IQP for WPI's curriculum and to improve the quality of STEM Education, facility, etc. of WTHS. The idea would be that these projects could be completed over multiple terms with WPI students working directly in the high school for less time per week or for a full 7 week term, visiting the school more often in the week. The projects outlined below were found in the initial data collected from interviews with both WTHS and WPI faculty and staff members. The full scope of IQP projects that could be completed at the High School are not limited to just the ones listed below. These projects can also be adapted and changed to fully fit the needs of the current context.

#### **1.3.1 Science Department Lab Design**

The idea for this IQP project surrounds designing a potential lab for the Science Department at WTHS. WPI students would need to assess the current materials that the high school has, as well as plans for any materials needed and come up with an educational and engaging lab that the students could complete. This could be completed in the Chemistry, Biology or Physics academic classrooms. WPI students would have to analyze what labs would assist WTHS students in understanding the topics in their curriculums. This could seek to apply WPI students' STEM based knowledge to a classroom setting with an engaging project students can complete. IQP students would have to gather information about best lab practices for this age group of students as well as an idea for how to acquire the materials and effectively execute the lab activity. They would also need to seek feedback on the effectiveness of the lab lesson.



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### 1.3.2 Sustainable Tutoring Lab

A major area that WTHS could use WPI's help with is tutoring. Throughout many of the interviews with WTHS, the idea of providing extra support for the high school students outside of the classroom arose. Many teachers stated they did not currently have the extra time available needed to set up a tutoring program. Our team saw this as an opportunity for a future IQP project to take place within WTHS. By using WPI's STEM based knowledge, the idea is that an IQP team could design a plan for a STEM Tutoring Lab including determining a physical location, schedule, and general plan for this tutoring lab. Because WPI's IQP students would seek to complete this process of establishing a sustainable tutoring lab, it would allow for the students to get the extra help with what they need while taking a project off of the busy WTHS teacher's hands.

### 1.3.3 Robotics Club and Competition

Another topic that came from our interviews was the idea of having WTHS students learn classroom material in a different way in the form of an exciting after school club. This led our team to the idea of creating a Robotics Club. The benefit of establishing a Robotics Club at the school is students can learn the concepts of basic programming, mechanics and math through the building of a robot. This IQP would have WPI students take their STEM knowledge and apply it to the creation of a Robotics Club and intra-school competition. The details of what kind of robot with students of this skill level would be able to create, what new knowledge do they need to learn, where would the materials for the robot come from, would all be questions the IQP team would have to solve. This will hopefully allow WTHS students to engage in classroom material through a new and exciting way by building a robot of their choice and then potentially competing with their creation.

## 1.4 Project Summary

The creation of this partnership leads the way for both students to be able to further incorporate project-based learning into their respective schools. The intention is that the program will start small with only a couple of projects and with more time and preparation given to the logistics of implementing these projects, the program will grow. While the projects listed above are outlines of project ideas, the amount that can be accomplished is not limited by only these. This project center has the capabilities to expand into a center with many different types of projects

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going on at once. Also, the projects listed above may need modifications in order to be implemented correctly. They are meant as a guideline for a pilot program testing this project center.



## Site Recommendations for WPI and WTHS Project Center

**Date Created:**

05/13/2020

**Created for:**

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Worcester Polytechnic Institute  
Worcester Technical High School

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### Abbreviations and Definitions

<b>Term</b>	<b>Definition</b>
WTHS	Worcester Technical High School
WPI	Worcester Polytechnic Institute
IQP	Interactive Qualifying Project
MQP	Major Qualifying Project
PBL	Project-Based Learning
MOU	Memorandum of Understanding
GPP	Global Projects Program
Chapter 74-Approved Program	Programs that meet the definition of vocational technical education contained in Massachusetts General Law Chapter 74
Teaching Practicum	15 week student teaching experience in a local school required by the Teacher Preparation Program at WPI
Project Center	Location where students can go to complete project-based-learning projects at Worcester Polytechnic Institute

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### **Purpose of Partnership**

As stated in the Memorandum of Understanding (MOU) that was established for this project center, the purpose and mission statement for this collaboration is “To create a lasting and growing partnership between the WPI STEM Education Center and the Worcester Technical High School for the development and growth of the students from each institution”. The creation of these site recommendations will all tie back to this mission statement and every progression of this partnership will uphold the guidelines set out in the MOU that was approved by both parties: Worcester Polytechnic Institute (WPI) and Worcester Technical High School (WTHS).

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## **1.1 Pilot Groups**

The WPI STEM Education Center has had many students in their Teacher Preparation Program complete their junior year Teacher Practicum at WTHS but never has an IQP team completed an IQP at WTHS. Therefore, it is the recommendation of our team that a pilot group completing their IQP do so at the project center in order to explore this new partnership slowly to start and to also set a precedent for future IQP groups. This will allow for both sides to get a sense for what this partnership will actually look like in the future and work out logistics and potential problems as the project center moves forward. This pilot IQP group can complete a project recommended by our team in the accompanying Project Recommendations or a new IQP project can be developed for the group to complete. Our team recommends that IQP projects completed at the project center be over the course of multiple terms in order to better fit the schedule of WTHS students and establish a better connection with WTHS students.

## **1.2 Advertisement**

When our team reviewed the current model surrounding promoting the STEM Education Center and our work on the partnership, we discovered that the program and project center could benefit from an emphasis on marketing and advertising. This way, if current WPI students are more informed and aware of the partnerships and types of projects that can be completed at this center than more people will be interested in participating. Our team also wants to ensure that the partnership is still going for years to come, which requires student interest from WPI. Student interest could be generated through proper advertising of the partnerships through the eProjects website and a personalized website.

### *1.2.1 eProjects Website*

Since most students at WPI plan to go abroad for their IQPs, finding students to complete their IQPs on campus may be difficult. Out of the students that do decide to stay on campus, it may be challenging to find those students that have an interest in STEM education and wish to complete their IQP in this area. Those students that are in the Teacher Preparation Program often use their teacher practicum to double count as their IQP so they will already have a connection with WTHS through the STEM Education Center. The students staying on-campus who might have an interest in education, it may be a challenge for them to connect with the project center

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unless they already know about it. Our team recommends that potential project opportunities be put on the eProjects site in order for the project center to be more accessible for the students that do have an interest in the potential projects at the project center.

#### *1.2.2 Website*

The eProjects website at WPI is an excellent way for faculty and students to connect and complete projects, but it is not accessible to the outside world. It would be beneficial for information about the project center to be accessible to the public so that both the STEM Education Center and WTHS can showcase their innovative partnership to the world. Parents of WTHS students will be able to find information about the program that their children are participating in. Projects could be displayed in order to promote the project center and the potential impact on the Worcester community. Therefore our team suggests that a website could be built for the new project center for further promotion outside WPI.

### **1.3 Off-Campus Project Center**

With the conclusion of our project, we are leaving the project center as an on-campus program with all the benefits that being on-campus provides such as flexibility and the retention of control by the STEM Education Center. The project center will be able to provide the three-term IQP projects that work best with WTHS student schedules while also including the Teacher Preparation Program in the same project center as IQP projects. While there are no current plans to include the new project center in the GPP due our new project center not meeting the criteria, we believe that this remains a possibility at some point in the future and should remain a viable option for a future IQP team to explore, if the STEM Education Center so desires.

### **1.4 Method of Feedback**

As the project center goes forward and projects begin at WTHS, it's important to have a method for both sides to give and receive feedback in order to improve. Therefore, our team recommends that moving forward, there should be a way for WTHS to give WPI feedback and vice versa. Without feedback, there can be no improvement and without improvement, the project center cannot hope to be successful. The project center must work with the needs of the students



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and teachers at WTHS as well as the needs of the students at WPI. With a way to give feedback, potential issues can be worked out and the project center can continue successfully.

### **1.5 Future Expansion of Program**

The aforementioned projects for this unique project center only touch the surface on the potential impact the project center could have on both WPI and WTHS. Serving as both a way for WPI to give back to its Worcester community and for WTHS's students to gain collegiate exposure and a new perspective on learning, this center creates many opportunities for expansion throughout the coming years. Starting initially with practicum, pre-practicum and IQP projects, and after a pilot program, this center can expand to better fit both WPI and WTHS needs. Outlined below are some of the potential pathways for expansion of the program in future years that our team has discussed.

#### *1.5.1 Potential for MQP Projects*

In the initial round of data collected from the team, only IQP, Teaching Practicum and pre-practicum related projects were discussed. However, this does not exclude the potential for this site to host future Major Qualifying Projects (MQP). With further research, this center could become a hub for MQP students looking to complete their senior year project off campus and with a sponsor. This is because of the overlap between WTHS's focus on the trades and WPI's STEM based focus. WPI could benefit from this expansion because it would open up more opportunities for senior college students to apply their major based knowledge to the Worcester community. WTHS would benefit from having experienced college students to help work on a project that they determine they need within the high school.

#### *1.5.2 Graduate Teaching Program*

Along with opening this site up to future students for MQP, this site could be used to host other types of students and programs as well. With the establishment of this center as a hub for Teaching Practicum and pre-practicum WPI students, it opens the way to the potential creation of a graduate teaching program at WPI where students can earn their Master's Degree of Education—all while working at WTHS. This new program would benefit WTHS as they would gain more experienced level student teachers helping out in their classrooms all with a focus in STEM education, as those are the programs WPI certifies students in. It would also expose future

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educators from WPI to the Worcester Public School system and show the difference that STEM educators can have in a public school setting. This opportunity has the potential to further establish WPI's reputation not just for STEM related careers but for STEM education as well.

#### *1.5.3 Integration into WTHS Curriculum*

Even without adding different types of projects to this center, there is still room for expansion. The majority of projects completed at this project center involving the students would be extra work outside of the classroom. An important step to further expand this program after a few years of the pilot program could be to integrate this PBL approach working directly with college students from WPI into the WTHS curriculum. This could give more leeway in terms of project development for the students. This would also allow them more time and resources to focus on projects and would give WPI practicum students more experience teaching within a curriculum.

#### *1.5.4 Replication in Other Worcester Schools*

In the future, if this model of integrating WPI into a local high school proves successful in terms of creating meaningful connections to college and a better understanding of content for the high school students and project opportunities for WPI students, this could be replicated in other local schools. The Worcester community is home to a multitude of different schools along with Worcester Tech. Similar to how Teacher Preparation Program students can be placed in a variety of schools throughout the Worcester Public School system and surrounding schools, this project center could also be replicated in many schools. This way WPI would foster a deeper connection of mutual benefit with its Worcester community and Worcester Public Schools could benefit from having college exposure for its students as well as continuous practicums, IQPs, MQPs or graduate level projects taking place to help improve their schools. If this partnership is successful within just one school, the impact it could have in the Worcester community being implemented in many schools is substantial.