Battelle Teacher Academy: Submarine Industrial Base Partnership

Year 1 Recap

BlueForge Alliance

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September 10, 2024

Battelle Teacher Academy:

Submarine Industrial Base Partnership

Year 1 Recap

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Executive Summary

Battelle Education created an immersive professional development program for educators to provide manufacturing content information, an externship experience in industry and a problem-based learning training to address the growing STEM technical skills gap experienced by Submarine Industrial Based (SIB) employers. Because teachers have significant influence on the career paths of students, Battelle Teacher Academy equipped them with manufacturing content and career information to enable them to be advocates for their students to help fill the high-skilled technical trade workforce that is needed to build submarines.

Battelle Education utilized our STEM Networks (Ohio STEM Learning Network, Tennessee STEM Innovation Network, and STEMx) to recruit 30 elementary, middle, and high school teachers from Ohio for the 2023-2024 school year to participate in a year-long cohort. The cohort of teachers participated in a weeklong professional development to familiarize them with SIB manufacturing industries before being placed in an externship with an industry partner. While visiting the industry partner, teachers learned about the different careers needed to support the skilled labor shortage within those industries. Teachers were then coached to create authentic learning lessons and units for their students focusing on the skills and jobs they encountered.

The cohort of 30 teachers was placed with SIB manufacturers or similar industries for the externship. These educators impacted 5,767 students in the first year of this program. In its second year, the program added an additional 30 Ohio teachers and expanded recruitment to Michigan, where it recruited an additional 15 teachers to participate.

Figure 1: Middle school teachers externship experience at Hollaender Speed Rails in Hamilton, Oh.

Program Goals

- Provide educators with knowledge of manufacturing processes and critical careers that support the Submarine Industrial Base's need for a high-skilled technical workforce
- Leverage authentic problem-based learning units to engage students with local industry or STEM careers.
- Provide ongoing support for teachers' professional development to encourage industry-classroom connections and expose students to industry skills and career opportunities.

Overview of Data

Evaluation

Battelle Education contracted with ICF to conduct a 2-year external evaluation of its Teacher Academy program. The Teacher Academy was implemented in its inaugural year for a cohort of 30 teachers in the state of Ohio for the 2023–24 school year. Year 1 participants completed pre-and post-surveys. ICF also interviewed 6 teachers from the Year 1 cohort in a semi-structured format to discuss their experiences. The program has since begun its second year of implementation for the 2024-25 school year in Ohio and Michigan.

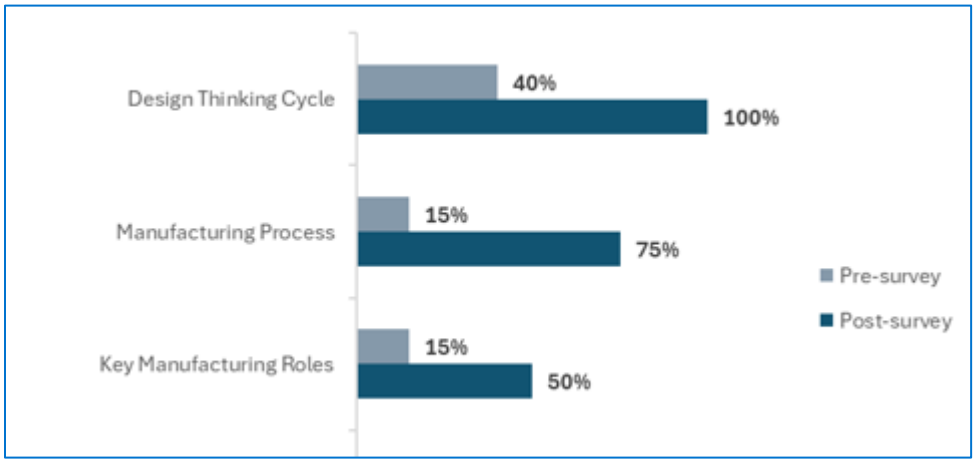
Knowledge Gained on Key Concepts

Understanding of the engineering design process and design thinking cycle:

+60%

Participants' knowledge of the manufacturing industry grew substantially during their time in the cohort. One noticeable change was the increase in teacher's knowledge related to the engineering/design thinking cycle where the percentage of participants who felt knowledgeable or very knowledgeable increased from 40% to 100%. Participants also grew in other areas—for example, 75% and 50% of participants, respectively, felt knowledgeable or very knowledgeable about the Manufacturing Process and Key Manufacturing Roles respectively after the conclusion of the program.

Figure 2: Percentage of participants who indicated they were knowledgeable or very knowledgeable about the following components of the manufacturing field (n=20).



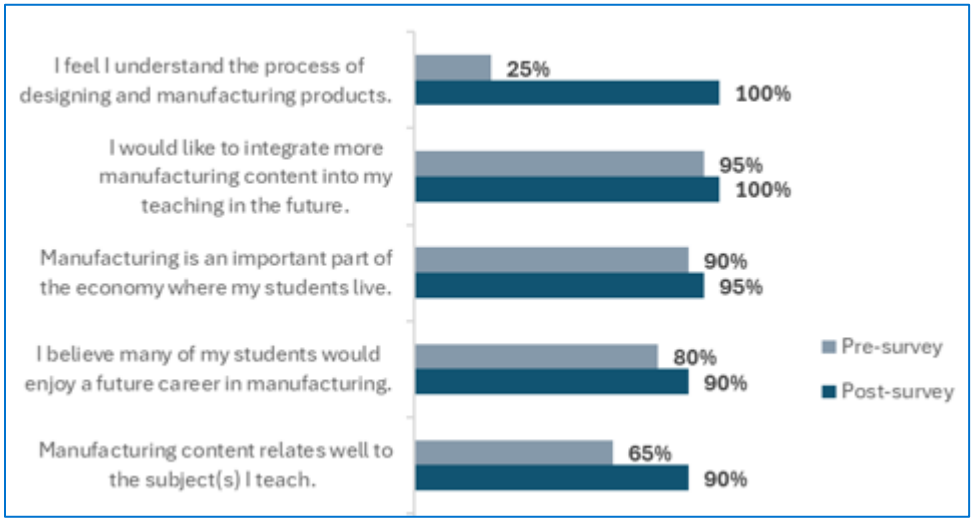
Perception and Understanding of Manufacturing

Increase in understanding of the manufacturing process:

+75%

Participants' perception and understanding of manufacturing improved across all areas during the program. The largest increase was seen in the percentage of participants who agreed or strongly agreed that they understood the process of designing and manufacturing products—only 25% said they understood this process prior to the program, and 100% said the same after the program.

Figure 3: Percentage of participants who agree or strongly agree with the following statements (n=20).



Teaching Key Manufacturing Content

Participants grew in all areas of measured confidence after the Teacher Academy program, and after the program most participants were confident or very confident in all areas related to teaching manufacturing content.

Participants confidence in teaching manufacturing content:

+74%

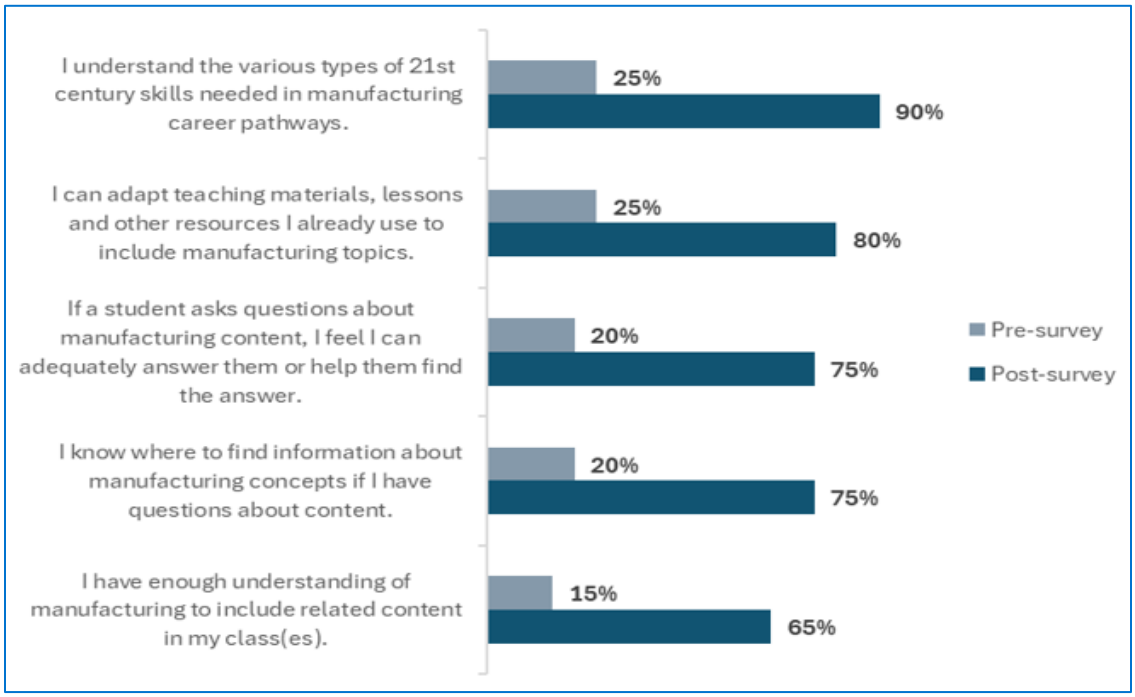
Ninety percent of participants, up from twenty-five percent, were confident or very confident in their understanding of the types of skills needed in manufacturing career pathways.

At least 50% increase in the percentage of confidence for the following:

- participants who felt confident or very confident that they were able to adapt teaching materials
- answer student questions
- find information about manufacturing concepts
- include related content in their classes (from 15% to 65%).

Figure 4: Cohort field experience at EWI Welding Research Center

Figure 5: Percentage of participants who indicated they were confident or very confident in the following content areas (n=20).



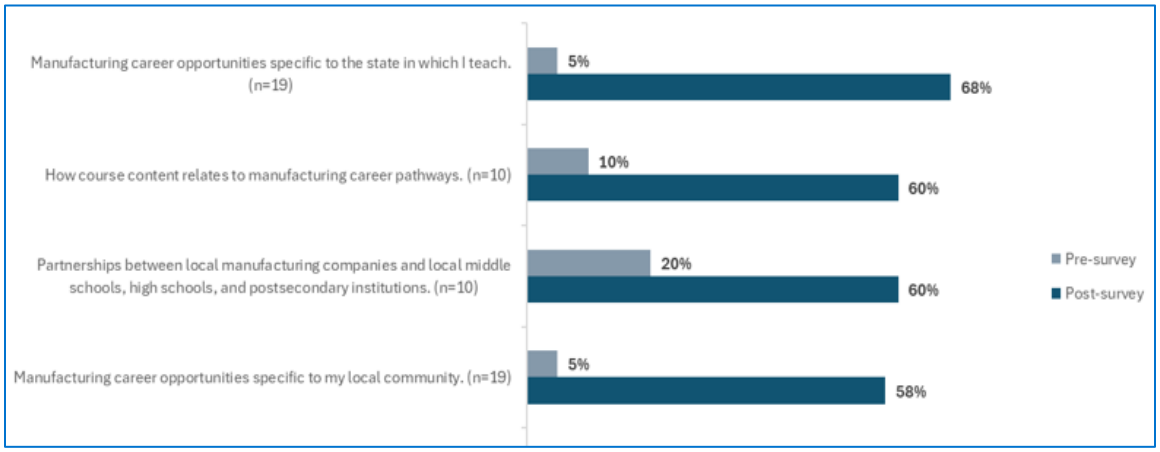
Understanding Career Pathways

The participants demonstrated growth in all areas of understanding related to career pathways. Participants increased in their awareness of manufacturing career opportunities in their state (from 5% who were aware or very aware before the program to 68% after the program) and how course content related to manufacturing career pathways (10% to 69%).

Awareness of manufacturing opportunities in home state:

+63%

Figure 6: Percentage of participants who were aware or very aware of the following. (Questions related to internships or apprenticeships, local partnerships, or career pathways were only shown to participants who taught students in grades 6 and up.)



Student Learning Transformed

I now understand the importance of career education for my students and having them participate in real world applications. I will take the risks to reach out to manufacturing companies to get them involved with my students.

- Patti H.

Canfield Local Schools, Ohio

Fig 7 :Clockwise from top left: Sixth-grade students from Berne Union Local Schools visit Mid West Fabricating Company; Teachers April B. and Amy S. complete their externship at AT&F Metal Fabrication just outside of Cleveland; Eighth-grade class from Good Shepherd Catholic School visits Tomak Precision; Students from Good Shepherd Catholic School discuss capabilities and outcomes with a machine operator at Tomak Precision.

Full School Engagement: Two teachers from Northwest Ohio attended the Teacher Academy summer workshop together. They were so taken with building STEM culture and making connections to the SIB that they decided to create a back-to-school staff professional development around what they had learned. Their colleagues embraced the two teachers' enthusiasm and ended up making "Under the Sea" the direction of the entire school's learning for the 2023-24 year of study. The school year ended with a huge community event that was planned by the students and showcased their "Under the Sea" learning.

Impact on Curriculum

Each teacher was required to create a problem-based learning unit that involved their manufacturing externship in some way. The following chart shows the breadth of lessons created during the teacher's cohort experience

Table 1. Examples of lessons created from externship experience.

Grade Level	Topic	Industry Externship Partner
11-12	Welding /Waste Management	American Hydraulic Services
11-12	Design Process/Additive Manufacturing	American Ceramic Society
7-8	Increasing efficiency practices	Tomak Precision
8	Manufacturing techniques-CAD-SolidWorks	Screen Machine
6	Tool production and logistics	B - K Tools
6	STEM Career Awareness	Vega & General Tool
6	Assembly line process	Omega Engineering
6	Quality control, assembly line process	Mid West Fabrication
K	STEM Career Awareness	B-K Tools

For an in-depth example of one of the lessons listed above, see *Appendix A*. The unit was created by a career technical education teacher from southern Ohio. Her externship host was American Hydraulic Services, which specializes in welding, metal fabrication and machine lathing.

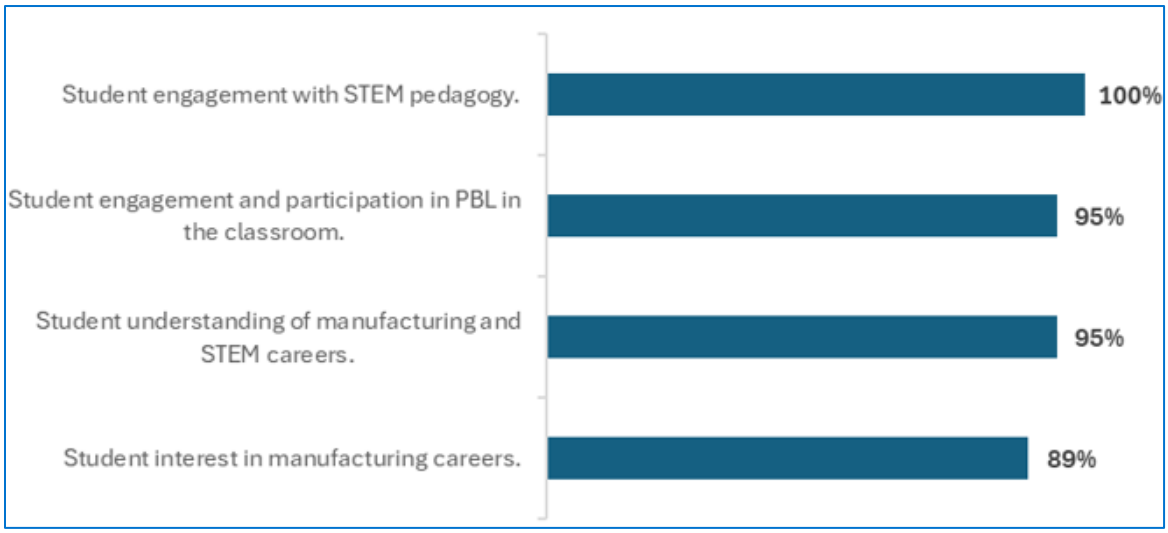
Students Impact

Respondents who felt program was helpful or very helpful in increasing student engagement with STEM pedagogy:

100%

Participants said that they felt that the program was either helpful or very helpful in promoting all measured areas of student outcomes. One hundred percent (100%) of respondents said they felt the program was helpful or very helpful in increasing student engagement with STEM pedagogy, while 89% or more of respondents felt the same about student engagement and participation in problem-based learning (PBL) in the classroom, student understanding of manufacturing and STEM careers, and student interest in manufacturing careers.

Figure 8: Percentage of participants who indicated that the program was helpful or very helpful in promoting the following student outcomes (n=19).



Tasks

Table 2. Contracted tasks. Completed Tasks are marked with an X.

Year 1 (Ohio)	Year 2 (Ohio and Michigan)	Task
X	X	Host in-person kick-off event
X	X	Recruit teacher participants for the cohort program
X	X	Provide a week-long training, including presentation of the manufacturing course
X		Matching and facilitating participants with an externship opportunity related to the purpose of the program
X		Host virtual booster sessions for program participants to review key program operations, goals, and to provide support
X		Host in-person final event

Additional Services Provided

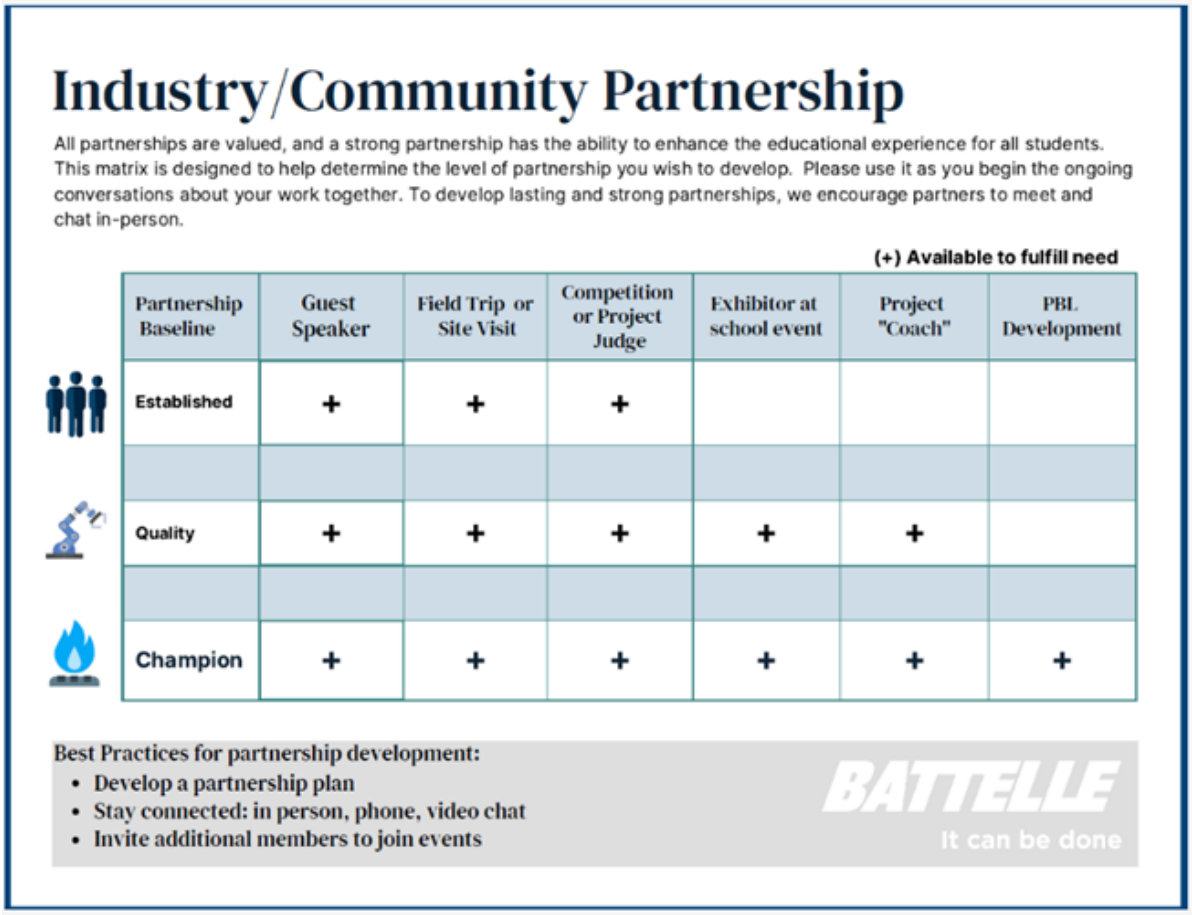
- **Development of teacher externship guidebook for industry requirements:** The externship guidebook offered SIB industries a guide to what to expect when hosting a teacher for an externship experience. This provided BlueForge/SIB a tool when approaching potential industries to host teachers.
- **Bi-monthly facilitator meetings with BlueForge project managers:** Meeting with BlueForge allowed all parties to be actively involved in teacher/industry externship placements and to address any issues that surfaced during the inaugural year of the cohort. This also allowed for input from the BlueForge team on both the development of curriculum and industry recruitment materials.
- **Introductions/networking opportunities with industry connections:** Through Battelle's extensive partnership network, the Battelle team was able to foster multiple connections for BlueForge and its affiliates. The Battelle team provided introductions to the national director of STEMx, the director the Michigan STEM organization and the online career curriculum development company Learning Blade. Since these introductions, buildsubmarines.com has contracted with Learning Blade to produce a submarine focused career exploration unit that will be shared with middle school students across the US.

Lessons Learned

Teacher Support

After the first year of the cohort, it was apparent that both teachers and industry needed more guidance about how to engage with the other. Battelle created documents and teacher training for the second year of the cohort that focused on the different ways to engage an externship partner. The *Industry/Community Partnership Matrix* was developed as a tool for teachers to use with their externship industry to begin conversations about how the industry partner could support the teachers during their problem-based learning units.

Fig. 9: Industry Matrix showing different ways an industry partner can engage with a school.



Industry/Community Partnership

All partnerships are valued, and a strong partnership has the ability to enhance the educational experience for all students. This matrix is designed to help determine the level of partnership you wish to develop. Please use it as you begin the ongoing conversations about your work together. To develop lasting and strong partnerships, we encourage partners to meet and chat in-person.

(+) Available to fulfill need

Partnership Baseline	Guest Speaker	Field Trip or Site Visit	Competition or Project Judge	Exhibitor at school event	Project "Coach"	PBL Development
Established	+	+	+			
Quality	+	+	+	+	+	
Champion	+	+	+	+	+	+

Best Practices for partnership development:

- Develop a partnership plan
- Stay connected: in person, phone, video chat
- Invite additional members to join events

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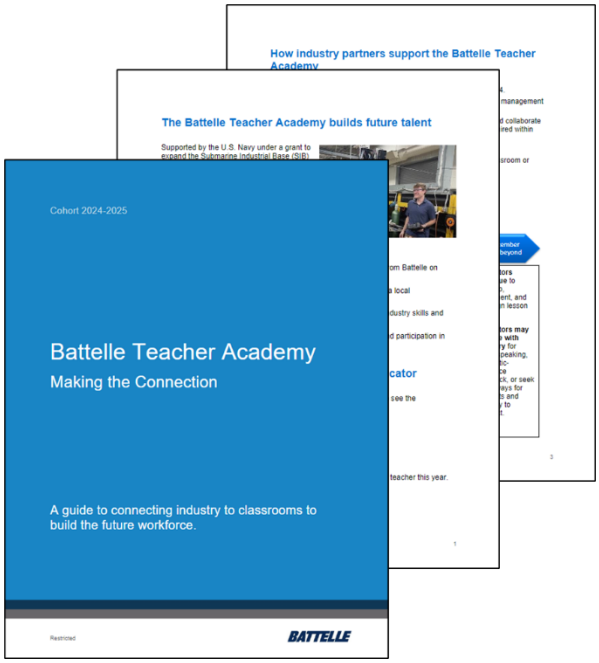
Industry Support

It was discovered that Submarine Industrial Base (SIB) suppliers were willing to host teachers for an externship experience but were unable to engage with the teachers' classrooms because of Department of Defense security guidelines. This hindered the goal of having students engage with industry



and careers located in their community to support the need for growing technically skilled individuals. Battelle created an industry guide for year two of the cohort to promote better engagement between the teachers and industry. The *Battelle Teacher Academy Making the Connection* guide describes the Teacher Academy externship program for industry stakeholders and outlines the expectation of commitment by the industry partner. This allowed potential partners to determine if they could fulfil the partnership portion of the program before they committed to hosting teachers at their facility.

Fig 10: Battelle Teacher Academy: Making the Connection guidebook.

Industry Recruitment

Identifying SIB suppliers in the teacher's local community also proved challenging, particularly in the rural areas of the state of Ohio. Battelle learned that there was a need to identify "industry adjacent" companies that used the skills desired by the SIB industries, but that were not actual SIB suppliers. By identifying local machine shops and small manufacturers, Battelle was still able to promote the technical skills that are needed to fulfill the deficit of skilled labor needed by the SIB. Battelle created an interest flyer to help in the recruitment of these smaller industries.


Michigan and Ohio Businesses

Advance manufacturing and STEM education in your area by hosting a teacher

Overview

Help teachers advocate to students about the career opportunities in modern manufacturing and engineering, including the Submarine Industrial Base (SIB). Host a teacher for the 2024 Battelle/SIB Teacher Academy. Your business can support the growth of future ready talent in our state!

What's Involved

The Battelle/SIB Teacher Academy includes an industry internship. Teachers complete a *one to two-day externship* between June and August with a local business or manufacturer within their community.

During the experience, teachers immerse themselves inside the business to observe and learn. Participants gather information about the inner workings of STEM in the real world.

Through the externship, teachers answer key questions including:

- How could inner workings of this industry apply to classroom experiences?
- What problems faced by this industry work could my students tackle?
- What local careers are available to students and how can I teach them about those careers?

Every effort is made to partner industries and teachers within the same community. *Teachers will be compensated by the Battelle/SIB Teacher Academy for the time they spend at the industry site.*

Submarine Industrial Base

The Teacher Academy is supported, in part, by the U.S. Navy under a grant to expand the Submarine Industrial Base in the United States. The SIB needs100,000-150,000 new hires over the next 10 years to complete the mission of building three submarines per year and maintaining that cadence for the foreseeable future. The Submarine Industrial Base includes millions of workers across 16,000 suppliers. Key trades include Welding, CNC Manufacturing, Pipefitting, Non-Destructive Testing, Additive Manufacturing, Electrical, Machining and Metrology.

Learn more at https://buildsubmarines.com/

Host an Educator

To get more information about hosting an educator, please contact guinto@battelle.org and complete the form at: https://osln.org/host-an-educator/

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Fig 11: Industry recruitment flyer.

Planning for the Future

Teacher and Industry Recruitment

When recruiting future teacher cohorts, Batelle will purposefully select SIB industries who are eager to engage with schools and teachers within their communities. These industries will be identified through past engagement with the Battelle/STEMx programing, ongoing recruitment efforts and those industries identified by our BlueForge/SIB partners. Once a commitment to host teacher externs has been received, the focus will shift to recruiting teachers within a 30–45-minute radius of the industry partner based on the number of teachers they are willing to host. This will allow for a more productive experience for both the teachers and partner.

It has been identified through conversations with our Blueforge/SIB team that hosting a meeting of potential SIB industry partners in the spring of the year would be helpful for recruitment of industry to participate in the summer teacher externship program. The gathering would offer industries the opportunity to hear from other successful SIB industries who have hosted teacher externs and from the teachers who participated. This would allow potential SIB industry hosts to see firsthand the benefits of the program on their future workforce and to be able to ask questions surrounding the process.

Teacher Engagement

When the next cohort of teachers is selected, facilitators will ask the teachers to complete a community survey of local industries. These industries will be focused on the SIB identified technical skills and that they are located within 45 minutes of their schools. This will be used as a placement resource if Battelle facilitators are unable to place the teacher for an externship with a SIB identified industry partner.

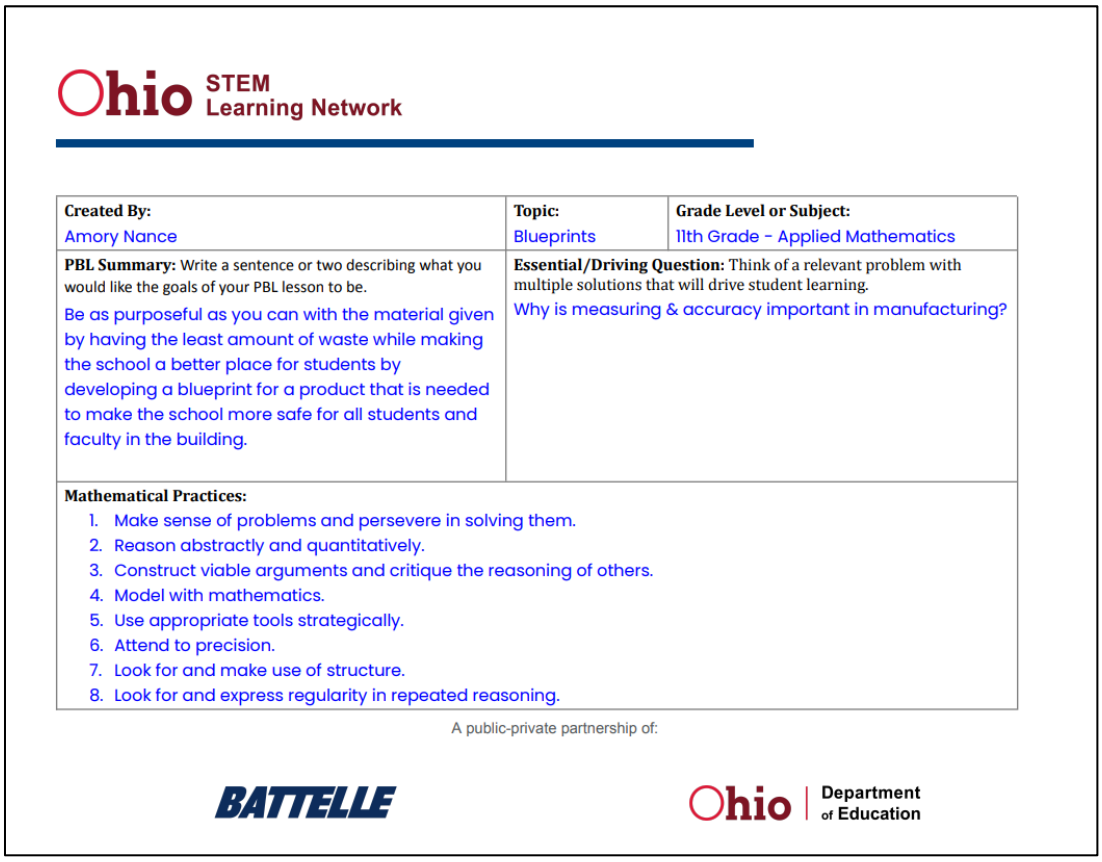
Conclusion

The Teacher Academy Program concluded with resounding success, providing educators with invaluable insights into advanced manufacturing, engineering, and the critical role of STEM in national security. Participants left with a deeper understanding of the submarine industry's intricacies and the skills needed to prepare students for careers in this vital field. By meeting our program goals through hands-on experiences and direct engagement with industry leaders, teachers are now equipped to bring real-world applications of STEM back to their classrooms. The excitement for next year’s externship is already building, as Battelle looks forward to expanding the program's reach and impact, empowering even more educators to inspire the next generation of innovators.

Appendix A

Example PBL Unit

The following PBL unit was submitted by Amory Nance of Collins Career Technical Center. It is an in-depth example of the unit she created with her externship host at American Hydraulic Services, which specializes in welding, metal fabrication and machine lathing.



Ohio STEM Learning Network

Created By:	Topic:	Grade Level or Subject:
Amory Nance	Blueprints	11th Grade - Applied Mathematics

PBL Summary: Write a sentence or two describing what you would like the goals of your PBL lesson to be.	Essential/Driving Question: Think of a relevant problem with multiple solutions that will drive student learning.
Be as purposeful as you can with the material given by having the least amount of waste while making the school a better place for students by developing a blueprint for a product that is needed to make the school more safe for all students and faculty in the building.	Why is measuring & accuracy important in manufacturing?

Mathematical Practices:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

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Math Standards:

N.Q.1 *Use units as a way to understand problems & to guide the solution of multi-step problems; choose & interpret units consistently in formulas; choose & interpret the scale & the origin in graphs & data displays.*

N.Q.2 *Define appropriate quantities for the purpose of descriptive modeling.*

N.Q.3 *Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*

A.CED.1 *Create equations and inequalities in one variable and use them to solve problems.*

G.CO.12 *Make formal geometric constructions with a variety of tools and methods.*

G.SRT.2 *Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar.*

G.GMD.5 *Understand how and when changes to the measures of a figure (lengths or angles) result in similar or non-similar figures.*

G.GMD.6 *When figures are similar, understand and apply the fact that when a figure is scaled by a factor of k, the effect on lengths, areas, and volumes.*

G.MG.1 *Use geometric shapes, their measures, and their properties to describe objects.*

G.MG.3 *Apply geometric methods to solve design problems.*

Additional Standards:

EM.1.1.7 *Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.*

EM.1.1.9 *Give and receive constructive feedback to improve work habits.*

EM.1.2.1 *Extract relevant, valid information from materials and cite sources of information.*

EM.1.2.2 *Deliver formal and informal presentations.*

EM.1.2.3 *Identify and use verbal, nonverbal, and active listening skills to reach solutions.*

EM.1.2.4 *Use negotiation and conflict-resolution skills to reach solutions.*

EM.1.2.10 *Use interpersonal skills to provide group leadership, promote collaboration and work in a team.*

EM.1.3.2 *Follow protocols and practices necessary to maintain a clean, safe and healthy work environment.*

EM.1.3.3 *Use ethical character traits consistent with workplace standards (e.g., honesty, personal integrity, compassion, justice).*

EM.3.1.5 *Work from a process sheet and part print.*

EM.5.1.3 *Develop multiple solutions and select an approach.*

EM.5.2.2 *Sketch possible solutions to an existing design problem.*

EM.5.2.7 *Sketch geometric forms and shapes.*

EM.5.2.8 *Describe geometric constraints.*

EM.5.3.2 *Evaluate a sketch and generate a model utilizing three-dimensional modeling software and techniques.*

EM.5.5.7 *Estimate time, tooling, product packaging, and material costs.*

Externship or Community Partnership(s)	
Externship or Community Partners: Include names, websites or contact info. Also list other community partners who may add to the student's experience as well. 1. Tracy Frazier, *Executive VP of Sales & Marketing* American Hydraulics Services 2. Dave Davenport, *Welding Instructor* Collins Career Technical Center 3. Samuel Nelson, *Machining Instructor* Collins Career Technical Center	What do you need from these partners? (i.e., consultation before unit, guest speaker, field trip, help facilitate an activity) 1. Guest speaker before beginning to develop the blueprint 2. Consultation prior to starting the blueprint on the materials available for use & help facilitating the activity (specifically welds needed, etc.) 3. Consultation prior to starting the blueprint on the materials available for use & help facilitating the activity (specifically machine processes to use, etc.)
Skills Addressed (Highlight all that apply): Creativity Collaboration Critical Thinking Communication	
Hook Event: Develop an introductory activity that will spark student interest and further questions. Tracy Frazier from AHS will come to present to the class and introduce them to their latest product development including how the need arose, the process of developing the new product, and the effects this new product has on their business and the economy.	**Culminating Event:** What final student learning products will show student mastery of the content area standards? Blueprint & calculations of waste produced with the possibility creating a prototype or miniature model

Activities: What activities will students complete to answer the multi-dimensional/driving question that reinforces content from the standards? (Add more steps as needed.) **Activity:**	**Resources/Materials Needed:**
1. GimKit: Proportions & Ratios *- review concepts on ratios & proportions* 2. Similar Triangle Exploration *- Students measure triangles to discover the properties of congruence and similarity.* 3. Similarity - apply ratios & proportions to similar figures using a "Building Thinking Classroom" setup (randomized groups at whiteboards completing scaffolded tasks) 4. Build a Rectangle *- students are given constraints and must create a rectangle in order to fit those constraints* 5. Tolerances *- discussion on tolerances, their importance, how to identify them, etc.* 6. Floor Plan *- read a blueprint and calculate perimeter, area, and scale* 7. Paper Blueprint Project *- given a welding blueprint students create a prototype using paper* 8. Safety & Other Ways to Improve CCTC *- use recent events with the tornadoes in Lawrence County to discuss safety and the concept of safety in our schools*	• GimKit https://www.gimkit.com/login?location=%2Fme • Similar Triangle Exploration handout • Similarity Thinking Tasks • ClassDojo https://www.classdojo.com/ • Whiteboards, markers, & erasers • Build a Rectangle handout • cardboard • scissors and cardboard cutters • measuring tape and rulers • Floor plan • Welding blueprint • Colored paper • tape • large poster-size post-its • post-its • Grid paper • pencils • calculators • chromebooks

9. Brainstorming *- begin to develop ideas individually for safety additions, then collaborate within a team to develop a single idea* 10. Grows and Glows *- teams share their ideas with the class for grows & glows* 11. Constraints *- constraints are shared to rethink their* 12. Safety Product Plan *- teams develop their idea into a blueprint and explore materials and costs* 13. Presentations *- teams share their designs and costs* 14. Administrative Review *- ideas are shared with administration to receive approval to proceed with the product development and implementation*	
Technology Integration: What technology applications are used to enhance learning beyond basic research in this PBL unit? Students will research using their chromebooks and the Google Chrome browser. Research includes during the idea phase, material costs and information, etc. Teams will present their ideas using whatever form or setup they select which could include Google Slides, Powerpoint, Canva, pictures/videos for a slideshow, etc.	
Capstone Presentation: How will students present what they've learned? This can be the culminating event if that event is presenting what has been learned to an authentic audience or public. Teams will present their design, material costs, etc. in whatever form they deem would best suit the presentation. If administrators are available, they will sit in on the presentations. Information will be shared for administrative and superintendent approval prior to creating the products and implementing their design.	

Performance Based Rubric

Criteria	Novice (1)	Developing (2)	Basic (3)	Proficient (4)	Exceptional (5)
Problem Definition	Fails to identify or define the problem effectively. Lacks meaningful background information.	Identifies the problem without significant clarity. Lacks background information.	Identifies the problem, but without some clarity. Provides limited background information.	Identifies the problem to be solved with reasonable clarity. Offers some background information.	Clearly identifies and states the problem to be solved. Provides detailed background information.
Brainstorming	Fails to generate any meaningful solutions. Shows no creativity.	Generates only one or two solutions, with limited practicality. Lacks creative thinking.	Generates a few solutions, some of which are practical. Demonstrates limited creativity.	Generates several practical solutions. Shows some creative thinking.	Generates a wide range of creative and practical solutions. Demonstrates innovative thinking.
Design Development	Fails to develop a coherent design.	Develops a basic design with little consideration for relevant factors.	Develops a design with some consideration for relevant factors.	Develops a design with consideration for most factors.	Develops a detailed, well-thought-out design, considering all factors.
Blueprint	Blueprint is missing, not to scale, or contains no measurements.	Blueprint is present, but measurements/scale is missing.	Blueprint is accurately completed, but measurements/scale are not consistent.	Blueprint is accurately completed with most measurements/scale consistent.	Blueprint is accurate with consistent measurement/scale.
Constraints	Fails to consider any constraints given.	Consider minimal constraints.	Some constraints are considered in design.	Most constraints are considered in design.	Design reflects all constraints.
Waste	Fails to include waste calculations.	0-69% of material is used in design leaving 31-100% waste.	70-79% of material is used in design leaving 21-30% waste.	80-89% of material is used in design leaving 11-20% waste.	90-100% of material is used in design leaving 0-10% waste.

Presentation	Fails to include relevant information. Presents findings and recommendations unclearly or incompletely.	Includes limited relevant information. Presents findings and recommendations with limited clarity.	Includes some relevant information. Presents findings and recommendations with some clarity.	Includes most relevant information. Presents findings and recommendations effectively.	Includes all relevant info - reasoning, design process, blueprint, waste calculations, etc. Presents findings and recommendations professionally and persuasively.
Teamwork	Team was ineffective at collaborating and unable to communicate and work together for a common purpose.	Team had several issues with collaborating, but everyone participated in some aspect of the design process.	Team had some issues with collaborating. All but one member participated in most of the design process.	Team had some issues, but worked together to overcome those issues with some teacher assistance. All members worked collaboratively on the entire design process.	Team had some issues, but worked together to overcome those issues as a team without teacher assistance. All members worked collaboratively on the entire design process.
Total Points ____/80 = ____%					

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It can be done