Welding: Wisconsin's Ultimate Rural Pathway

Year 3 Evaluation Report

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Executive Summary

Northeast Wisconsin Technical College (NWTC) is addressing the need for more skilled welders in Northeast Wisconsin through the *Welding: Wisconsin's Ultimate Rural STEM Pathway* project. Funded through the National Science Foundation's Advanced Technological Education program, the project seeks to increase the number of skilled workers in the welding industry. To meet this objective, the goals of the project are to: 1) Change perceptions of the welding industry through outreach to high school students, their parents, counselors, and teachers; 2) Strengthen the K12 welding education pipeline; and 3) Improve retention through the development of contextualized mathematics activities.

This comprehensive report focuses on the project as a whole, while highlighting the activities and accomplishments of the current year. During the third year of the project, implementation of activities occurred as planned. Several of these activities were continuations of Year 2 activities, such as conducting industry tours, developing and hosting a *Welding for Non-Welding* professional development opportunity, offering a summer welding professional development session, holding monthly math and welding learning community meetings, and finalizing materials for the enhanced Math 1- Trades course.

Available outcome data are encouraging. Findings from the industry tours suggest that the experience is positively impacting students' perceptions of welding. Additionally, the enhanced Math 1 – Trades course appears to improve performance for NWTC students. While the enhanced Math 1 – Trades course did not impact performance for high school students, these findings could be attributed to lack of fidelity in implementation of the enhanced and traditional (e.g., control) version of the courses. Regardless, it is encouraging to have actual performance outcomes that suggest that the course is making a difference. Results from a pre-/post-test disseminated to instructors who are part of the monthly learning community meetings indicate that cross-functional knowledge and attitudes improved from the start of the project in September 2014 to mid-way through the second year (e.g., December 2015).

The report concludes with recommendations for Year 4. These recommendations reinforce many of the current project activities, such as engaging in continuing data collection efforts and disseminating project findings, and efforts toward sustainability.

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Background

Manufacturing is one of Wisconsin's largest industries, and while the demand for welders is great, particularly in Northeast Wisconsin, the supply of qualified workers falls short. Several circumstances contribute to this shortage. First, there is a need for more students in the welding "pipeline" who develop an interest in welding in high school or before. Second, there is a need for more high school instructors to be proficient in welding and welding instruction. Third, students' ability to compete in the workforce is in some cases hampered by a lack of math skills. Finally, employers in Wisconsin, as in other rural areas, are hindered in hiring skilled workers by young workers leaving rural areas for urban/suburban areas.

In September 2014, Northeast Wisconsin Technical College (NWTC) was awarded a grant through the National Science Foundation's Advanced Technological Education program to fund the *Welding: Wisconsin's Ultimate Rural STEM Pathway*. The project is intended to increase the number of skilled workers in Northeast Wisconsin, and seeks to accomplish this goal by attracting students to the welding industry, providing quality experiences for students in their high schools, and retaining students through the technical diploma credential.

Over a three-year (3) timeframe, the project intended to achieve the following:

1. Change perceptions of the welding industry through outreach to high school students, their parents, counselors, and teachers;
2. Strengthen the K12 welding education pipeline; and
3. Improve retention through the development of contextualized mathematics activities.

The purpose of the current document is to report on the evaluation findings through the end of the third year of funding.

Purpose and Design of the Evaluation

At the beginning of the project, The Rucks Group, LLC was contracted to serve as the external evaluator for the project. Formed in 2008, The Rucks Group is a southwest Ohio (Dayton) based research and evaluation firm that gathers, analyzes, and interprets data to enable their clients to measure the impact of their work.

The evaluation has a two-fold purpose: First, to capture information regarding the effectiveness of the implementation of activities for continuous improvement; and second, to gather evidence of the outcomes of the project. The firm, in collaboration with the project team, distilled the logic model, evaluative questions, and evaluation methodology. The logic model provides the theoretical framework of the evaluation, the evaluative questions guide the nature of the data gathering process, and the evaluative methodology provides the context for interpreting the findings. These elements are continually reviewed to identify optimal approaches to execute the evaluation. The logic model is presented in Appendix A, while the evaluative questions are provided below:

1. How is the project being implemented?
2. What differences are activities having on students and instructors' attitudes toward welding and their sense of self-efficacy in understanding/teaching welding math concepts?
3. How are the activities making a difference in enrollment and retention?
4. What is the impact the program is having on the industry?

A mixed-methods approach is used to address the evaluative questions. Evaluative question #1 is addressed through the review of project documents and discussions with the project team and members of the learning community. When feasible, a comparison group design is used to gather evidence concerning evaluative question #2. Comparison data related to math skills and related attitudes were gathered in Fall 2014 and 2015. Evaluative question #3 relates to enrollment and retention. At this point, limited data are available to fully address this evaluative question. The evaluative question #4 relates to the ultimate purpose of the grant which is to "increase the numbers of skilled welders in Northeast Wisconsin and help prevent rural 'brain drain'" (NWTC, 2013). Initial baseline data are presented for evaluative questions #3 and #4.

Findings

The evaluation findings are organized around each of the evaluative questions.

Evaluative Question #1: How is the project being implemented?

The thrust of this evaluative question is to focus on whether the project is being implemented as planned or if there are any major obstacles or challenges that are being experienced. For the current project, the former description is appropriate. Specifically, all of the activities outlined in the proposal were completed as planned[1]. These activities included:

1) Conducting industry tours;
2) Developing and providing a *Welding for Non-Welding* professional development offering for high school and collegiate math teachers;
3) Providing summer welding professional development offerings;
4) Holding monthly learning community meetings;
5) Creating industry videos and related materials; and
6) Enhancing Math 1 – Trades Course at NWTC and high schools.

Each of these activities is discussed in greater detail below.

<u>Industry Tours</u>
Industry tours allowed students to visit a local business, a large manufacturing organization, and NWTC to get a better understanding of the welding industry. In all three years of the project, each of the three (3) partnering high schools participated in industry tours. During the industry tours, students were provided the opportunity to engage in a hands-on welding activity (i.e., creating a simple welded figure). In Year 1, approximately 50 students participated in the tour. In Year 2, two (2) industry tours were completed in the fall and spring with approximately 140 students participating in total. While the tours are promoted to both students and parents, across both years, only one (1) to two (2) parents participated. Participation by parents remained low, despite the implementation of strategies to increase their involvement. One change from the previous years' industry tours was the adjustment of the welding activity, which created a more challenging welding figure through the requirement of more difficult math calculations. Year 3, two (2) additional industry tours were held in Fall 2016 and Spring 2017, respectively. The Year 3 tours resulted

[1] The minor exception to this concerns the K12 Lab Assessment. The majority of the equipment has been purchased and put in place. However, one partnering high school is currently under renovation. When the renovation is complete, additional materials will need to be purchased to construct the welding booths.

in 177 tour participants. Through three (3) years of the project, more than 350 students have been reached by the industry tours.

Welding for Non-Welding Professional Development

The purpose of this professional development course is to familiarize high school math, career technical education (CTE), and NWTC math instructors with welding by demonstrating how each math activity is applicable in the welding field. The one-day course was offered in all three funding years, and will be offered again in Year 4. The course is facilitated by a NWTC welding instructor with support for welding CTE instructors. In Years 1 and 2, the course was attended by 11 and 13 individuals, respectively. Two offerings were held in Year 3, (i.e. January and May) with a total of 21 individuals attending from both NWTC and three (3) area high schools (i.e., Coleman, During, and De Pere). For a list of the participants at each years' course, see Table 1 below.

***Welding for Non-Welding* Professional Development Participation Overview (Years 1-3)**		
Project Year	**# of Participants**	**Participant List**
Year 1	11	NWTC math instructors, CTE math instructors, school superintendent
Year 2	13	NWTC math instructors, CTE math instructors, additional CTE instructors
Year 3 (January session)	7	High school math and technical education teachers
	14	NWTC math instructors, NWTC advisors, NWTC staff members, high school teachers, high school counselors, grant evaluator

Table 1. *Welding for Non-Welding* Participation Overview

The participants currently teaching Math 1 – Trades reported that they would be able to relate the information learned from the professional development opportunity into teaching Math 1 – Trades.[2] Additionally, regardless of teaching responsibilities, all respondents indicated that they wanted to see similar events conducted within other disciplines.

Welding Summer Professional Development Offering

Consistent with national trends, CTE instructors in NWTC's district need ongoing professional development to help bolster essential skills. The professional development offerings were summer training sessions and monthly meetings, a day-long conference, and course enhancements.

High school CTE instructors participated in summer train-the-trainer sessions to enable them to provide dual-credit courses. These sessions occurred during the summer of each of the project grant years. The sessions covered topics including Materials Cutting Applications, Shielded and Gas Metal Arc Welding, and Blueprint Reading 1. In Year 3, NWTC offered the same four (4) summer sessions for high school CTE instructors. Participation included sixteen (16) enrollments spanning eight (8) school districts.[3] As NWTC increases dual credit welding offerings, there is greater potential for interest in the enhanced Math 1 – Trades course.

[2] Of the 13 participants, two (2) individuals did not have responsibilities for teaching the Math 1 – Trades course.
[3] In Year 1, ten (10) and in Year 2, fifteen (15) individuals enrolled in the Welding Summer Professional Development Offerings.

At the end of April, NWTC held a day-long conference entitled the *Wisconsin Technical College System Workshop*, to provide an overview of the project's objectives with math and welding instructors from other technical colleges, high school math and technical education teachers, and related technical college staff, such as K-12 Relationship representatives. The 27 participants in the workshop were presented with topics such as: a review of math activities, videos, and math kits; welding processes and safety overview; a welding demonstration and hands-on welding activity; and a group collaboration exercise between trades/general studies and college/high school with a focus on implementation of learned information at respective schools.

Monthly Learning Community Meetings

The monthly learning community meetings are designed for NWTC and high school instructors "to find ways to reinforce mathematics skills in the welding course and to contextualize the mathematics competencies in a way that will be useful to future welders" (NWTC, 2013). During the first year of the project, the learning community meetings were held monthly, however, during the latter two years of the project the learning community meetings transitioned to convening only once or twice a semester. The meetings covered topics including: planning and improving industry tours, creation of a promotional video targeted to high school enrollment, development of new activities, and contextualization of Math 1 -Trades curriculum focused on joint projects between welding and math classes to promote collaboration.

Create Industry Videos

The industry videos were developed during the first two years of the grant. The purpose of this task was to develop videos with industry participation that demonstrate how math is applied in welding. In partnership with the Northeast Wisconsin (NEW) Manufacturing Alliance and with feedback from learning community members, in Years 1 and 2 NWTC produced nine (9) videos in the "Get Real Math!" series while also creating related lesson plans. Filmed at NWTC and two (2) local businesses, the videos were incorporated in the Math 1 – Trades course. Additionally, the NEW Manufacturing alliance is promoting these videos to middle and high school students through schools, conferences, and other educational events throughout Northeast Wisconsin.

Enhanced Math 1 – Trades Course

High school math and CTE instructors collaborated to develop nine (9) math activities that contextualized math into welding and hands-on activities using a math kit. For example, one exercise requires students to replicate building a fuel tank. Completing this task requires the application of geometric principles. Each kit contained materials for producing a sample product. The curriculum now incorporates the math kits, videos, and related lesson plans. The program was piloted in Fall 2015 at the partner high schools and three course sections at NWTC. Five (5) additional high schools agreed to incorporate the enhanced Math 1 – Trades Course curriculum in Fall 2016, resulting in eight (8) area high schools utilizing the enhanced Math 1 – Trades Course (see Table 2). Additionally, all sections of Math 1 – Trades at NWTC began utilizing the enhanced curriculum as of Fall 2016.

Schools Utilizing the Enhanced Math 1 – Trades Course			
Fall 2015 (Original Piloted)	**Fall 2016 (Additions)**	**Fall 2017 (Unconfirmed)**	**Fall 2018 (Projected)**
Bonduel	Bay Port	East De Pere	Marinette
Kewaunee	Denmark		Wrightstown
Oconto Falls	Luxemburg-Casco		
	Pulaski		
	West De Pere		

Table 2. Current and projected list of schools utilizing the Math 1 – Trades course.

Evaluative Question #2: What differences are activities having on students and instructors' attitudes toward welding and their sense of self-efficacy in understanding/teaching welding math concepts?

Outcomes of Project on Students

As outlined in the logic model, the theory of change of the project is that improving attitudes towards welding and increasing math self-efficacy among students will have a positive impact on welding enrollment and retention. Therefore, the evaluation sought to gather a deeper understanding of attitudes held by students and parents regarding welding as a career option. Towards that end, during Year 1 focus groups were held with students at NWTC and Bonduel (see Appendices B and C). The knowledge gleaned from these focus group discussions were used to inform the items on surveys disseminated at selected activities (e.g., industry tours, Math 1 – Trades course, and Learning Community meetings).

Industry Tours

Students who attended the industry tours were asked to complete a six (6)-item questionnaire at the end of the tour. The purpose of the survey was to understand their attitudes towards welding. Additionally, because the attitudes of parents appear to be important to students, the project team wanted to understand what parents' attitudes were towards welding. Parental attendance was expected to be low; therefore, items were included on the student survey to ascertain students' perceptions of parents' attitudes.

In 2014, the mean responses appeared to be high (see Figure 1). However, it was difficult to determine the extent to which the tours impacted on attitude changes.[4] To remedy this interpretative challenge, a counterfactual survey methodology was utilized for the industry tours starting in 2015.[5] A counterfactual survey asks respondents to provide their pre-intervention attitudes and their current attitudes at the same time (Mueller, Gaus, & Rech, 2014) as a measure of impact. In the present context, "before" reflects participants' attitudes regarding a particular item before the industry tour, whereas, "after" reflects participants' attitudes after partaking in the industry tour. The counterfactual survey was utilized because research indicates that individuals tend to make overestimations in the absence of a defined standard regarding attitudes and skills (Kruger & Dunning, 1999). As a consequence, traditional pre-/post-test dissemination methodologies do not fully reflect the impact of an intervention.

[4] A pre-test would have aided in the ability to interpret the findings, distributing a pre-test was not feasible.
[5] Counterfactual surveys will be folded within all the self-perception data collection efforts.

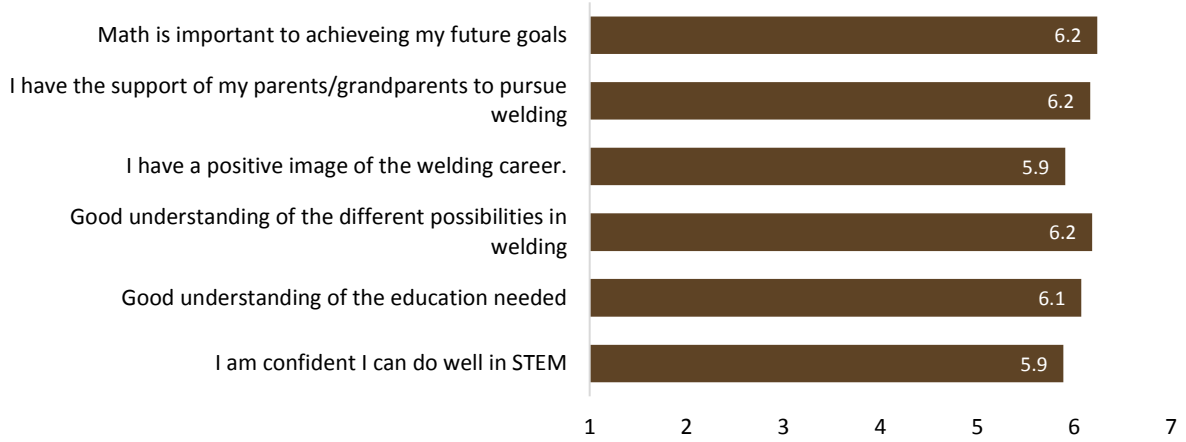

Figure 1. Mean responses to questionnaire items disseminated to students following industry tours (1 = strongly disagree; 7 = strongly agree). A total of 54 responses were received in 2014.

Using the counterfactual survey methodology, at both tours students' self-reported attitudes around targeted areas increased (see Figure 2). For instance, in Fall 2015, for the item "*Do you feel that you have a good understanding of the different possibilities of career options in the welding field?"* participants reported a mean response before the tour as m=4.4, and a mean response after the tour as m=5.9. On a key item related to the image of the welding field, when participants responded to the item, "*I have a positive image of the welding career",* they indicated a mean response of m=4.6 before the tour and a mean response of m=5.7 afterwards. A similar pattern emerged for the results from the Fall 2016 and Spring 2017 tours (see Figures 3 and 4).[6]

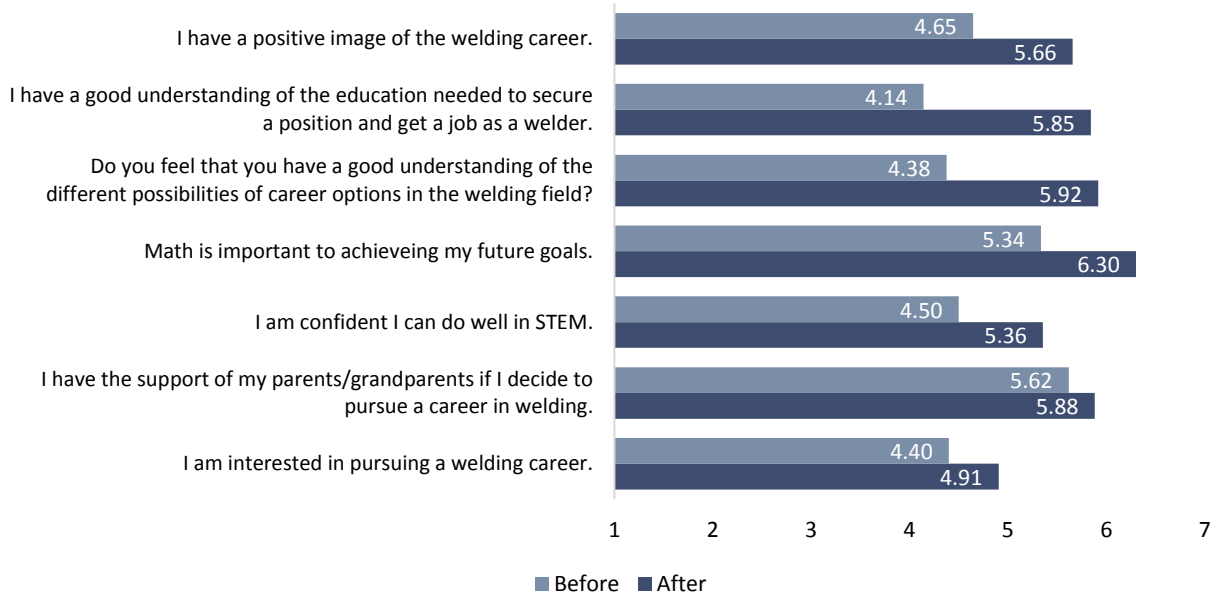

Figure 2. Mean responses to counterfactual questionnaire items disseminated to students following a Fall 2015 industry tour (1 = strongly disagree; 7 = strongly agree). A total of 85 responses were received in Fall 2015.

[6] For the item *"Do you feel that you have a good understanding of the different possibilities of career options in the welding field?"* the mean responses for Fall 2016 were m=4.52 (before) and m=5.91 (after), and Spring 2017 were m=4.30 (before) and m=5.80 (after). For the item *"I have a positive image of the welding career"* the mean responses for Fall 2016 were m=4.70 (before) and m=5.93 (after), and Spring 2017 were m=4.66 (before) and m=5.95 (after).

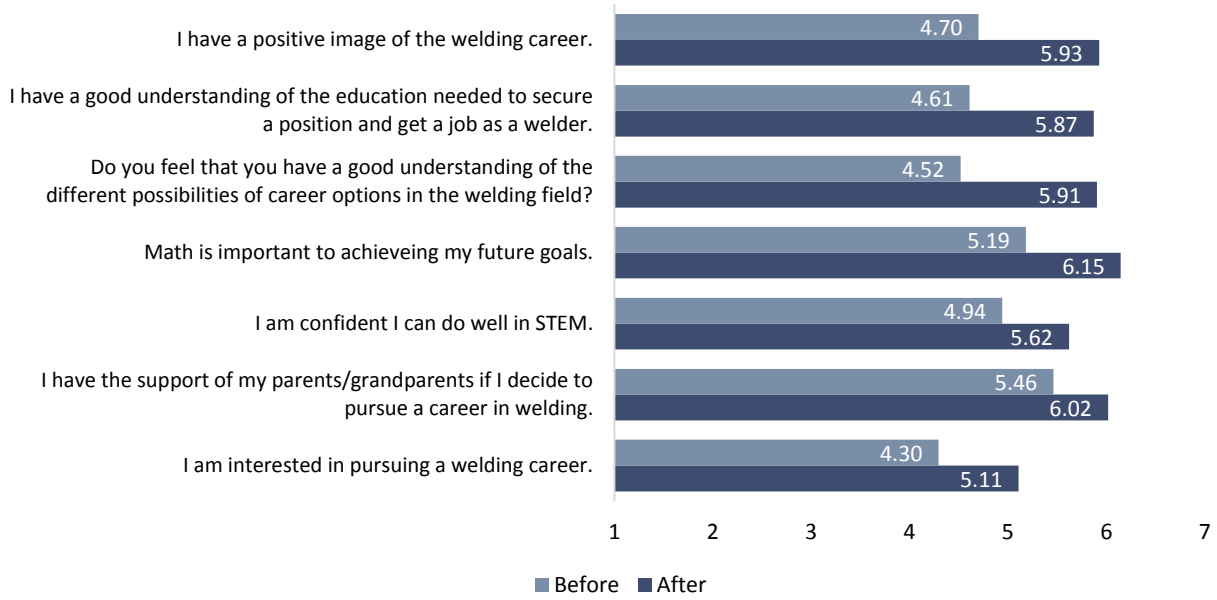

Figure 3. Mean responses to counterfactual questionnaire items disseminated to students following a Fall 2016 industry tour (1 = strongly disagree; 7 = strongly agree). A total of 56 responses were received in Fall 2016.

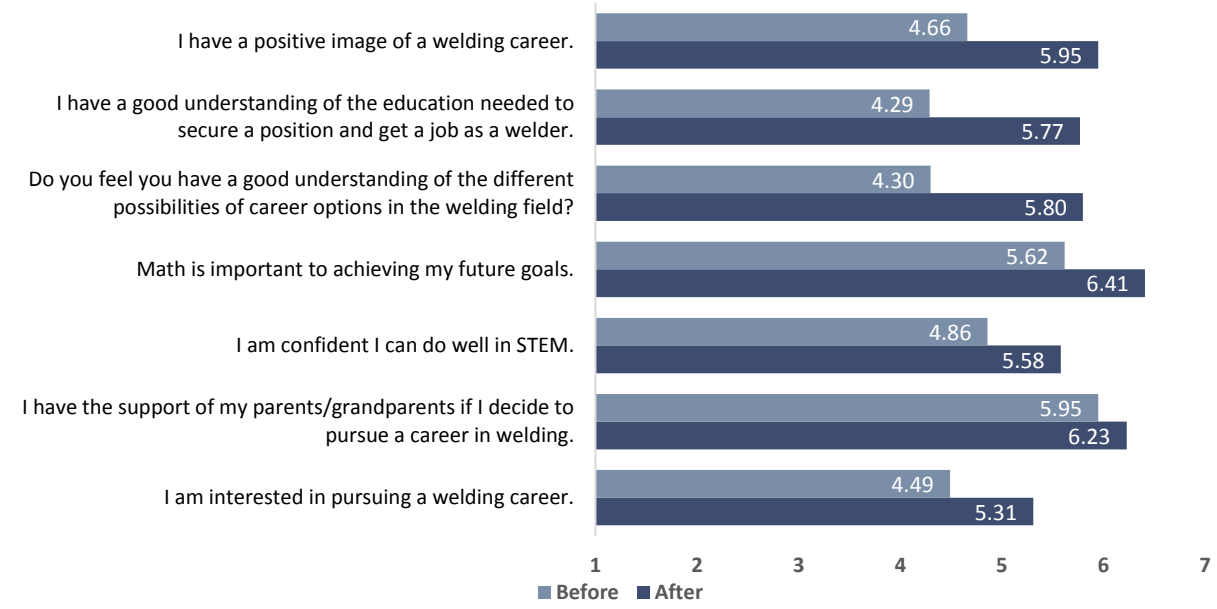

Figure 4. Mean responses to counterfactual questionnaire items disseminated to students following a Spring 2017 industry tour (1 = strongly disagree; 7 = strongly agree). A total of 19 responses were received in Spring 2017.

STEM Self-Reported Attitudes among Math 1 – Trades Students

As noted in the overview of the purpose and design of the evaluation, the design incorporates a comparison group to aid in the interpretation of the findings. Measures assessing attitudes towards welding and self-efficacy, along with a math test, were distributed in Math 1 – Trades courses at NWTC and classes at Bonduel towards the beginning and at the end of the Fall 2014 semester. Assessment of welding attitudes and self-efficacy used a six (6)-item questionnaire. The attitudinal measures and math test were disseminated again in Fall 2015, this time to three (3) NWTC classes and classes at Bonduel, Kewaunee, Oconto Falls, and West De Pere. Results from the enhanced course were then compared against the non-enhanced version of the course (see Table 2).

Overview of the Comparison Group		
Pre-	**Intervention**	**Post-**
Fall 2014 students and Fall 2015 students in the traditional version of Math 1 – Trades	Traditional Math 1 – Trades Course	Fall 2014 students and Fall 2015 students in traditional version of Math 1 – Trades
Fall 2015 students in the enhanced version of Math 1 – Trades	Enhanced Math 1 – Trades Course	Fall 2015 students in the enhanced version of Math 1 – Trades

Table 3. Overview of the comparison groups.

Continuing from the baseline comparisons established in 2014, the 2015 classes were separated into four categories: NWTC Traditional (e.g. Control), NWTC Enhanced, High School Traditional (e.g., Control), and High School Enhanced. Each of these groups received a measure of STEM attitudes and self-efficacy at the beginning of the semester and a counterfactual questionnaire with the same items at the end of the semester. Except for perceptions in parents' attitude, the before and after means on the STEM attitude measure were essentially unchanged across groups (see Figures 5 and 6).

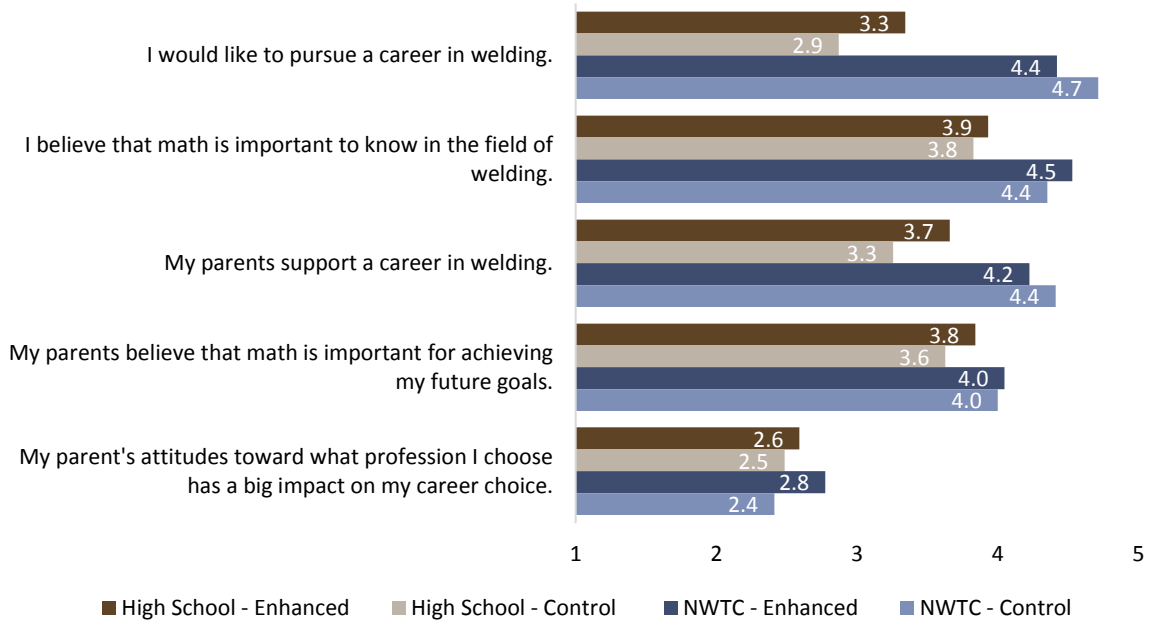

Figure 5. Mean responses to questionnaire items disseminated to students towards the beginning of the Fall 2015 semester (1 = strongly disagree; 5 = strongly agree).

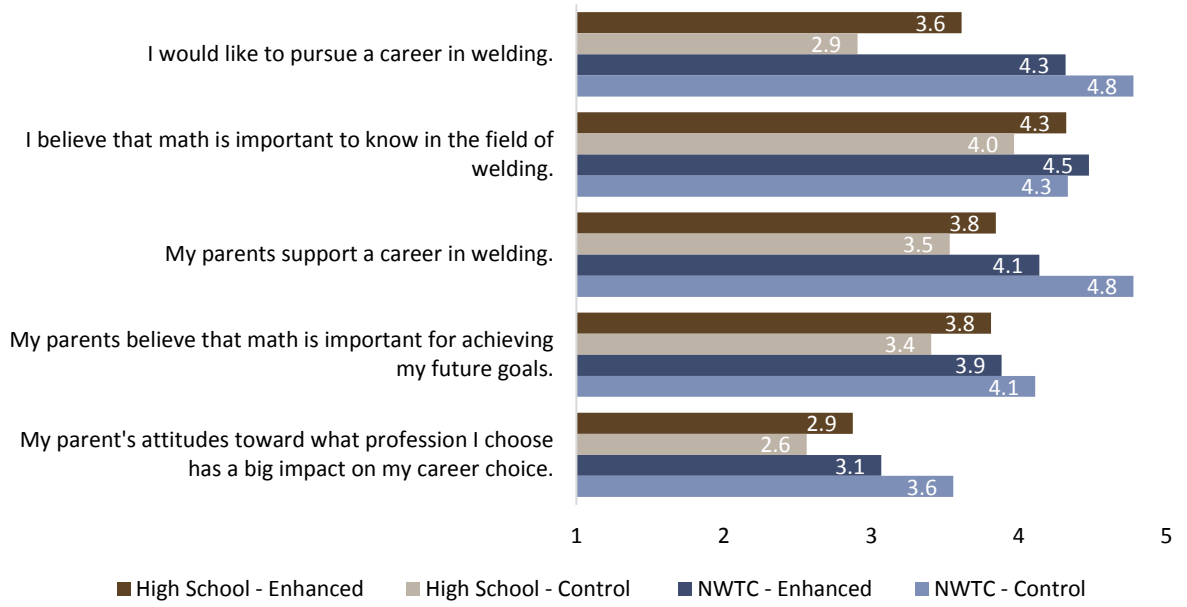

Figure 6. Mean responses items disseminated to students towards the end of the Fall 2015 semester (1 = strongly disagree; 5 = strongly agree).

In Fall 2016 semester, a similar methodology was utilized except the measures were disseminated to only one instructor at NWTC. In general, there was not much change across the items when examining the "counterfactual before" and "counterfactual after" means (see Figure 7).

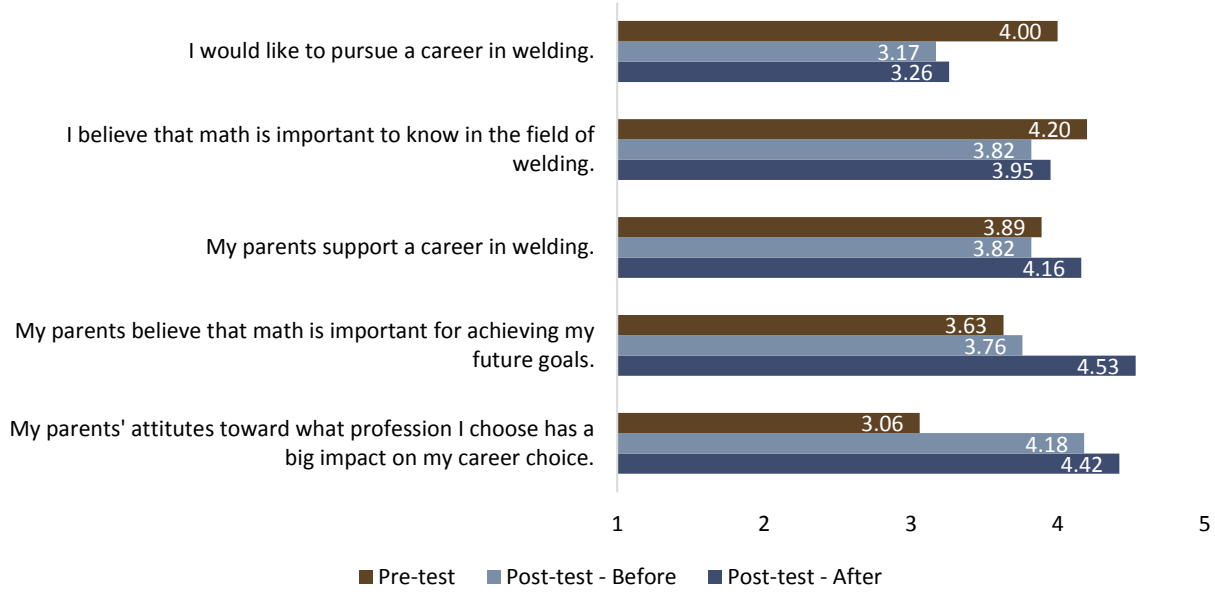

Figure 7. Mean responses to survey items disseminated to students towards the beginning of the Fall 2016 semester and again towards the end of the Fall 2016 Semester in counterfactual format (1 = strongly disagree, 5 = strongly agree).

Engagement was also measured using a 12-item Student Engagement Scale (Appleton, Christenson, Kin, & Reschly, 2005; see Appendix B). Students were asked to indicate the extent to which they agreed or disagreed to a series of items. As before, these questions were presented toward the beginning of the semester, then once again toward the end of the semester in counterfactual format. Overall, students reported higher agreement with engagement items at the end of the term (m=4.30), and hence, reported higher levels of student engagement (see Figure 8). This finding was most pronounced when compared to the "counterfactual before" responses provided at the end of the term (m=3.41), then with the "pre-test" items provided at the beginning of the term (m=3.89).

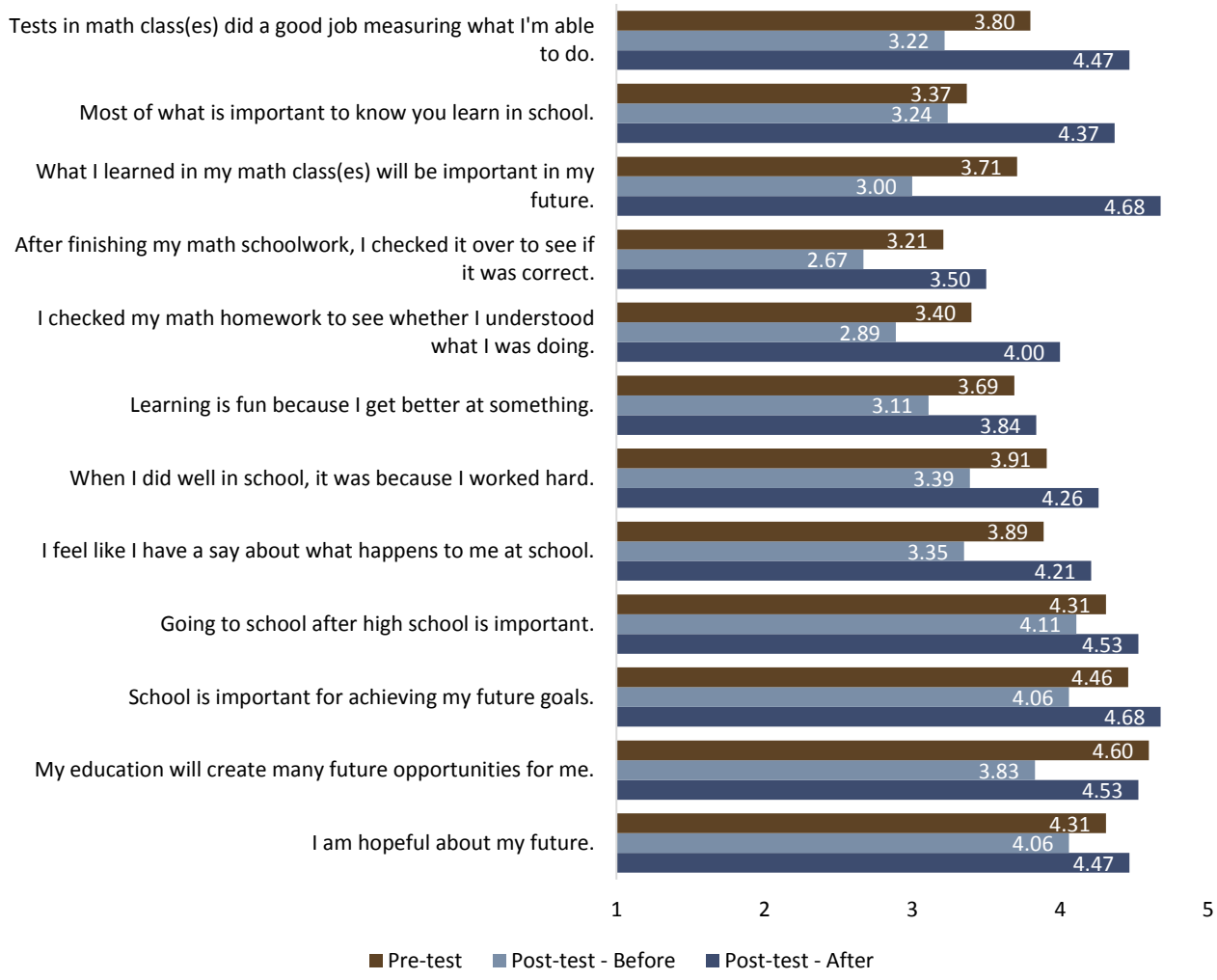

Figure 8. Mean responses to engagement survey items disseminated to students towards the beginning of the Fall 2016 semester and then again at the end of the Fall 2016 semester in counterfactual format (1 = strongly disagree, 5 = strongly agree).

Performance among Math 1 – Trades Students

A math test was distributed at the beginning and end of the semester to both the control and enhanced groups to determine if the modified course impacted on actual performance. To standardize performance, the mean difference score rather than the mean actual score was utilized. A difference score was calculated by subtracting the pre-test score from the post-test score. Only students that completed both tests were included.

Overall, the enhanced NWTC group outperformed the control NWTC group, while the two high school groups performed similarly when examining the difference scores (see Figure 9). The two high school groups had similar pre- and post-test scores. This finding could be because the high school students had taken math courses more recently and consistently than the NWTC students. In trying to interpret these findings it became apparent that there were differences across the control and enhanced groups that could be attributed to more than differences in the presence or absence of the enhanced math course. For instance, the control NWTC course was taught using a different format. Additionally, conversations with high school instructors as well as the project team's understanding of the high schools suggest that the control and enhanced conditions may not have been implemented to fidelity.

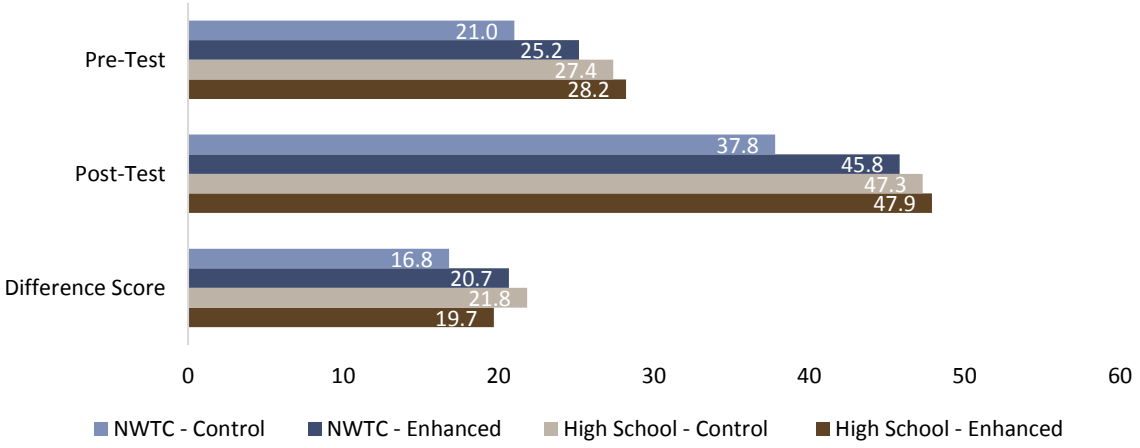

Figure 9. Mean scores for the math test given to students towards the beginning and at the end of the Math – 1 Trades course. Only students who completed both tests are included in the analysis (n = 129). The tests were out of 67 points.

Results from this instructor's course from Fall 2014 were compared against the results from the instructor's course in Fall 2015, allowing the instructor to serve as her own "control" group.[7] Although the post-test scores from both classes were approximately equal, the 2015 class exhibited greater improvement in test scores (see Figure 10). Additionally, the difference in performance was statistically significant, indicating that there is a less than 5% probability that the observed changes in scores occurred solely by chance. This trend continued for the 2016 class as well, although the improvement in difference scores was not as large.

[7] Similar data were not available for the other instructors.

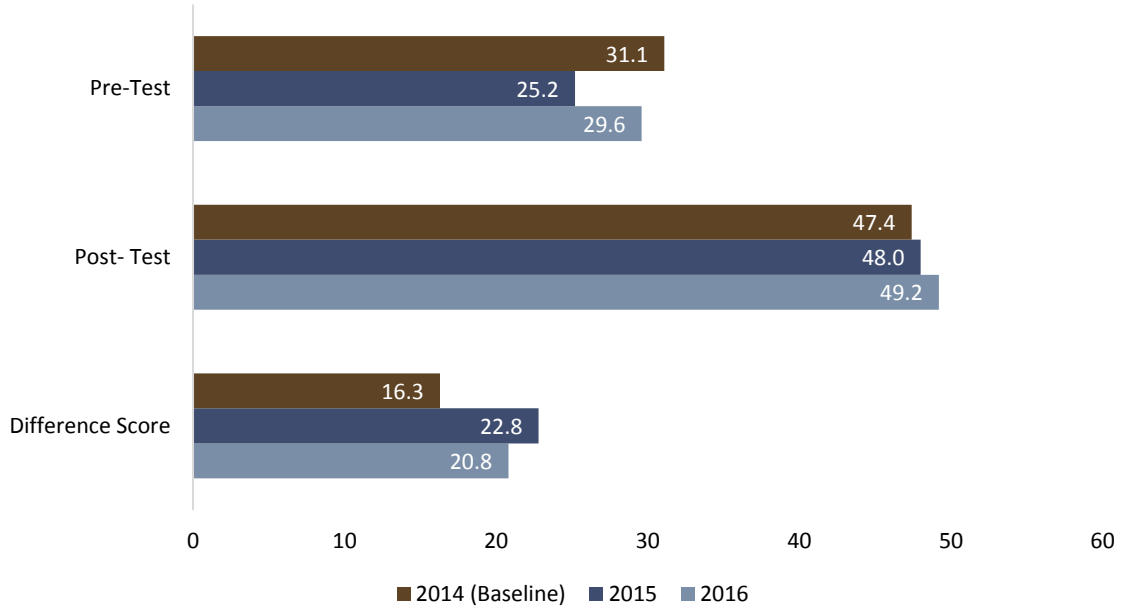

Figure 10. Mean scores for the math test given to students in one instructor's classes towards the beginning and at the end of the Math – 1 Trades course. The tests were out of 67 points.

Outcomes of Project on Instructors

The project hypothesizes that instructors who deepen their skills will have a positive impact on the production of skilled workers. Towards that end, instructors participated in the monthly learning community meetings and other professional development activities. A skills test was disseminated in early Fall 2014 and again in late Fall 2015, the first year of the project, to assess cross-functional knowledge (e.g., welding for math instructors and math for welding instructors; see Table 3). During Year 2, interviews were conducted to provide additional context regarding cross-functional knowledge. Together, these findings suggest that there was an increase in skills for both math and welding instructors' cross-functional knowledge. In Year 3 no additional data were gathered as the project was working with the same group; however, it is valuable to note that the group has indicated a willingness to continue the meetings, demonstrating the value of these meetings to the individuals of the group.

Results of the Cross-Functional Knowledge Test		
2014 (pre-test)	**Math Test**	**Welding Test**
Math Instructors	---	Mean = 16. 17 (range: 0 – 31)
Welding Instructors	Mean = 16.25 (range: 11 – 24)	---
2015 (post-test)	Math Test	Welding Test
Math Instructors	---	Mean = 23.50 (range: 20 – 26)
Welding Instructors	Mean = 31.25 (range: 29 – 34)	---

Table 4. Mean (range) score items correct on cross-function knowledge test.

Additionally, attitudes towards supporting students in a welding training program were assessed. These measures were completed at the same time as the skills test. The math instructors greatly increased their understanding and attitudes towards welding over the course of the semester. After a year of participating in the learning community meetings, math instructors viewed welding more positively and are more interested in incorporating welding

concepts into the Math – Trades 1 course (see Figure 11). These findings suggest that welding instructors already held high regard of teaching math concepts (see Figure 12).

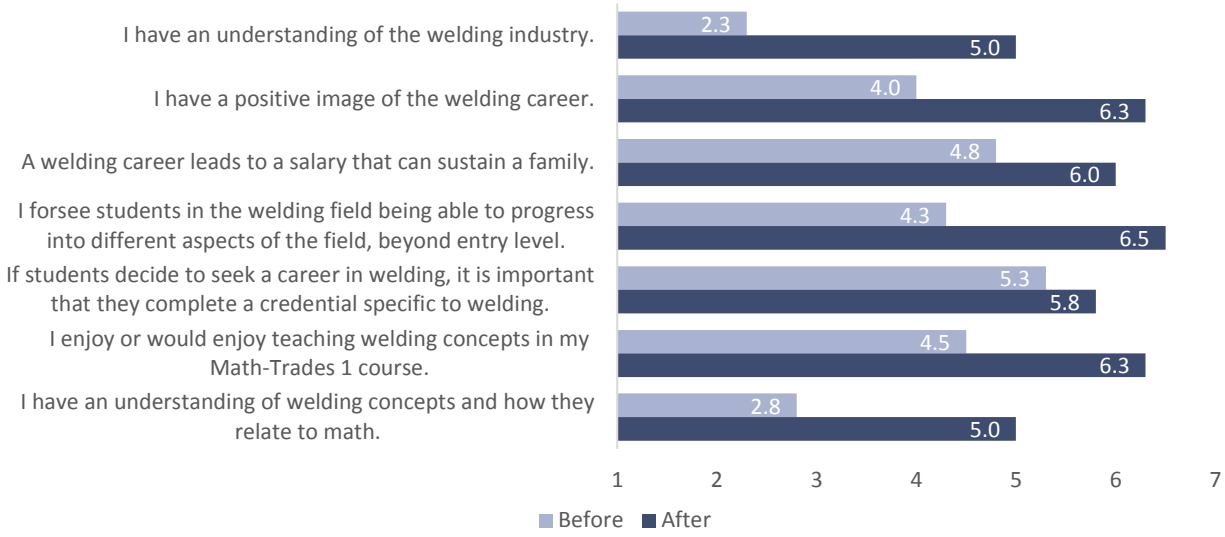

Figure 11. *Mean responses to attitude counterfactual questionnaire items related to the welding profession for math instructors disseminated at the end of the Fall 2015 semester (1 = strongly disagree; 7 = strongly agree).

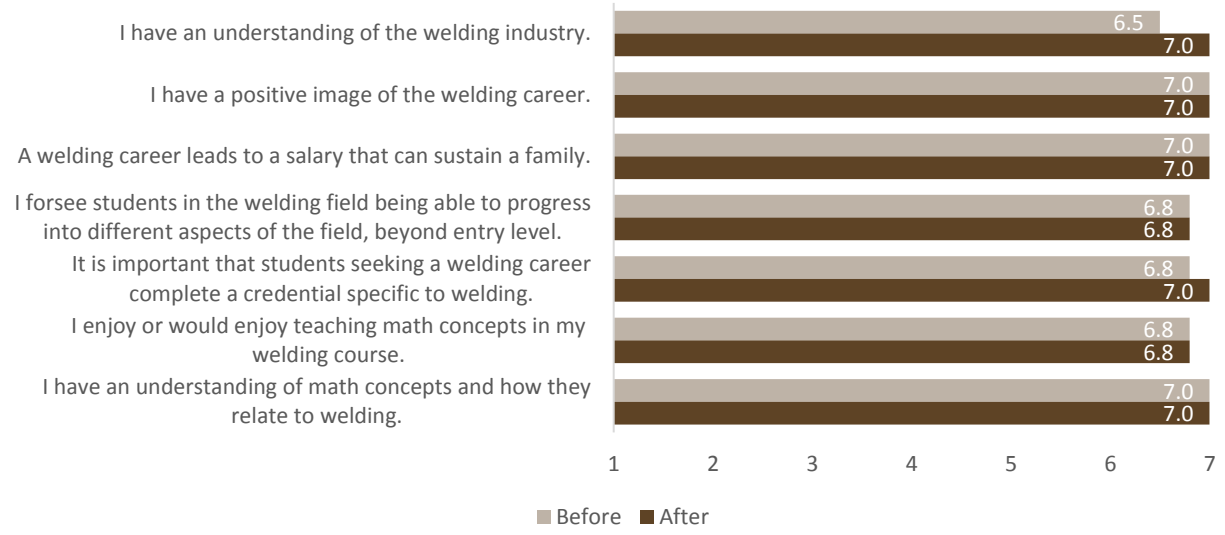

Figure 12. *Mean responses to attitude counterfactual questionnaire items related to the welding profession for welding instructors disseminated at the end of the Fall 2015 semester (1 = strongly disagree; 7 = strongly agree).

Similarly, over time math instructors increased their perception of the importance of doing well in science and math courses in order to be successful in a welding career but already understood the importance of English and Language Arts (see Figure 13). These findings also suggest that welding instructors already understood the importance of doing well in the targeted academic areas (see Figure 14).

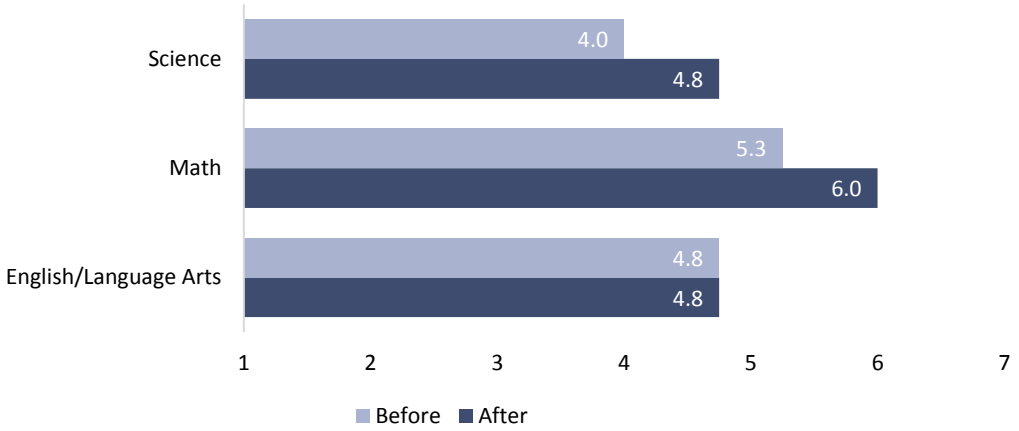

Figure 13. Mean responses to attitude questionnaire items related to the importance of specified academic areas for math instructors disseminated at the end of the Fall 2015 semester (1 = strongly disagree; 7 = strongly agree).

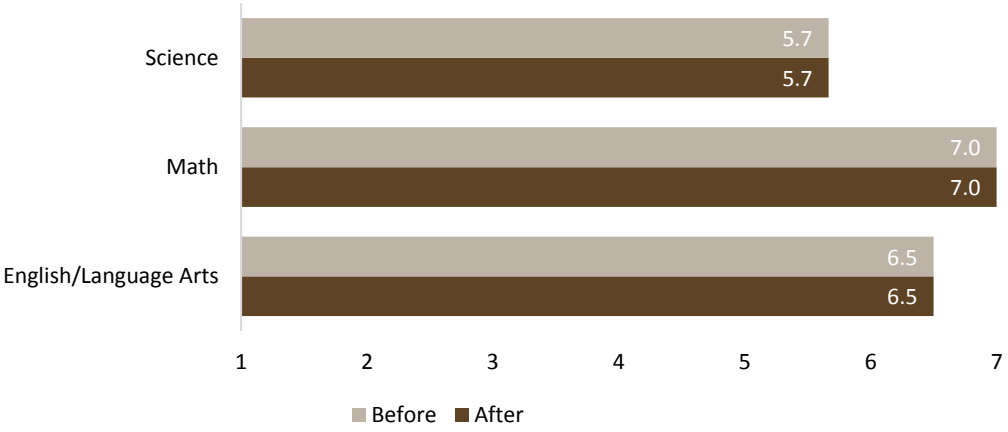

Figure 14. Mean responses to attitude questionnaire items related to the importance of specified academic areas for welding instructors disseminated at the end of the Fall 2015 semester (1 = strongly disagree; 7 = strongly agree).

As reported in Year 1, interviews with the NWTC project team suggest that the instructors' experiences with the learning community meetings and professional development opportunities were very positive. For example, meeting minutes from the monthly meetings suggest high attendance and regular attendance consistent with highly engaged individuals. Additionally, the project team and instructors highlighted the following outcomes:

- By engaging in the monthly learning communities there is a deeper understanding of the needed skill sets to teach the dual-credit course;
- The professional development opportunities helped to identify additional ways to contextualize math within welding; and
- Through the learning communities, there is now overall greater collaboration among these instructors.

Evaluative Question #3: How are the activities making a difference in enrollment and retention?

The purpose of this evaluative question is to focus on how the activities are improving enrollment and retention within the program. Overall, the project has taken steps to increase awareness and interest not only in the project, but welding in general. The industry tours during the 2015-2016 academic year, which had 140 students participating, increased students' overall understanding and interest in pursuing welding as a career.

Professional development opportunities, such as the *Welding for Non-Welding* sessions, increased the knowledge and understanding of welding for non-welding instructors, many of whom now want to incorporate welding concepts into their courses. Over the course of this project, industry tours were also held for prospective high school students of all grade levels (i.e., freshman to senior). Of the 177 high-school students who attended tours at NWTC, only 7% (n=13) enrolled at NWTC. While this rate initially seems small, further investigation shows that only 18 of the 177 students were high-school seniors, showing a 72% enrollment rate for students qualified to enroll the following year (see Table 5).

Student Matriculation Summary			
Tour Year	**Total Participants (FR, SO, JR, SR)**	**Total Senior participants (at time of tour)**	**Students transitioning to NWTC**
Spring 2015	18	1	3
Fall 2015	95	15	7
Spring 2016	64	2	3
Total	**177**	**18**	**13**

Table 5. Overview of Student Matriculation from Tour Participation (Spring 2015 – Spring 2016).

Evaluative Question #4: What is the impact the program is having on the industry?

The modified Math 1 – Trades Course was not fully implemented among all the partnering schools until Fall 2016. As a consequence, full impact of the program on industry is not yet available. However, it is useful to present baseline data that will ultimately serve to address this evaluative question, such as, the number of welding graduates and the percentage of welding graduates who are employed. Figures 15 and 16 present these data for academic years from 2011-2016 along with the five-year average covering that timeframe (NWTC, 2016). Both the number of graduates and employment rates are remaining relatively high.

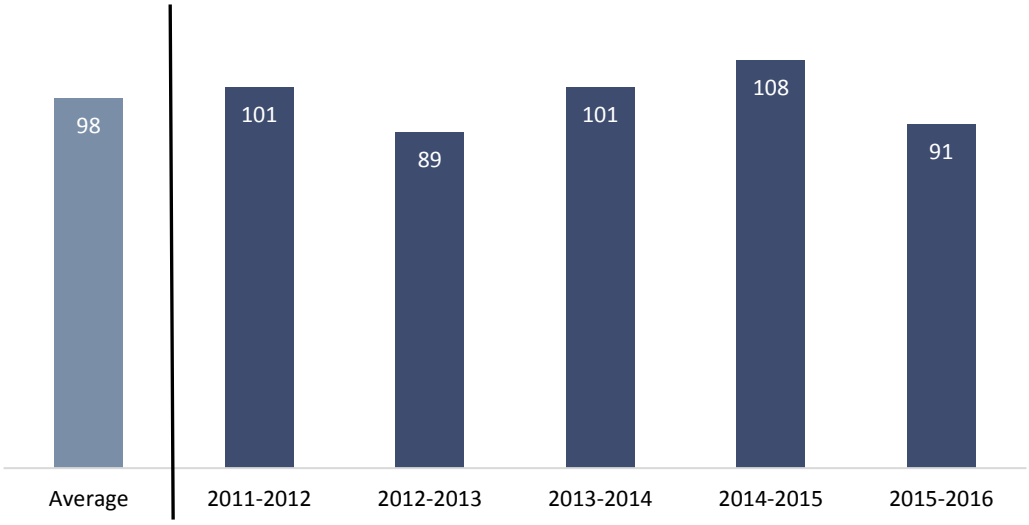

Figure 15. Number of welding major graduates for the academic years from 2011 – 2016 along with the five-year average.

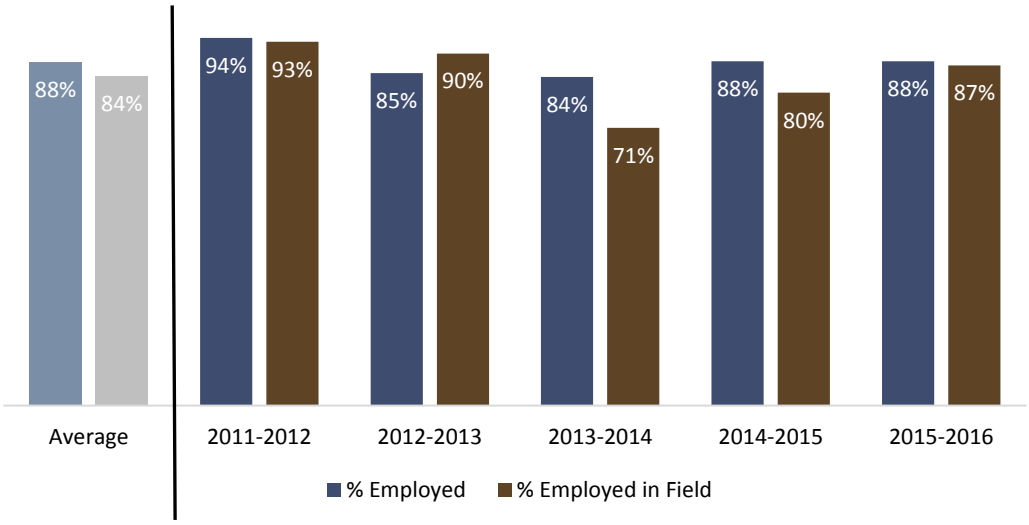

Figure 16. Percentage of welding major graduates for the academic years from 2011 – 2016 who are employed (e.g., portion of survey respondents available for employment reporting full- or part-time employment approximately 6 months after graduation) and employed in the field (e.g., portion of survey respondents reporting employment who have a job related to their specific program of study).

Recommendations

As recommendations for moving forward into the fourth year of funding are made, it is important to consider two key points. One point of consideration is that implementation of the project appears to be proceeding well with all Year 3 activities occurring as planned. Additionally, credible evidence of the difference the project is having on math performance is emerging. Another important component to consider, is that the project team implemented the recommendations from the Year 2 evaluation, which included continuing to implement activities with similar levels of quality, discussing the findings from the enhance and traditional (e.g., control versions of the Math 1 – Trades course

with members of the learning community, and considering expansion of learning communities to include welding and math instructors.

With that as context, the following two (2) recommendations are provided.

- Begin working towards the sustainability of the project after the grand funding period has concluded. The project team should reach out to industry representatives to expand opportunities to place program completers. This would ensure that individualized needs from potential industry partners were being met and promote further project sustainability.

- Continue to monitor enrollment data and program graduates' impact on industry. Additionally, by reaching out to industry partners, the project could conduct both an ongoing needs assessment and ensure that program graduates are fulfilling these needs.

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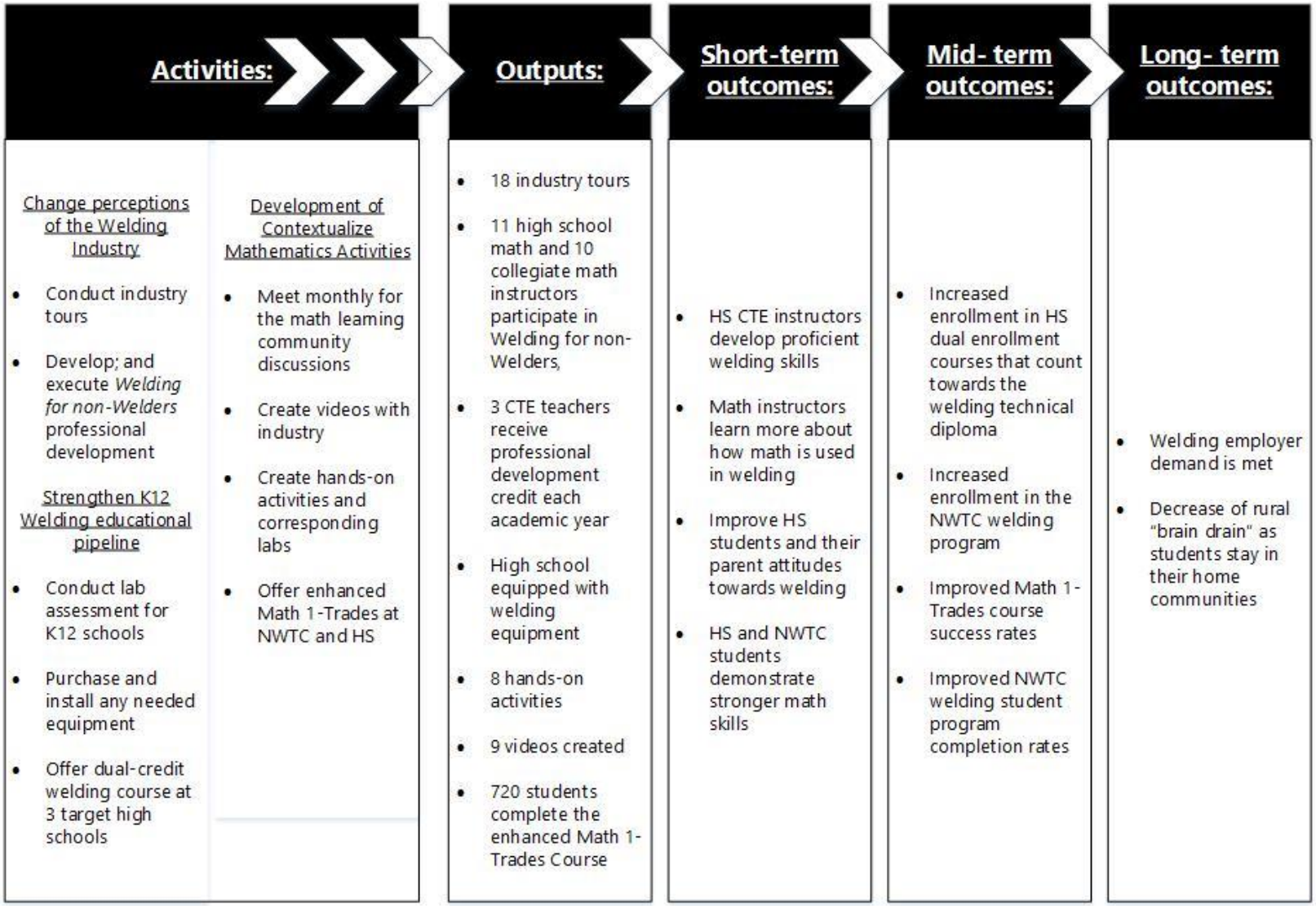
Appendix A – Welding: Wisconsin's Ultimate Rural STEM Pathway Logic Model



Appendix B – Course Satisfaction Survey[8]

1. Indicate the extent to which you agree or disagree with each item.

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
a. I feel at ease talking with my teacher outside of the classroom.	○	○	○	○	○
b. In general, my teacher attempts to be fair and objective in their presentation of course materials.	○	○	○	○	○
c. My teacher clearly defined how I will be graded.	○	○	○	○	○
d. My teacher cares about my success.	○	○	○	○	○
e. My teacher has been available for help outside of class.	○	○	○	○	○
f. I believe this class will prepare me well for future employment.	○	○	○	○	○
g. I believe this class will prepare me well for transfer to a 4-year institution.	○	○	○	○	○
h. Overall, I am satisfied with the class content in this class.	○	○	○	○	○
i. The amount of homework in this class was fair.	○	○	○	○	○
j. This class was interesting.	○	○	○	○	○
k. I am satisfied with how the class was taught.	○	○	○	○	○

[8] Items modified slightly from the original survey to be appropriate for a high school audience.

Appendix C – Focus Group Results from NWTC

NSF ATE Grant: "Welding: Wisconsin's Ultimate Rural STEM Pathway"
Focus Group, Fall 2014
NWTC: Monday, December 15th, AP208, 11:45 am

Purpose of Focus Group:
NWTC received a grant with a purpose of increasing the number of skilled welders in the area by integrating NWTC introduction welding classes into the area high schools and blending the welding and math classes together for students to see the importance and relevancy of math in the field. The surveys, tests, and this focus group are used in reporting the outcomes of the grant to the National Science Foundation and other schools who may want to participate in the model and activities produced. This focus group is to determine more details behind the reasons for responses on the survey that each Math 1 – Trades student took at the beginning and end of the semester.

Questions:

1. When thinking about a career what makes you want to do one thing over another? Is it the potential money? the amount of education? other factors?

    - **Don't necessarily need all the details of a project, just want to build it.**
    - **Knowing someone who is already doing the job (parents, grandparents, uncle)**
    - **Enjoy hands on work**
    - **Good wage**
    - **A lot of job opportunities**
    - **Allows for travel and work in other areas**
    - **Being able to get school done quickly and get into the field as soon as possible, some would rather start working quickly versus becoming an engineer who are the "hard thinkers" and require more schooling**

2. How are you making these decisions?

    - **Family in welding.**
        - **Been around it, familiar.**
        - **Worked on a farm so made repairs there using welding skills.**
    - **Enjoyed it in high school**
    - **Enjoy welding much better than a current job (farming)**
    - **Didn't want to go to 4-year school. (At least 3 students mentioned this one.)**

3. Who are some individuals who are helping you decide on what career to go into?

    - **Parents encouraged going into the Welding field after student showed interest.**
    - **Grandparents were also supportive in the decision after student suggested welding.**
    - **High school shop teachers helped map out pertinent classes.**
    - **High School Counselors recommended NWTC for welding program.**

4. What about high school counselors? High school tech ed instructors? NWTC recruiters? Family members (e.g., parents, other individuals)?

    This was answered above.

5. Are your parents influencing your decision? In what way? What are they saying? What are they encouraging/pushing you to do?

   Parents offered encouragement after students expressed interest in high school. They generally said that a student should continue a career path that builds on their interests. Many parents knew that a 4 year college was not in their child's future.

6. Now that you're in the program?

   In support:
   - **Parents are still supportive and encouraging.**
     - **Parents are supporting by fixing car so he could go to work and school.**
     - **Parents purchased more expensive tools.**
     - **Parents paid tuition.**
   - **Uncle is a welder that shares expertise.**
   - **Friends are generally supportive, but it's hard when they work at night and student is in class during the day.**
   - **Helps girlfriend with her biology and she helps him with math.**

   Not supportive:
   Focus group brought up that they might drop out without support. Some reasons mentioned were:
   - **If someone was pushing for something else it would be mentally exhausting to continue.**
   - **While on waitlist, the current employer didn't want student to leave so he offered a raise. Made it a hard decision to still go on to NWTC.**
   - **Friends are generally supportive, but it's hard when they work at night and student is in class during the day. This reason was brought up in both supportive and unsupportive.**

7. What did you think about welding as a career option before taking this course? What do you think about it now?

   - **Before taking courses, they thought it was easy, now a little more challenging and fun.**
   - **Seemed simple in high school, now it's more complex.**
   - **Though it was an easy career choice to go from HS, to TC, to workforce.**
   - **Wasn't what they expected—a lot more into it than HS—mentioned certain courses.**
     - **Learned more in 2 months here than in HS.**
     - **Thought only geometry was useful as far as Math. Now realized that because of welding math is much more important. An example mentioned was, in mental fab circumference, area, etc. are necessary skills.**
     - **In HS thought math was useless. Now applying math to everyday. Should have paid attention more in high school math class. *Trig is important.**

8. For those of you who are interested in pursuing welding:

   One of the nine stated they might go to 4 year but good to have welding as a fall back. The rest are planning on staying in the field.

   a. When did you first become interested in welding as a career? **Mostly in high school.**

What would keep you from ultimately finishing with a certificate or an associate's degree? **No one seemed to think at this point this would happen.**

b. Do you foresee moving into positions other than being a welder? Do you think having a strength or weakness in math has an effect on the possibility of advancing within the welding career and related careers?

Everyone one thought they would continue on with welding but would expand their certificate. Some suggestions were:

- **5 year apprenticeship, join union, become Journeyman Welder.**
- **Thinking of going to Seattle to train for underwater welding.**
- **Go where the money is good.**

What would prevent you from getting the technical diploma?

- **Going to work. Most classes are during 1st shift.**
- **Medical reasons**
- **Military deployment and training**
- **Family or relationship problems**
- **Laziness**

9. For those of you who are not interested in pursuing welding: **N/A**
   a. What do you know what you will pursue? When did you first become interested in that career option? What influenced your decision to pursue that field?
   b. Is math as important to that career option as it is to welding? **YES. Examples given:**

- **In laying out an elbow, but not knowing your math, you won't be able to complete the project. This would not only hinder the project but also your career.**
- **Knowing how long something is/measurements are important.**
- **The more you understand about math the faster you can move on to next step in career path.**
- **Fractions to decimals are really important.**

The group expanded on the math aspect:
There is a need to work with the HS more with welding, automotive, and wood tech. High school students don't know there are different ways to weld. Teaching them the basics should be done in high school so they are better prepared for this program. Putting more practical math into HS is also needed. The focus group agreed that they were totally unprepared in regards to Math when getting here.

Appendix D – Focus Group Results from Bonduel High School

NSF ATE Grant: "Welding: Wisconsin's Ultimate Rural STEM Pathway"
Focus Group, Fall 2014
Bonduel High School: Monday, December 22nd, 1:52 pm

Purpose of Focus Group:
NWTC received a grant with a purpose of increasing the number of skilled welders in the area by integrating NWTC introduction welding classes into the area high schools and blending the welding and math classes together for students to see the importance and relevancy of math in the field. The surveys, tests, and this focus group are used in reporting the outcomes of the grant to the National Science Foundation and other schools who may want to participate in the model and activities produced. This focus group is to determine more details behind the reasons for responses on the survey that each Math 1 – Trades took at the beginning and end of the semester.

Questions:

1. When thinking about a career what makes you want to do one thing over another? Is it the potential money? the amount of education? knowing someone who is already doing the job? other factors?
    - **Job openings**
    - **Money**
    - **Whether or not you have to sit in an office**
    - **If you enjoy what you are doing were all brought up.**
    - **Most of the group reiterated job openings.**

2. How are you making these decisions?

Influence of people such as:

- **Parents taught them some welding growing up**
- **Friends who have similar interests**
- **Grandpa and uncle share skills and knowledge**
- **Dad recommended getting a job that was easy on the body.**

3. Who are some individuals who are helping you decide on what career to go into?
    a. What about high school counselors? High school tech ed instructors? NWTC recruiters? Family members (e.g., parents, other individuals)?
    - **Like mentioned above, friends, parents, and other family members do influence a career decision but mainly encourage interests.**
    - **What others have said that they do not like influences them in what not to go into**
    - **Teachers and counselors help teach the pros and cons of a job. They show you things that could help out in the future such as recommending activities that they wouldn't generally advertise based upon the student's interest.**
    - **In Tech Ed there have been field trips that show the actual job to help students gain a better understanding of what the career actually is and what options are out there. One student also was hired at the place they toured. The Career Fair at KI was also mentioned as a way for students to learn more about the careers available and what they entail.**

4. Are your parents influencing your decision? In what way? What are they saying? What are they encouraging/pushing you to do?
    - **Parents are supportive of career choices in allowing the student to pick their own classes.**

- **Parents also encourage the student to research college degrees so they don't end up paying for a 4 year degree that isn't a good match for a desired career.**

5. What did you think about welding as a career option before taking this course? What do you think about it now?
    - **One student said after taking this course he is convinced welding is a field he would enjoy and wants to take more classes in this field.**

6. For those of you who are interested in pursuing welding:
    a. When did you first become interested in welding as a career? What would keep you from ultimately finishing with a certificate or an associate's degree?
        - **The student mentioned above stated that his father was a welder so after taking a welding course, and knowing he could go to his father for help; he realized he did enjoy it and is considering it for a career.**

    b. Do you foresee moving into positions other than being a welder? Do you think having a strength or weakness in math has an effect on the possibility of advancing within the welding career and related careers?
        - **We discussed trades in general as the students were not decided on a career. They stated math is important in all careers. There are always numbers involved. An example given was in farming. A student believed that if he didn't enjoy school, farming would be an option. He realized that math was very much a part of farming as well such as in taking measurements.**

7. For those of you who are not interested in pursuing welding:
    a. What do you know what you will pursue? When did you first become interested in that career option? What influenced your decision to pursue that field?
        - **Other careers mentioned were a Tech Ed teacher and CNC.**
    b. Is math as important to that career option as it is to welding?
        - **Answered above. The general consensus is that math is important in all careers.**

Additional information from the group:

Does the length of college affect career decision?
In going to a Tech School, you can get in and out quickly and get a job. The classes you are taking are training you for the job. At a 4 year, you take stuff you don't need and you may not like the career.
Education and technology also change so quickly. A concern brought up was if a job becomes obsolete.
1 person out of the group was planning on going to a 4 year college; this was the one who wants to become a Tech Ed instructor.

Focus Group:
The students also asked what we wanted in regards to the focus group. Val explained what a focus group was and that we did not want to influence their answers in any way. Rachel explained the purpose of the grant in that we would like to integrate math and welding, much like the students in Bonduel were already doing.
The students also asked if they could tour NWTC.
*****We will follow up with Brooke on this request.

Appendix E – Self-reported Attitudes for Instructor's Classes for both versions of the Course