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Chopin, Michael, A. A Survey of Students Enrolled in the Metals I Course at Waterloo High School Regarding Manufacturing Careers in Metalworking Occupations.

Abstract

The manufacturing sector of the economy has recently been hard hit, but current labor statistics indicate in the subsection of metalworking occupations, jobs have remained stable or shown growth. Yet many jobs are unfilled because applicants lack the higher level skills required. Thus is a challenge to educational institutions, particularly high schools, to develop 21st century technology education programs.

The purpose of the study was to survey Waterloo High School students' perceptions regarding manufacturing careers in metalworking occupations. Perceptions were sought about student career awareness, workplace environment knowledge, basic and technical skills, and post secondary training plans. Other factors influencing students, like school personnel, parents, and academics were also investigated. Study subjects were 24 males in the Metals I course. Descriptive research and survey methodology was used with a Likert Scale questionnaire. Data analysis was carried out by a panel that included the researcher, a counselor, the local vocational education coordinator, and the building principal. Findings revealed students perceive they have good career awareness, workplace environment knowledge, basic and technical skills, and post secondary training plans. Data showed little student influence from other factors. Importance of study results relates to rethinking the mission, structure, curriculum, and pedagogy of the school's technology education program.

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Chapter I: Introduction

While the manufacturing sector of the United States economy has been hard hit in the past decade by rapid growth in imports and global job outsourcing, leading to job loss for many Americans, it still remains of critical importance to the nation as well as to most states (Scott, 2008). The manufacturing sector made the highest contribution to gross domestic product growth between 2001 and 2006. For each manufacturing dollar generated there is an additional $1.37 in economic activity (National Association of Manufacturers, 2006).

Manufacturing has played important roles in Wisconsin's history and culture. Many of the industries from the 19th and 20th century are the center of the state's economy today (Manufacturing Performance Institute, 2000). The highest percentage of the state's workforce is still employed in the manufacturing sector. About 24 percent of Wisconsin's workers are employed in manufacturing, while at the national level it is 17 percent (Ward, 2000). Moreover, the Milwaukee region ranks in the top fifty United States metropolitan areas for employment in manufacturing (Schell, 2012).

Even in the community Waterloo, Wisconsin, where the population is 3227, three of the four major employers are focused on manufacturing that relied on metalworking occupations. These industries are Sussek Machine Corporation, which employs over 100 employees, Centerline Industries with about 25 employees, and Trek Bicycle Corporation that has approximately 1,600 employees.

In spite of the recession and other factors contributing to manufacturing job losses over the last several years, there are segments of the manufacturing industry where jobs have not been lost but have remained stable or seen growth. These segments include

metalworking occupations including welders, machinists, CNC specialists, tool and die makers, and mold makers.

Many stable and growing manufacturing occupations require basic academic knowledge, problem solving abilities, and higher-level technical skills. Modern manufacturing is often relies on automation and computerization. Many of these organizations do not have dirty work environments, low skill requirements, or guaranteed access to employment after high school.

Changes in manufacturing careers, and more specifically metalworking occupations, have raised concerns among employers who have jobs that are not filled because they cannot find skilled workers. Reggie Newson, Secretary for the Wisconsin Department of Workforce Development, was quoted as saying, "I can tell you the skills gap is definitely real. The employers, job creators, and H.R. practitioners I talk to on a daily basis say this is a significant issue" (as cited in Finkelmeyer, 2012, p. 20). Studies show most Americans believe manufacturing is important to our economic prosperity, our standard of living, and our national security. Less than a third reported they would encourage their children to go into manufacturing as a career" (Fabricators and Manufacturers Association, 2012).

Given the current availability of manufacturing jobs and careers in metalworking, educators at the high school level need to develop and implement career and technical education programs that will prepare tomorrow's workforce. As author J. Davis wrote in *Tech Direction*, "The greatest challenge for education in the next quarter century may lie in the demand for a competent skilled workforce that will enable American business and industry to compete in global markets" (Davis, 2006, p. 22). Career and technical

education programs need to go beyond competency-based curricula with predetermined performance objectives and address higher-order thinking, problem solving, and teamwork. Such programs can prepare students for entry level employment or give them a head start for post-secondary training, and at a minimum, spark an interest in careers that they would not consider without an introduction in school. James Wright (2009) wrote, "technology education has the potential to play a critical role in the success of world class manufacturing in the United States" (p. 27).

Statement of the Problem

Current labor market statistics show that there are manufacturing, and more specifically metalworking careers and jobs available and in some instances, they are growing in number. Furthermore, many employers are reporting that they are unable to fill the open positions because applicants do not meet today's expectations for higher-levels of basic and technical skills.

The availability of manufacturing careers in metalworking occupations, the misconceptions about these jobs, and the dissatisfaction with the available labor pool creates a host of issues for high schools technology education teachers to address. It is important that these teachers move away from behaviorism and begin developing and implementing programs that provide students up-to-date career awareness, work experiences, and skills that employers say they need in the 21st century workplace (Finch & Crunkilton, 1999).

The manufacturing industry has long been a vibrant part of the economy. Although the industry may have declined somewhat in numbers of employees, the literature suggests it does not diminish its importance (Henderson, 2012). There is a need

to study students' perceptions regarding the availability of jobs and careers in manufacturing and more specifically, metalworking occupations. There is also a need to gather their perceptions about the work environment associated with these jobs, the basic and technical skill proficiencies required to perform these jobs, and the need for post-secondary education. Lastly, there is a need to identify the factors that are influencing students' perceptions regarding metalworking occupations in the manufacturing sector. With this kind of information teachers can begin to explore best practices in career and technical education and implement a relevant program that prepares students for a future in manufacturing and metalworking occupations.

Purpose of the Study

The purpose of the study was to gather and analyze student perceptions about the technology education program at Waterloo High School to better prepare them for potential manufacturing careers in metalworking occupations. More specifically, the study addressed the following research questions:

1. What are the perceptions of 10th, 11th, and 12th grade Waterloo High School students enrolled in the Metals I technology education course regarding manufacturing careers in metalworking occupations?
2. What factors influence the perceptions of 10th, 11th, and 12th grade Waterloo High School students, enrolled in the Metal I technology education course regarding manufacturing careers in metalworking occupations?

Assumptions of the Study

The study was based on the following assumptions:

1. Although the United States is in recession and has high unemployment rates generally, there are currently manufacturing careers in metalworking occupations that high school students do not know about, have misconceptions about, or are not prepared for.
2. It is the traditional role of a high school technology education teacher, with employer involvement and support, to develop and implement programs that prepare students for entry into the workforce or the pursuit of post-secondary training.
3. Since the curricula for Introduction to Technology and Metals I courses addressed, in varying degrees, the nature of modern manufacturing (i.e. file conversion, tool path simulations, statistical process control, and print reading), the students participating in this study had adequate background knowledge to respond to the statements on the questionnaire in an informed and accurate manner.

Definition of Terms

The following definition of terms were adopted for the purpose of this study:

Career Awareness/Exploration. A class or lesson where students learn about different jobs and career opportunities and the skills needed to perform in those jobs or careers.

Introduction to Technology. An introductory technology education course at Waterloo High School that includes aspects of manufacturing, construction, communications, and transportation.

Local Vocational Education Coordinator (LVEC). A career and technical education leadership position mandated for high schools that want to receive federal funds.

Metals I. A technology education course at Waterloo High School that teaches welding techniques and modern manufacturing processes, including file conversions, tool path simulations, computer-aided manufacturing, and print reading (See Appendix D).

Metalworking Occupations. Jobs in the manufacturing sector that deal with metal, including CNC operator, welders, tool and die makers, and machinist.

Perceptions. Students' level of agreement with teacher developed statements about the study of metalworking, occupations related to metalworking, and plans for further education related to metalworking.

School Personnel. Faculty such as teachers and counselors that work at the Waterloo High School and address student's educational needs.

Technology Education. A program of study under the auspice of career and technical education that addresses manufacturing careers and more specifically, metalworking occupations.

Methodology

This study was descriptive in nature and utilized a survey methodology to gather the data needed to address the research questions. A researcher developed 24 item questionnaire to secure the perceptions of 24 10^{th}, 11^{th}, and 12^{th} grade Waterloo High

School male students enrolled in the Metals I technology education course regarding manufacturing careers in metalworking occupations. Each statement was followed by a five-point Likert consisting of strongly agree, agree, neutral, disagree, and strongly disagree. The statements addressed career awareness, knowledge of workplace, basic and technical skills, plan for post secondary training, and factors that influenced their perceptions about course work and future careers. The questionnaire, administered during class time, yielded data that was collated by question and then translated to frequencies and percentages. The data analysis was then carried out by the researcher along with a panel of colleagues comprised of the school counselor, the local vocational education coordinator (LVEC), and the high school principal. The results of the data analysis process were used to address the research questions, to formulate conclusions, and to propose recommendations for future endeavors.

Chapter II: Review of Literature

The purpose of this study was to gather and analyze student perceptions regarding manufacturing careers in metalworking occupations. More specifically, it examined the perceptions of 10th, 11th, and 12th grade students enrolled in the Metals I course at Waterloo High School.

The following review of literature was conducted to gather detailed information about manufacturing careers in metalworking occupations and how to prepare students for them at the secondary level. It also uncovered information on metalworking occupations. Lastly, it provided the background knowledge needed to develop the questionnaire used to measure the students' perceptions. It is divided into sections that address jobs/career availability, skills needed for jobs, role of school, and matching education with employer needs.

Jobs/Career Availability

Manufacturing has long been a mainstay of the American economy and there are many considerations that contribute to developing a skilled workforce. According to Eisen, Jasinowski, and Kleinert (2005), the largest manufacturing country in the world is having difficulty finding the skilled workers needed to remain competitive in a global economy. The talent shortages and skills gaps are having negative impacts on manufacturing firms. According to Still (2012), manufacturing firms in the United States have added about 330,000 jobs in the last two years, after nearly 30 years of decline. Even with the decline, Wisconsin still ranks first among the 50 States in manufacturing jobs per capita.

Wisconsin has been affected by the national decline in manufacturing jobs. "Wisconsin's ratio of manufacturing jobs to government jobs has been falling more slowly in Wisconsin than in the nation as a whole" (Peacock, 2010, p. 1). The ratio of manufacturing jobs to government jobs in a state is a good measure of a state's economic health. According to Peacock (2010), Wisconsin has the highest percentage of its workforce in manufacturing among all states. Peacock (2010) also stated the ratio of manufacturing to government jobs is a good measure of state's economic health and competitiveness. If it is a useful gauge of a state's economic vitality, then Wisconsin is far above most other states.

Waterloo, while being a small southeastern rural community, has several large manufacturing companies. Waterloo is the headquarters for Trek Bicycles whose products are sold worldwide in 90 countries. Sussek Machine Corporation also resides in Waterloo and utilizes CNC technology to perform machining processes on different parts for companies like John Deere. Waterloo is also home to a smaller manufacturing company.

According to Stills (2012), the nation has lost approximately 7.5 million manufacturing jobs since 1980. The peak of manufacturing in Wisconsin was in March 2000, when the state had around 600,000 workers in manufacturing, compared to around 450,000 jobs today. He argued the slide in manufacturing jobs is likely to continue as productivity increase due to advances in technology and the implementation of lean practices.

The recession that occurred in 2007 has affected jobs throughout the United States and the world. "Industries are affected differently, and the recovery for each industry can

occur at different paces and along different paths. These recovery paths for an industry are greatly influenced by a recession's impact on the industry" (Henderson, 2012, p. 65). Henderson (2012) argued the recession that began in December 2007 and ended in June 2009 contributed to the decline in employment at the end of 2010.

There is a shortage of workers to choose from for those in the manufacturing business. “More than 80 percent of employers indicated that they are experiencing a shortage of qualified workers overall” (Eisen, Jasinowski, & Kleinert, 2005, p. 1). According to Henderson (2012), within the sector, 32 of the 77 industries are projected to increase employment. According to Eisen, Jasinowski, and Kleinert (2005), many manufacturing firms are also dissatisfied with the quality of workers that they already employ. Their problems include poor attendance, inadequate problem-solving skills, and insufficient reading, writing, and communication skills. According to Eisen, Jasinowski, and Kleinert (2005), 83 percent of employers indicated that worker shortages are impacting their ability to serve their customers. The retiring baby boomers are reducing the available talent pool even further.

According to Eisen, Jasinowski, and Kleinert (2005), employers reported a moderate to severe shortage of scientists and engineers. These are highly skilled positions requiring a minimum of a four-year college degree. There is a declining percentage of students in United States colleges who are studying science and engineering.

According to Eisen, Jasinowski, and Kleinert (2005), there is also a shortage of qualified unskilled production employees. These jobs include machine operators and assembly workers. They also point out that job requirements are expected to include

some technical skill in almost every position, thus almost eliminating unskilled positions. According to Henderson (2012), the manufacturing sector that is projected to grow the fastest utilizes skilled worker to produce computer and electronic products.

"Many of the 40,000 jobs available on the JobCenterof-Wisconsin.com website require at least a technical degree but more than 65 percent of workers age 26 and older across the state have no such level of education" (Finkelmeyer, 2012, p. 20). These workers need to know what skills they need to be qualified for jobs that are in high demand. According to Finkelmeyer (2012), Wisconsin employers report they are having difficulty filling positions in manufacturing, specifically, CNC machine operators and welders.

Skills Needed for Jobs

"There is a growing disconnect between what today's workforce wants and what employers traditionally offer" (Eisen, Jasinowski, & Kleinert, 2005, p. 9). Manufactures are trying to address this disconnect by offering workers more than they in the past. According to Eisen, Jasinowski, and Kleinert (2005), the competitive wages, health care, and retirement benefits are givens and new employees are looking for other incentives like flexible work arrangements, tuition reimbursement, employee referrals, and professional development.

Many manufacturing firms are trying to determine what they need to do to remain competitive in the future. According to Eisen, Jasinowski, and Kleinert (2005), 74 percent of employers indicated that a high-performance workforce would be the largest factor influencing their company's success over the next three years. It was rated higher than new product innovation or increased customer service orientation. "The National

Association of Manufacturers report notes that smaller manufacturers rank finding qualified workers ahead of energy costs, taxes, and government regulations on the list of the problems most affecting their businesses" (Bernard, 2007, p. 22). "Seventy four percent of employers indicated that having a high-performance workforce will be key to their business success" (Eisen, Jasinowski, & Kleinert, 2005, p. 6). They need workers that are able to think on their own when there is a problem and to remedy the situation.

Manufacturing careers are more than just assembly line workers. Many jobs in manufacturing plants are professional positions occupied by educated people. According to Reese (2007), a wide variety of high paying jobs are available with annual salaries around 65,000 dollars. According to Bernard (2007), many people, including parents and counselors, consider manufacturing a dead-end profession.

Workers have been accustomed to developing skills that they can use for their entire careers. However, according to Ginsburg and Elmore (1998), over the last few decades, it has become apparent that workplace technology changes quickly. New technologies are introduced on an annual basis. Workers must understand how to cope with these annual changes and be able to embrace the changes and upgrade their skills.

Computer technology is becoming commonplace in many jobs, even jobs that never needed any technical skills in the past. According to Ginsburg and Elmore (1998) it is common for employees to expand their professional repertoire to include technology skills as a necessity instead of an extra employability skill. Technology has prompted significant reorganization of work settings, which means workers need to develop a more complete understanding of their workplace.

The manufacturing industry is increasingly relying on computer-integrated manufacturing as well as automated manufacturing technologies. According to Ginsburg and Elmore (1998), workers also need to be able to know how to use industry-accepted software packages ranging from word processing to computer-aided drafting (CAD). They must also be able to communicate to co-workers and customers via electronic mail and other electronic modes. Employers also expect workers to maintain a general understanding of computer functions. Workers must be able to use computers to help keep records, monitor inventory, and maintain quality control. Employees also must be able to keep files organized and in logical places.

Even as technology takes the place of some skilled labor, other aspects can become even more important. "Skilled machinists are still expected to correct malfunctions and monitor and inspect the performance of machining operations. Good Computer Numerical Controlled (CNC) programs may not run effectively if the particulars of the machine and material are not adequately taken into account" (Ginsburg & Elmore, 1998, p. 13). Technology is only as advantageous as the operator will allow it to be. If someone is not able to fully use the equipment, productivity will be lost. According to Albright and Smith (2006), modern manufacturing is using automation to increase productivity, however it takes more skill to develop programs to control the robots and other CNC systems. Students have to have an academic knowledge to be able to program computers that run the machines, as well as having knowledge and understanding of the machines' operations and functions.

Role of School

For over three quarters of a century the basic learning theory underlying the high school curriculum and instructional delivery of what was industrial arts, then vocational education, and now under the category of career and technical education has been behaviorism (Finch and Crunkilton, 1999). The behaviorist theory orientated program revolves around a set of distinct courses usually clustered around broad topics like manufacturing, construction, transportation, and communication as in the case of high school technology education programs. As a theoretical foundation, it is based on a competency based curriculum, structured toward industry needs and standards, and delivered through instruction that targets pre-determined performance objectives which include the learning setting, task, and standard (Finch and Crunkilton, 1999). In the behaviorism structure, students are provided specific knowledge and skills learning targets to acquire, teachers instruct using direct instruction techniques and both student and program evaluation is based on criteria referenced measures (Doolittle and Camp, 1999). It is on this theory that the Waterloo High School Technology Education program and curriculum is organized and implemented.

Many students are incorrectly pushed to pursue post-secondary education that is not right for them. According to Reese (2007), many students are told the only way they are able to make good money is to attend a four-year college. However, almost half of the students who go straight to a four-year college after high school end up dropping out. If these students were provided more guidance into what area of education they really require, then they would be likely to get the correct education to achieve their future goals.

Showing students that manufacturing careers are available is not always enough. "Research has shown a direct relationship between manufacturing's negative image, which is tied to the old stereotype of the assembly line, and the decreasing number of young people pursuing careers in the industry" (Eisen, Jasinowski, & Kleinert, 2005, p. 2). There are some manufacturing firms that are trying to change this stereotype by creating a clean and high tech environment. According to Eisen, Jasinowski, and Kleinert (2005), more manufactures are spending money on training programs that try to attract new workers than a few years ago.

Globalization has changed the manufacturing environment. This has also affected the way manufacturing is taught. While previously successful courses and curricula are still important, Mehrabi (2005) showed that new requirements are needed to emphasize hands-on experience, teamwork, innovation, and leadership practices. There are three features that should be introduced to the education system: rapid launch of new programs and adjustment of the capacity to demands, rapid integration of new functions and process technologies, and easy adaptation for a comprehensive response to variable demands.

One of the most important overall skills shown by Ginsburg and Elmore (1998) is the ability to learn on the job. It is vital for workers to recognize the importance of being able to adapt to changes in the workplace. This is crucial because the technology itself is constantly evolving. Workers need to be open for adapting to the changes as well as identifying them. This also means the employers need to be willing to train workers as the technology changes. They must be willing to stay on the cutting edge to stay viable in the global economy.

Manufactures are working with the public education system to address the skills gap. According to Eisen, Jasinowski, and Kleinert (2005), 32 percent of employers indicated they are working with schools including participating in career days, hiring students for internships, and having employees act as mentors to students. With budgets getting tighter for school districts, help from local manufactures is becoming more important to schools. According to Eisen, Jasinowski, and Kleinert (2005) 54 percent of employers have contributed space or equipment to schools and 43 percent have worked with schools on curriculum development.

According to Eisen, Jasinowski, & Kleinert (2005), employers must become more engaged in public education, working with educators on curricula, hosting field trips, and participating in career fairs. They also must provide internships and apprenticeships and generally give community schools opportunities to learn about manufacturing. It is important for manufacturing firms to show students there are numerous opportunities available to them if they work hard.

Matching Education with Employer Needs

As the world moves to a more highly competitive and global environment, the preparation of workers for entry and advancement in the workplace of the next decade requires an educational program that provides not only job skills, as provided based on behaviorist theory, but also skills centered around higher order thinking, problem solving, and teamwork. For career and technical education programs, especially at the high school level this involves a huge shift in both thinking and programming. Leaders in the general education subjects of mathematics, science, social studies, and English appear to have already made the shift. To make the change, the educator must move away from the

current instructional model of transmitting teacher knowledge of a discrete and establish set of skills to students and a move toward creating a program that focuses on students constructing their own knowledge and meaning from experience. This learning theory is called constructivism (Fosnot, 1996). It is often described as a continuum and divided into three categories. One of the categories, which is said to be most applicable to career and technical education, is called cognitive constructivism. A technology education program facilitating a constructionist learning environment would revolve around student discovery and gaining knowledge through problem solving strategies. Essential program factors for such a program would include:

1. learning taking place in a real world situation or simulation
2. learning involving social negotiation and mediation
3. learning of content and skills which are relevant to the student
4. learning that includes frequent formative assessment targeted toward future learning activities
5. learning where by the student is active in self regulation, is able to self mediate and is always self aware through metacognition strategies

From cognitive constructivism point of view the teacher in the instructional setting should be a facilitator of inquiry based and not an instructor teaching in a manner that is consistent with behaviorist theory. Moreover, constructivism promotes teachers as utilizing cause and effect teaching techniques that promote multiple perspectives and a variety of content (Doolittle and Camp, 1999).

Chapter III: Methodology

The purpose of the study was to survey the perceptions of 10th, 11th, and 12th grade students enrolled in the Metals I technology education course at Waterloo High School regarding manufacturing careers in metalworking occupations. Specifically, student perceptions were sought about their career awareness, knowledge of the workplace environment, basic and technical skills acquisition, and post secondary training plans. In addition, other factors influencing student perceptions like school personnel, parents, and academic programming were examined. The findings will be used to update the high school technology education program. The following narrative will describe the research design used to address the research questions.

Design of the Study

The research design for the study was descriptive and a survey methodology was used to gather data on a variety of variables. The independent was the completion of the Introduction to Technology and Metals I course at Waterloo High School. The independent variables were the respondents' perceptions regarding manufacturing careers in metalworking occupations included their career awareness, knowledge of work environment, acquisition of basic and technical skills, and plans for post secondary training. They also include perceptions about the factors that influenced the enrollment in the classes that including school personnel, parents, and academics. These variables were measured using a five-point Likert scale that reflected levels of agreement, neutrality, or disagreement with the variables. Data was also collected regarding each respondent's age, gender, and race.

Subject Selection

Subjects for the study were 24 10th, 11th, and 12th grade students enrolled in the Metals I course at Waterloo High School. All subjects were white males. All had taken the Introduction to Technology course prior to enrolling in the Metals I course. The subjects for this study were a convenient sample comprised of students that chose to enroll in the course where the questionnaire was administered. By virtue of their enrollment in the course, they were predisposed to expressing an interest in manufacturing careers in metalworking occupations.

Table 1

Questionnaire Subject Summary

Grade	Number
10	11
11	6
12	7

Table 2

Questionnaire Subject Demographics Summary

Grade Level	Male	Female	White	Hispanic	Black	Asian Pacific Islander	Native American
10	11	0	11	0	0	0	0
11	6	0	6	0	0	0	0
12	7	0	7	0	0	0	0

Instrumentation

The study instrument was a questionnaire developed by the researcher. It featured 24 statements focused on manufacturing careers and metalworking occupations. The questionnaire utilized a five-point Likert scale (i.e., strongly agree, agree, neutral, disagree, strongly disagree). All questionnaire statements were aligned to the study problem, purpose, and questions. The questionnaire was created to ascertain the perceptions of the students who were the study subjects (see Appendix B). A consent form was created to secure permission for participation in the study (see Appendix A).

Data Collection Procedures

The questionnaire was administered to study subjects during the two sections of the Metals I course. Subjects were allotted 42 minutes to complete the questionnaire. The questionnaire was administered on the last day of the Metals I course, which was first semester course in 2008-2009. Subjects were not required to reveal any information that would identify them thus keeping the survey anonymous.

Data Analysis

Data analysis began with numerical tabulation of questionnaire results. The raw data was entered into a Microsoft Excel spreadsheet in order to calculate the frequencies and percentages for each of the sub-ordinate variables. Data was then analyzed to address the research questions in a descriptive manner. The study design and methodology did not include statistical testing techniques. The data analysis was completed by the researcher along with a panel of colleagues comprised of the school counselor, the local vocational education coordinator (LVEC) and the high school principal. The panel examined and discussed questionnaire results for each of the sub-

ordinate variables in the two study questions. From the examination of data the researcher and panel members formulated conclusions, implications, and recommendations. See Appendix C for a complete overview of student questionnaire results.

Limitations

The limitations of the study were as follows.

1. The study was limited to only a small population of students in one Wisconsin high school and thus it is difficult to project findings to a larger population and universally across all high schools.
2. No attempt was made to establish the reliability, face validity, content validity, construct validity, predictive validity, or concurrent validity of the study questionnaire.
3. The study was limited to only the perceptions of males as no females were enrolled in the Metals I course where the questionnaire was administered.
4. Study subjects were predisposed to expressing positive responses to questionnaire statements by virtue that they elected to take the course where the questionnaire was administered over other elective courses in other occupational areas.
5. The study design and methodology did not include statistical testing techniques.

Chapter IV: Results

The purpose of the study was to secure and analyze student perceptions regarding manufacturing careers in metalworking occupations. More specifically it examined the perceptions and factors that influence the perceptions of 10th, 11th, and 12th grade Waterloo High School students enrolled in the Metals I Technology education course regarding metalworking occupations.

Respondents

Students enrolled in the Metals I technology education course at Waterloo High School were surveyed about their perceptions of manufacturing careers in metalworking occupations and factors which may influence those perceptions. A 24-item questionnaire was administered at the end of the 2008-2009 school year. All 24 students taking the Metals I course completed the questionnaire for a return rate of 100 percent. All students participating in the questionnaire had previously taken the Introduction to Technology education course in addition to currently being enrolled at the time of the survey in the Metals I course.

Perceptions about Metalworking Careers

The first research question addressed the perceptions of the students enrolled in the Metals I technology education course regarding manufacturing careers in metalworking occupation. More specifically, the students were asked to indicate their level of agreement with statements about their career awareness, workplace environment knowledge, basic and technical skills required, and intentions to pursue post secondary training.

Table 3

Student perceptions about their career awareness.

Survey Question	(SA) Strongly Agree	(A) Agree	(N) Neutral	(D) Disagree	(SD) Strongly Disagree	(NR) No Response
4. Metals courses have changed my perspective in making a career choice.	6 (25%)	8 (33%)	7 (29%)	2 (8%)	1 (4%)	0 (0%)
7. Metals courses provide students with information for a variety of potential job opportunities.	13 (54%)	7 (29%)	4 (16%)	0 (0%)	0 (0%)	0 (0%)
9. I have a better idea of the types of jobs or career field I might be interested in because of taking metals courses.	7 (29%)	9 (38%)	4 (17%)	3 (13%)	1 (4%)	0 (0%)
10. I consider myself well informed of the potential jobs and career choices that are available to me in the metals field.	7 (29%)	8 (33%)	8 (33%)	1 (4%)	0 (0%)	0 (0%)

Most of the students (83%) indicated the Metal I course at Waterloo High School introduced them to a variety of occupations in the metalworking field. Two thirds (67 percent) reported their increased career awareness created some interest in taking additional metalworking courses. Over half (63%) of the students signified they

considered themselves informed about career opportunities. About the same number of students (58%) showed the Metals I course changed their perspective on a metalworking career choice

Table 4

Student perceptions about the metalworking workplace environment.

Survey Question	(SA) Strongly Agree	(A) Agree	(N) Neutral	(D) Disagree	(SD) Strongly Disagree	(NR) No Response
8. Metals/ Manufacturing careers are only in dirty factories.	1 (4%)	0 (0%)	7 (29%)	8 (33%)	8 (33%)	0 (0%)
23. Metals/ manufacturing careers are only low skill jobs.	0 (0%)	0 (0%)	7 (29%)	4 (17%)	13 (54%)	0 (0%)

Just over half of the students (54%) responded that they know that metalworking careers are not only low skill jobs. Only one student (4%) strongly agreed and none of the students agreed with the notion metalworking occupations are only in dirty factories.

Table 5

Student perceptions about their basic and technical skills.

Survey Question	(SA) Strongly Agree	(A) Agree	(N) Neutral	(D) Disagree	(SD) Strongly Disagree	(NR) No Response
1. It is important to offer a broad based metals course offerings at the high school level.	17 (71%)	7 (29%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

(Table 5 continues)

Table 5 *(continued)*

Student perceptions about their basic and technical skills

Survey Question	(SA) Strongly Agree	(A) Agree	(N) Neutral	(D) Disagree	(SD) Strongly Disagree	(NR) No Response
2. Metals courses have contributed to help me prepare for my future educational career choice	11 (46%)	9 (38%)	2 (8%)	1 (4%)	1 (4%)	0 (0%)
3. Metals courses currently being offered are helping me acquire skills for making career choices in metals related field.	11 (46%)	11 (46%)	1 (4%)	0 (0%)	1 (4%)	0 (0%)
13. I plan on enrolling in additional technology education courses that are metals related.	12 (50%)	8 (33%)	3 (13%)	0 (0%)	0 (0%)	1 (4%)
15. I enjoy getting my hands dirty in the metals courses.	11 (46%)	11 (46%)	2 (8%)	0 (0%)	0 (0%)	0 (0%)
19. I have changed my metals/manufacturing career choice based on the type environment I would have to work in.	0 (0%)	2 (8%)	14 58%)	4 (17%)	4 (17%)	0 (0%)
22. I enrolled in a metals course so I could get more skills for a high paying job.	6 (25%)	10 (42%)	6 (25%)	2 (8%)	0 (0%)	0 (0%)

All of the respondents perceive importance of having a broad base of metals course offerings for their basic and technical skill development as related to manufacturing careers in metalworking occupations. Virtually all (90%) perceive they are acquiring good basic and technical skills in their metal course work and intend to take more courses. More than three quarters of respondents (83%) plan on enrolling in additional courses that are metals related. Two thirds (67%) of the students believed they would get more skills for a high paying job from the Metals I course. Most of the students (92%) reported they enjoyed working in a hands-on class where they get their hands dirty. Over half of students (58%) indicated they were neutral about having changed their metalworking career choice based on the type of environment.

Table 6

Students perceptions about their post secondary training plans.

Survey Question	(SA) Strongly Agree	(A) Agree	(N) Neutral	(D) Disagree	(SD) Strongly Disagree	(NR) No Response
5. I plan to enroll in a metals/manu-facturing course of study after high school.	5 (21%)	5 (21%)	10 (42%)	2 (8%)	1 (4%)	1 (4%)
17. I plan to attend a four-year school and maybe pursue a metals related major.	6 (25%)	5 (21%)	7 (29%)	2 (8%)	4 (17%)	0 (0%)

Somewhat less than half of the respondents (42%) perceive they will be pursuing post secondary training. The same number of respondents (42%) indicated they were

neutrality about a metals course of study after high school. Just under half (46 percent) of students enrolled in Metal I course plan to attend a four-year school.

The Schools And Parents Role

The second research question dealt with the factors the influence the perceptions of the students, enrolled in the Metals I technology education course, regarding manufacturing careers in metalworking occupations. More specifically, it examined the roles school personnel, parents, and academic factors play in shaping student's perceptions.

Table 7

Student perceptions about school personnel influence

Survey Questions	(SA) Strongly Agree	(A) Agree	(N) Neutral	(D) Disagree	(SD) Strongly Disagree	(NR) No Response
11. My guidance counselor suggested I take a metals course.	1 (4%)	1 (4%)	5 (21%)	8 (33%)	8 (33%)	1 (4%)
14. I made the decision to enroll in a metals course because of the teacher.	0 (0%)	6 (25%)	12 (50%)	3 (13%)	3 (13%)	0 (0%)

A few respondents (8%) indicated counselors influenced their decision to take metalworking courses and about a quarter of the respondents (25%) indicated teachers influenced their enrollment. Students did not have any strong perception positive or negative that the Waterloo Technology education teacher has a impact on whether or not

they decided to enroll in Metals I. Respondents did indicate that school personnel had little influence on their perceptions and career guidance.

Table 8

Student perceptions about parental influence on their thoughts and actions.

Survey Question	(SA) Strongly Agree	(A) Agree	(N) Neutral	(D) Disagree	(SD) Strongly Disagree	(NR) No Response
12. My parent/ guardian suggested I take a metals course to see if I would want to have a career related to metals.	2 (8%)	5 (21%)	8 (33%)	2 (8%)	7 (29%)	0 (0%)
20. One or both of my parents/guardian works in a metals/manufactu ring career.	3 (13%)	7 (29%)	4 (17%)	4 (17%)	5 (21%)	1 (4%)
21. My parent/ guardian suggested I take a metals course so I will have more skills for a hobby.	3 (13%)	2 (8%)	9 (38%)	8 (33%)	1 (4%)	1 (4%)
24. My parent/ guardian has a metals/ manufacturing job and I am interested in getting into the same career.	2 (8%)	3 (13%)	9 (38%)	4 (17%)	6 (25%)	0 (0%)

Nearly half of respondents (43%) indicated that they have parents in manufacturing and metalworking related careers. Nearly the same number (42%) indicated that they are not interested in going into the same career as their parents. Just under one third (29%) of students reported their parents or guardians suggested they take a metalworking related course to see if they would want a metals related career.

Table 9

Students' perception of other factors which shape their thoughts and actions.

Survey Question	(SA) Strongly Agree	(A) Agree	(N) Neutral	(D) Disagree	(SD) Strongly Disagree	(NR) No Response
6. I only enrolled in a metals course to see something different and have no plan in pursuing a career in metals/manufacturing.	1 (4%)	2 (8%)	8 (33%)	9 (38%)	4 (17%)	0 (0%)
16. I enrolled in a metals course because I can boost my G.P.A.	1 (4%)	2 (8%)	5 (21%)	9 (38%)	7 (29%)	0 (0%)
18. I do not have enough time to take more technology education courses because I have too many academic courses I need to take.	0 (0%)	1 (4%)	5 (21%)	10 (42%)	7 (29%)	1 (4%)

About two thirds of respondents (66%) indicated that academic factors such as grade point average and the need to take other academic courses did not influence their

decision to enroll in metalworking courses. Around two thirds (67%) of students enrolled in Metals I course at Waterloo High School without the idea that the course would boost their G.P.A. Just over half (55%) of students disagreed with the notion of enrolling in a metals course to see something different without any plans to pursue a metalworking career.

Chapter V: Discussion

The purpose of the study was to describe student perceptions regarding manufacturing careers in metalworking occupations. Securing such information was deemed essential to preparing students for successful employment in manufacturing careers and in metalworking occupations where the literature and labor market statistics show there are jobs those applicants with the skills needed to perform them. The study focused on the perceptions of students enrolled in the Metals I course at Waterloo High School regarding their current career awareness, knowledge of the workplace environment, acquisition of basic and technical skills, academic factors, and plans for post secondary education. More specifically, the study attempted to address the following research questions.

1. What are the perceptions of 10th, 11th, and 12th grade Waterloo High School students enrolled in the Metals I Technology education course, regarding manufacturing careers in metalworking occupations? Student perceptions were obtained according to various subordinate variables related to the questionnaire. The subordinates were awareness, workplace knowledge, basic and technical skills, and plans for post secondary training.
2. What factors influence the perceptions of 10th, 11th, and 12th grade Waterloo High School students, enrolled in the Metals I Technology education course, regarding manufacturing careers in metalworking occupations? Again, student perceptions were obtained according to various subordinate variables related to the questionnaire. The subordinates were what is the influence of school personnel, parents, and other academic factors.

To address these questions, a 24-item questionnaire was administered to the 24 10^{th}, 11^{th}, and 12^{th} graders. The respondents were all white males and had already taken the foundational Introduction to Technology course prior to the Metals I course where the questionnaire was administered. All students who were administered the survey responded. Data generated was summarized using a Microsoft Excel spreadsheets and reported in the form of frequencies and percentages.

Limitations

The limitations of the study were as follows.

1. The study was limited to only a small population of students in one Wisconsin high school and thus it is difficult to project findings to a larger population and universally across all high schools.
2. No attempt was made to establish the reliability, face validity, content validity, construct validity, predictive validity, or concurrent validity of the study questionnaire.
3. The study was limited to only the perceptions of males as no females were enrolled in the Metals I course where the questionnaire was administered.
4. Study subjects were predisposed to expressing positive responses to questionnaire statements by virtue that they elected to take the course where the questionnaire was administered over other elective courses in other occupational areas.
5. The study design and methodology did not include statistical testing techniques.

Conclusions

Based on an analysis of questionnaire data it can be concluded that at Waterloo High School:

1. Students perceive satisfaction with metalworking courses offered at Waterloo High School and plan to take more.
2. Students perceive they are acquiring needed basic and technical skills in metals courses, and see need for a broad base of offerings.
3. Students perceive they take metals courses because they want to, not because of counselor, teacher, parent, or other academic factors.
4. Students perceive satisfaction with the career awareness they receive about manufacturing careers in metalworking occupations.
5. About half of the students perceive they are going to pursue post secondary manufacturing career training in metalworking while about half either say they are neutral about post secondary training or will not pursue it.
6. Students are not heavily influenced by counselors, teachers, or academic factors in their perceptions about careers and course work as related to manufacturing careers in metalworking occupations.
7. Half of the students say they have parents in manufacturing careers or more specifically metalworking occupations. Half also perceive they do not want to go into the careers and jobs of their parents.

Recommendations

Based on data analysis and subsequent conclusions, two recommendations were formulated, one short term and one long term. Both are directed toward Waterloo High School's Technology Education program improvement plan so students can be better prepared for the expectations of the 21st century workforce as it relates to manufacturing careers and metalworking occupations.

First, there needs to be immediate communication and collaboration between the technology education teacher and school counselor so that students who perceive they are interested in future manufacturing careers in metalworking occupations know some form of post-secondary training will be needed. The results of the study suggest the students had good career awareness, but less than half indicated they were definitely going to pursue a post-secondary education. The evidence also suggests the counselor was of little influence when it came to registering for manufacturing and specifically metalworking courses. To the program's credit, the students reported they were getting good basic and technical skills training for manufacturing careers in metals working occupations. However, how do they know they are learning the correct skills without input and encouragement from their counselors? In most of today's high schools career information and technical skill expectations come from not only the technology education teacher through use of the new common career technical core standards, but also from the counselor's use of the new Wisconsin Counseling Model. In the new model students from K through 12th grade receive more in depth career assessment and awareness, have periodic parent, student, and counselor conferences and develop educational plans particularly around the career technical core standards. Not only is the communication

and collaboration between counselor and technology education teacher beneficial for students but it can encourage better parent involvement in their child's education so that students do not perceive, as nearly half did on the study questionnaire, that parents have little influence on the manufacturing/metalworking courses they take and that they are little interested in going into their parent's occupation.

The second study recommendation is more long range, but has the potential to totally transform the current technology education program at Waterloo High School so students are better prepared for what awaits them in their future careers and jobs. This second recommendation revolves around doing a thorough program needs assessment and developing a long-range plan for revision and updating. The perceptions expressed on the questionnaire about positive satisfaction with what they are learning in the current program is not directed towards 21st century career and technical education concepts. The current program's traditionalism can be found in the review of the literature. It is also evident in how the current program is structured. A more comprehensive and up-to-date review of literature and subsequent research is needed. There is also a need to enhance the dialogue between manufacturing/metalworking employers, the faculty and representatives of post-secondary institutions.

There are many different program evaluation models to be found in the education field. Many of the most highly used revolve around the old and simplistic, Tyler Model which is based on the questions, (1) where are we now, (2) where should we be going, (3) how will we get there, and (4) how will we know we are there (Tyler, 1969)? Through the Tyler model or whatever evaluation model may be chosen, Waterloo High School education can get beyond what was ascertained in the study.

References

Albright, C., & Smith, K. (2006, March 1). Welding--Trade or profession? *Techniques: Connecting Education and Careers*, *81*(3), 38.

Bernard, R. (2007, March). Workforce development for manufacturing. *Techniques: Connecting Education and Careers, 82*(3), 22-24.

Davis, J. (2006, October 1). Adopting industry skill standards can strengthen CTE. *Tech Directions*, *66*(3), 22.

Eisen, P., Jasinowski, J. J., & Kleinert, R. (2005). 2005 skills gap report: A survey of the American manufacturing workforce. *National Association of Manufactures, Center for Workforce Success, Deloitte Consulting LLP.* Retrieved May 3, 2008, from: http://www.nam.org/s_nam/bin.asp?CID=89&DID=235731&DOC=file.pdf

Fabricators and Manufacturers Association. (2012, July 2). *Manufacturing day aims to raise awareness of career options.* Retrieved July 25, 2012, from http://news.thomasnet.com/companystory/Manufacturing-Day-aims-to-raise-awareness-of-career-options-618497

Finch, C. R., & Crunkilton, J. R. (1999). *Curriculum development in vocational and technical education, planning, content, and implementation* (5th ed.). Boston, MA: Allyn & Bacon.

Finkelmeyer, T. (2012, July 18-24). Bridging the skills gap. *The Cap Times*, pp. 18 - 23.

Fosnot, C. T. (1996). *Constructivism, theory, perspectives, and practice*. New York, NY: Teachers College Press.

Ginsburg, L., Elmore, J., & Technologies, C. (1998, March). National Center on Adult Literacy. *Technology in the workplace: Issues of workers' skills. Technical report.* Retrieved January 29, 2008, from: http://www.eric.ed.gov/PDFS/ED417302.pdf

Henderson, R. (2012, January). Industry employment and output projections to 2020. *Monthly Labor Review, 135*(1), 65-83.

Manufacturing Performance Institute. (2005, September). *The Wisconsin manufacturing study: An analysis of manufacturing statewide and in Wisconsin's seven economic regions.* Retrieved July 25, 2012, from: www.mpi-group.net

Mehrabi, M. G. (2005). Lab system design in support of manufacturing engineering curricula. *Journal of Manufacturing Systems, 24*(3), 251-255. Retrieved January 29, 2008, from: ABI/INFORM Global database (Document ID: 1162093511).

National Association of Manufacturers. (2006). The facts about modern manufacturing (7th ed.). Washington, DC: The Manufacturing Institute.

Peacock, J. (2010, December). Wisconsin has nation's highest ratio of manufacturing jobs to government jobs. *Wisconsin Budget Project, 2,* 1-2.

Reese, S. (2007, March 1). Manufacturing success. *Techniques: Connecting Education and Careers*, *82*(3), 14.

Schell, T. (2012, July 18). *The Wisconsin manufacturing extension partnership announces a new downtown Milwaukee location.* Retrieved July 25, 2012, from http://finance.yahoo.com/news/wisconsin-manufacturing-extension-partnership-announces-151500362.html

Scott, R. (2008, February 12). *The importance of manufacturing.* Retrieved July 24, 2012, from http://www.epi.org/publication/webfeatures_snapshots_20080212/

Still, T. (2012, February 8). *Even in a manufacturing state, a diverse economy is vital for job creation.* Retrieved from: http:\\bizopinion.wisbusiness.com

Tyler, R. W. (1969). *Basic principles of curriculum and instruction*. Chicago, IL: University of Chicago Press.

Ward, D. (2000, November 30). High income strategies for the Wisconsin economy.

Wisconsin Department of Workforce Development, Division of Workforce Solutions, Bureau of Workforce Information. (2006, June). *Manufacturing: A Wisconsin industry perspective*. Retrieved July 25, 2012, from: http://dwd.wisconsin.gov /dwd/publications/dws/lmi/pdf/dwsi_15233_p.pdf

Wright, J. (1999, February). Teaming. *Technology Teacher*, *58*(5), 27.

Appendix A

Student Consent Form

I would appreciate your assistance with this research project on analysis of the perceptions of manufacturing careers by students enrolled in the metals course at Waterloo High School. The project is being conducted by Michael Chopin, from the University of Wisconsin – Stout, Technology Education Department masters degree research project. The research will help me determine if there is a need to change the perceptions of manufacturing careers. The study will also be able to determine positive perceptions and understand better ways to communicate them with students.

All your child needs to do is complete a short questionnaire, which should take approximately 10 minutes. Your child's participation is completely voluntary, so they have the option to skip questions or to stop participating at any time. If you or your child does not wish to participate, they may simply discard the questionnaire.

Responses will be completely anonymous; your child's name will not appear anywhere on the survey. You or your child's decision whether or not to participate will not affect your child's grade.

By completing and returning this consent form you are acknowledging that your child may participate in this study.

Keep this letter for your records. If you have any questions regarding the research, contact Michael Chopin, Technology Education Department, (920) 478-3633 ext 4154. If you have any questions regarding your child's rights as a research subject, please Research Services at 715-232-1126. Thank you again for your help.

This study has been reviewed and approved by The University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study please contact the Investigator or Advisor. If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB Administrator.

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"By signing this consent form you agree to participate in the project entitled, Analysis of the perceptions of manufacturing careers by students enrolled in the metals course at Waterloo High School."

_____

Signature..... Date

_____

Signature of parent or guardian (If under 18):..... Date

Appendix B

Waterloo High School
Technology Education Questionnaire
2008-2009

Directions: Carefully read each item and review the rating scale. **Circle** the number that best describes your individual view concerning each written statement.
5-Strongly Agree 4=Agree 3=Neutral 2=Disagree 1=Strongly Disagree NR =No Response

		SA	A	N	D	SD
1.	It is important to offer a broad based metals course offerings at the high school level.	5	4	3	2	1
2.	Metals courses have contributed to help prepare my future educational career choices.	5	4	3	2	1
3.	Metals courses currently being offered are helping me acquire skills for making career choices in metals related fields.	5	4	3	2	1
4.	Metals courses have changed my perspective in making a career choice.	5	4	3	2	1
5.	I plan to enroll in a metals/manufacturing course of study after high school.	5	4	3	2	1
6.	I only enrolled in a metals course to see something different and have no plan in pursuing a career in metals/manufacturing.	5	4	3	2	1
7.	Metals courses provide students with information for a variety of potential job opportunities.	5	4	3	2	1
8.	Metals/Manufacturing careers are only in dirty factories.	5	4	3	2	1
9.	I have a better idea of the types of jobs or career field I might be interested in because of taking metals courses.	5	4	3	2	1
10.	I consider myself well informed of the potential jobs and career choices that are available to me in the metals field.	5	4	3	2	1
11.	My guidance counselor suggested I take a metals course.	5	4	3	2	1
12.	My parent/guardian suggested I take a metals course to see if I would want to have a career related to metals.	5	4	3	2	1
13.	I plan on enrolling in additional technology education courses that are metals related.	5	4	3	2	1
14.	I made the decision to enroll in a metals course because of the teacher.	5	4	3	2	1
15.	I enjoy getting my hands dirty in the metals course.	5	4	3	2	1
16.	I enrolled in a metals course because I can boost my G.P.A.	5	4	3	2	1
17.	I plan to attend a four-year school and maybe purse a technical related major.	5	4	3	2	1
18.	I do not have enough time to take more technology education courses because I have too many academic courses I need to take.	5	4	3	2	1
19.	I have changed my metals/manufacturing career choice based on the type environment I would have to work in.	5	4	3	2	1
20.	One or both of my parents/guardian works in a metals/manufacturing career.	5	4	3	2	1
21.	My parent/guardian suggested I take a metals course so I will have more skills for a hobby.	5	4	3	2	1
22.	I enrolled in a metals course so I could get more skills for a high paying job.	5	4	3	2	1
23.	Metals/manufacturing careers are only low skill jobs.	5	4	3	2	1
24.	My parent/guardian has a metals/manufacturing job and I am interested in getting into the same career	5	4	3	2	1

Thank you for participating in this survey.

Appendix C

Table A1

Technology Education Questionnaire Results.

Question	SA	A	N	D	SD	NR
1. It is important to offer a broad based metals course offerings at the high school level.	17 (71%)	7 (29%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
2. Metals courses have contributed to help prepare my future educational career choices.	11 (46%)	9 (38%)	2 (8%)	1 (4%)	1 (4%)	0 (0%)
3. Metals courses currently being offered are helping me acquire skills for making career choices in metals related field.	11 (46%)	11 (46%)	1 (4%)	0 (0%)	1 (4%)	0 (0%)
4. Metals courses have changed my perspective in making a career choice.	6 (25%)	8 (33%)	7 (29%)	2 (8%)	1 (4%)	0 (0%)
5. I plan to enroll in a metals/manufacturing course of study after high school.	5 (21%)	5 (21%)	10 (42%)	2 (8%)	1 (4%)	1 (4%)
6. I only enrolled in a metals course to see something different and have no plan in pursuing a career in metals/manufacturing.	1 (4%)	2 (8%)	8 (33%)	9 (38%)	4 (17%)	0 (0%)
7. Metals courses provide students with information for a variety of potential job opportunities.	13 (54%)	7 (29%)	4 (17%)	0 (0%)	0 (0%)	0 (0%)
8. Metals/ Manufacturing careers are only in dirty factories.	1 (4%)	0 (0%)	7 (29%)	8 (33%)	8 (33%)	0 (0%)
9. I have a better idea of the types of jobs or career field I might be interested in because of taking metals courses.	7 (29%)	9 (38%)	4 (17%)	3 (13%)	1 (4%)	0 (0%)
10. I consider myself well informed of the potential jobs and career choices that are available to me in the metals field.	7 (29%)	8 (33%)	8 (33%)	1 (4%)	0 (0%)	0 (0%)
11. My guidance counselor suggested I take a metals course.	1 (4%)	1 (4%)	5 (21%)	8 (33%)	8 (33%)	1 (4%)

Table A1 (continued)

Technology Education Questionnaire Results

Question	SA	A	N	D	SD	NR
12. My parent/guardian suggested I take a metals course to see if I would want to have a career related to metals.	2 (8%)	5 (21%)	8 (33%)	2 (8%)	7 (29%)	0 (0%)
13. I plan on enrolling in additional technology education courses that are metals related.	12 (50%)	8 (33%)	3 (12%)	0 (0%)	0 (0%)	1 (4.%)
14. I made the decision to enroll in a metals course because of the teacher.	0 (0%)	6 (25%)	12 (50%)	3 (13%)	3 (13%)	0 (0%)
15. I enjoy getting my hands dirty in the metals course.	11 (46%)	11 (46%)	2 (8%)	0 (0%)	0 (0%)	0 (0%)
16. I enrolled in a metals course because I can boost my G.P.A.	1 (4%)	2 (8%)	5 (21%)	9 (38%)	7 (29%)	0 (0%)
17. I plan to attend a four-year school and maybe purse a technical related major.	6 (25%)	5 (21%)	7 (29%)	2 (8%)	4 (17%)	0 (0%)
18. I do not have enough time to take more technology education courses because I have too many academic courses I need to take.	0 (0%)	1 (4%)	5 (21%)	10 (42%)	7 (29%)	1 (4%)
19. I have changed my metals/manufacturing career choice based on the type environment I would have to work in.	0 (0%)	2 (8%)	14 (58%)	4 (17%)	4 (17%)	0 (0%)
20. One or both of my parents/guardian works in a metals/manufacturing career.	3 (13%)	7 (29%)	4 (17%)	4 (17%)	5 (21%)	1 (4%)
21. My parent/guardian suggested I take a metals course so I will have more skills for a hobby.	3 (13%)	2 (8%)	9 (38%)	8 (33%)	1 (4%)	1 (4%)
22. I enrolled in a metals course so I could get more skills for a high paying job.	6 (25%)	10 (42%)	6 (25%)	2 (8%)	0 (0%)	0 (0%)

Table A1 (continued)

Technology Education Questionnaire Results

Question	**SA**	**A**	**N**	**D**	**SD**	**NR**
23. Metals/manufacturing careers are only low skill jobs.	0 (0%)	0 (0%)	7 (29%)	4 (17%)	13 (54%)	0 (0%)
24. My parent/guardian has a metals/manufacturing job and I am interested in getting into the same career.	2 (8%)	3 (13%)	9 (38%)	4 (17%)	6 (25%)	0 (0%)

Appendix D

Waterloo High School
Course Syllabus

Course Number: 8431 Course Title: Metals I
Credits: .5
Pre-requisite: Introduction to Technology Instructor: Mr. Chopin

Course Description:

Students will learn a variety of metal working skills in Metal I. The welding phase will include the various welding operations in oxy-fuel, GMAW, SMAW, GTAW, and spot welding. Welding processes on mild steel, aluminum, and stainless steel will be included. Students will gain career awareness about metal related occupations.

Text:

Althouse, A. D., Turnquist, C. H., Bowditch, W. A., Bowditch, K. E., & Bowditch, M. A. *Modern welding*. Tinley Park, IL: The Goodheart-Willcox Company, Inc.

Course objectives: Linked with Wisconsin's Model Academic Standards for Technology Education.

1. To give the student knowledge of the tools and equipment of the metalworker.
    a. A.12.1 Contrast the increasing complexities of technology with its ease of use.
    b. B.12.5 Assess the impact new and improved products and services have had on the quality of life; explain how the development of new tools, materials, and processes is necessary to maintain and improve high productivity and quality.
    c. C.12.4 Select materials and other resources for a technological design and develop practical solutions.
    d. C.12.9 Apply basic engineering concepts in the design and creation of solutions to various problems or opportunities.
2. To give the student knowledge of the safety procedures involved with the use of tools and equipment in a metal shop.
    a. C.12.5 Identify constraints present in a given technological processes
3. To give the student an understanding of the basic metalworking materials.
    a. B.12.4 Illustrate how resources are essential to technological activity but that their availability and quality vary extensively throughout the world.
    b. B.12.7 Explain how new and higher quality products require new and high quality materials and processing techniques.
4. To give the student the ability to read plans and plan a metalworking project.
    a. A.12.7 Explain how scientific and technological research can contribute to improved quality of life and a better standard of living.
5. To give the student an opportunity to gain experience by working in the shop.
    a. B.12.8 Select and apply appropriate processes to transform information into its most useful format.

b. C.12.4 Select materials and other resources for a technological design and develop practical solutions.

Activity:

Week 1:

Overview of shop and Safety	1 hr
Introduction to Oxy-Acetylene welding	
Video – Oxy-Acetylene welding	1 hr
Demonstrate - Oxy-Acetylene torch setup	.25 hr
Start student practice Oxy-Acetylene welding	
Flat position, no filler rod	1 hr

Week 2:

Ongoing safety	
Continue oxy-acetylene welding without filler rod	1 hr
Introduce and demonstrate - use of filler rod	.25 hr
Continue oxy-acetylene welding with filler rod	2 hr

Week 3:

Ongoing safety	
Project - 3 inch weld in flat position	1 hr
Introduce - fillet weld	.25 hr
Continue oxy-acetylene welding on joints and fit up	2 hr

Week 4:

Ongoing safety	
Project - 3 inch fillet weld on a tee weld	1 hr
Introduce - SMAW safety and uses	
Video - SMAW welding	1 hr
Demonstrate - SMAW in flat position with 6013 rod on AC	.25 hr
Practice - SMAW with 6013 rod on AC voltage	1 hr
Introduce and demonstrate - oxy-acetylene cutting	.25 hr

Week 5:

Ongoing safety	
Introduce, discuss, and demonstrate - grinding and searing process	.25 hr
Continue SMAW welding practice	.5 hr
Introduce and demonstrate - DC voltage on 6013 rod	.25 hr
Continue SMAW welding on AC and DC voltage	1 hr
Introduce and demonstrate - 7013 welding rod	.25 hr
Continue SMAW welding on AC and DC with 6013 and 7018 rod	1 hr

Week 6:

Ongoing safety	
Project - 6 inch weld on 6013 AC, 6013 DC, and 7018 DC	2 hr
Introduce and demonstrate - fillet welds	.25 hr
Continue SMAW welding practice	1 hr

Introduce and demonstrate - Plasma cutting	.25 hr
Project - Cut a 3/8 thick piece of metal in half with oxy-acetylene	.25 hr

Week 7:

Ongoing safety	
Introduce - MIG welding	
Video - MIG welding	1 hr
Demonstrate - MIG welding in flat position	.25 hr
Project - 4 inch fillet weld on tee joint with 7018 rod 3/8 metal	1 hr
Introduce and demonstrate - cutting with bandsaw	.25 hr
Introduce and demonstrate - cutting and grinding with grinders	.25 hr
Practice - MIG welding in flat position	.5 hr

Week 8:

Ongoing safety	
Project - cut apart SMAW tee weld with plasma cutter	.25 hr
Continue MIG welding practice	1 hr
Introduce and demonstrate - MIG welding joints	.25 hr
Project - Metal Art, using scrap metal students create an animal	2 hr

Week 9:

Ongoing safety	
Practical - oxy-acetylene, setup, weld an inch, shut down	1.25 hr
Practical - SMAW, setup, weld an inch, shut down	1.25 hr
Practical - MIG, setup, weld an inch, shut down	1.25 hr

Week 10:

Ongoing safety	
Practice MIG welding joints	1 hr
Project - MIG Tee joint	1 hr
Introduce and demonstrate - TIG welding	.5 hr
Practice - TIG welding	1 hr

Week 11:

Ongoing safety	
Project - MIG bar cut and bevel with oxy, MIG weld and finish	2 hr
Introduce and demonstrate - TIG welding joints with filler rod	.5 hr
Practice - TIG welding joints with filler rod	1 hr

Week 12:

Ongoing safety	
Project - TIG weld 2 inch pipe on plate	1.5 hr
Introduce and demonstrate - TIG welding on aluminum	.5 hr
Practice - TIG welding on aluminum	1.25 hr

Week 13:

Ongoing safety	
Introduce and demonstrate - MIG spool gun on aluminum	.5 hr
Practice - MIG spool gun	1 hr
Project - aluminum weld, MIG or TIG	1.5 hr

Week 14:

Ongoing safety	
Introduce and demonstrate - TIG on stainless steel	.5 hr
Practice - TIG on stainless steel	1.5 hr
Project - TIG weld bead	1 hr
Resource - Speaker from Peterson Custom Stainless	1 hr

Week 15:

Ongoing safety	
Review - AutoCAD	.25 hr
Introduce and demonstrate - basic CNC techniques	.5 hr
Project - CNC cut wind chime	2.5 hr

Week 16:

Introduce - post-secondary schooling and careers	1 hr
Field Trip - Sussek Machine Corp.	2 hr

Week 17:

Paper - Research paper on a career in conjunction with guidance	1.5 hr
Presentation - Students present findings on careers	1.5 hr

Week 18:

Resource - Speaker from M.A.T.C. on post-secondary school	1 hr
Practical - TIG, setup, weld with filler rod, mild steel, shutdown	1.25 hr

Course Requirements/Assessments and Grading:

1. Lab Participation/Presentation 15%
2. Project Work 65%
3. Worksheets/Paper 10%
4. Final Practical 10%

General/Miscellaneous:

This syllabus is for student and instructional planning. It will be followed as closely as possible, but will only serve as a guideline. Any student having a need for special accommodations is encouraged to make their needs known to the instructor during the first class of the quarter.