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Cover

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Improving Educational Outcomes in Manufacturing Engineering Technologist and Technician Education (METTE) Programs

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Accomplishments

* What are the major goals of the project?

Major METTE Goals:

1. Acquire new knowledge about the key factors and program features related to enhanced student success; and
2. Use the results to strengthen the research-guided innovation capacity of METTE programs in technical and community colleges.

* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

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Major Activities:

Goal 1: To advance our knowledge generation goal, the major activities of the past four project years have centered on three areas: (a) Updating and expanding the statewide, longitudinal METTE Project Database, (b) Completing Research Data Analyses and Preparing Papers and other information resources, and (c) Expanding a focus on qualitative research to develop deeper insights about how, when, and when certain factors or practices influence METTE student success in technical college pathways.

(a) Across our four project years, we have continued to update the METTE project longitudinal database by including all students matriculating into the Wisconsin Technical College System through 2013-14. This database now contains the updated (as of March 2015) administrative, program, transcript, graduation/transfer, and labor market engagement data for the 2005-2014 cohort of beginning students. With records for more than 450,000 individuals who enrolled for credit during this 9 year period, we are able to identify a broad set of factors influencing student success, which is our primary research goal.

(b) We have continued to develop and release various publication resources (e.g. working papers, research briefs, conference presentations, as well as chapters and articles for peer-reviewed referred publications. As noted below, we have developed and released findings from 11 different studies over four years.

(c) Over the past 3 years we have developed and facilitated the work of four technical college Networked Improvement Communities (NIC). Led by the Engineering and Manufacturing Dean, the chief academic officer, and leaders from the Institutional Research Office, the NICs have used the METTE database to inform practices and innovations on each campus. This past year we have supported the NICs by developing several qualitative research protocols and procedures aimed at addressing campus level student success questions. Qualitative research

activities will include interviews, focus groups and/or surveys. This aspect of our research has allowed us to enrich our quantitative, quasi-experimental findings.

Goal 2: To advance our broadening impact goal, we have actively engaged in research dissemination activities by (a) preparing research briefs, (b) presenting new results at national conferences, (c) developing manuscripts for peer-reviewed journals, and (d) enhancing the capacity of the NICs to sustain research and evaluation activities aimed at improving METTE student success.

Over the final project year, our primary accomplishments have included the following:

- Establishing priorities for Year 4 outcomes and developing sustainability plans for each of the four NICs. As outlined below, we worked closely with each NIC to assist the key stakeholders (e.g., deans of manufacturing and engineering technology, institutional researchers, and program leaders) to advance their understanding and use of evidence-based, student success driven decision-making.
- Conducting two statewide meetings of the Local Leadership Teams (LLTs) to review, compare and expand findings and finalize next steps for innovations.
- Disseminating results at national, state and local conferences and seminars, including a state-called in July 2015 for all WTCS deans for manufacturing and engineering technology. Sixty-five state and local leaders of postsecondary METTE programs attended.

Specific Objectives:

Goal 1: Acquiring new knowledge about key factors and instructional practices associated with METTE student success.

As suggested above, under this goal we have pursued three specific objectives: (a) continue the expansion and integration of a statewide, longitudinal student-record data set, (b) develop and release publications and information resources with findings and recommendations, and (c) continue to develop four NICs at the partner technical colleges.

Objective A: Database Update and Expansion.

To support the analyses in this part of the study, the METTE project partnered with the Wisconsin Technical College System, the Wisconsin Departments of Public Instruction and Workforce Development, and four of Wisconsin's technical colleges to create the METTE Project database. This longitudinal database is designed to permit project researchers to identify and follow groups of students over time to identify program characteristics, student characteristics and enrollment patterns in METTE and non-METTE programs that correlate with various measures of student success. The METTE Project database consists of eight subfiles of various types of administrative records from a variety of sources augmented with an additional subfile of survey information from the Community College Survey of Student Engagement

(CCSSE) for a sample of students (n= 4,447) in four Wisconsin technical colleges. Staff from the WTC System Office assembled and provided the METTE Project with the database for all students enrolled in a postsecondary program in one of the sixteen technical colleges between FY2006 and FY2011¹ in February 2012. The WTCS delivered the original longitudinal database to the METTE Project staff in February 2012. In February 2013, March 2014, and April 2015 respectively, the WTCS provided annual updates of new to the original database and continuing enrollment records for students in the original database. Earlier in the project Dr. Washbon and Dr. Wang developed a data dictionary that details the coding of the variables in the longitudinal database as well as a number of constructed measures. The CCSSE file includes data on student engagement from a survey administered in Spring 2012. CCSSE data for students enrolled in FY2011 was added into the larger database in March 2013. To support data analysis work on individual partner campus, the student ID has been linked to locally maintained records. At FVTC for example, the locally useful records include the incoming ACCUPLACER test results. Placement data are not available in the state client records database because campuses use different placement exams and require different scores for admission to various programs.

Goal 1, Objective B: Develop and Release Publications on Student Success Factors and Practices.

The METTE project involves a massive amount of administrative and survey data, as well as institution-specific enrollment data and qualitative data collected during the project, based on which a series of targeted research questions have been, are being, and will be pursued. As of August 2015, we have completed 9 research studies and delivered study-focused presentations at 14 national and state conferences including the annual meeting of the American Educational Research Association, the Association for the Study of Higher Education, the Council for the Study of Community Colleges, the NSF-ATE Principal Investigators Conference, and the National Career Pathways Network. In the following, we discuss each of these analyses and studies and how they contribute to the knowledge base on METTE.

Study 1--Our first study is entitled “Students in Manufacturing and Other STEM Fields at Two-Year Colleges: An Exploration of Aspirations and Enrollment.” This study was completed in early 2012 using a robust national database (the Education Longitudinal Study of 2002). With this study, the aim is to look at the profiles of students who aspire to study manufacturing-related programs and those who actually enroll in them. Students in these programs are separated from other students in STEM fields at two-year colleges. The variables of the study are analyzed using logistic regression models. The dependent variables of the study are self-reported academic aspirations and actual major. The set of predictor variables include demographic background and academic factors such as high school academic track, math/science courses, GPA, math/science credits, and interaction with faculty or advisors. Among the findings, male students are more likely than female students to aspire to and eventually enroll in manufacturing-related areas of study. Students who take more science courses in high school are more likely to enroll in

¹ Wisconsin’s fiscal year runs from July 1st to June 30th of the next calendar year. FY2014, for example, refers to the period from July 1, 2013 to June 30, 2014.

manufacturing-related programs compared to other STEM fields. Also, at least one AP credit in math during high school is associated with an increased probability of aspiring to and enrolling in a manufacturing-related field. Interaction with faculty or advisors does not appear to have a significant association with aspiring to or enrolling in manufacturing areas of study. Students who are in the academic track during high school are more likely to aspire to manufacturing-related fields. However, students in both the academic and occupational track during high school are more likely to eventually enroll in manufacturing programs rather than other STEM fields. This study provides a more general overview of the students that aspire to and enter manufacturing-related programs. It serves as a first step to gain a sense of the students, their background characteristics, and the academic factors that have the potential to impact students considering and going into these areas of study. This research also identifies the students who may not go into manufacturing fields and the potential policy implications and efforts needed to recruit a more diverse student population. For example, the finding illustrating the great number of males aspiring to and enrolling in manufacturing-related areas of study shows the necessity in targeting efforts toward females in order to reconcile this situation. This study also points to math course-taking patterns in high school, which may suggest focusing efforts at the secondary level in order to alleviate any future math score issues that arise in the METTE programs. This study has been published as a research brief on the METTE website.

Study 2--Our second study is "Fuel for Success: Academic Momentum as a Mediator Between Dual Enrollment and Educational Outcomes of Two-Year Technical College Students." In this study, we draw on a sample of over 15,000 first-time postsecondary students who entered Wisconsin's two-year technical colleges in 2009-2010 after graduating from high school between 2007 and 2009. Using a path analysis, we investigate student transcript records along with data from the National Student Clearinghouse. Our results indicate that participation in dual enrollment is related to more attempted credits, higher likelihood of college enrollment without delay, summer enrollment, as well as stronger academic performance. These early academic momentum indicators are then positively related to students' college completion or retention, fully accounting for the positive relationship between dual enrollment participation and college outcomes. Our study provides a finer look into two-year college students' academic progress and success, and how dual enrollment may fuel this process by promoting students' academic momentum early during their college careers. This study is additive toward the METTE project since it provides insight into the impact of dual enrollment and academic momentum in relation to college retention and completion. Exposing high school students to college-level coursework has the potential to assist them, particularly those who enroll in METTE programs, to persist and graduate. They can receive the necessary preparation in math and manufacturing-related courses, thus avoiding any challenges related to score cutoffs and developmental education once they enter college. This study has been published in *Community College Review* (Citation: Wang, X., Chan, H., Phelps, A., & Washbon, J. (2015) Fuel for success: Academic momentum as a mediator between dual enrollment and educational outcomes of two-year technical college students. *Community College Review*, 43(2), 165-190.)

Study 3--The third study is “The role of socialization in educational expectations and progress of community college students” This research focuses on the importance of educational perceptions and expectations as a precursor to eventual attainment. The study treats these as outcome measures in order to provide a deeper understanding of the psychological and educational processes that underlie students’ academic progress and success. Weidman’s (1989) undergraduate socialization theory is used to ground this research. The sample consists of one of the four partner technical colleges in Wisconsin and data are collected from the CCSSE. Factor analyses were first applied to extract a theoretically sound factor structure aligned with the study’s conceptual underpinning, followed by a structural equation modeling analysis to answer the research questions. The undergraduate socialization model shows validity based on the study’s sample. Results indicate that socialization processes underlying transfer expectations versus completion expectations are distinctive from each other. While socialization that concentrates in the interpersonal, social domain tends to foster student expectations to complete a two-year college credential, these socialization sources do not matter much for promoting transfer expectations, which are largely subject to influences of socialization processes with a distinct academic focus. In addition, both completion and transfer expectations positively influenced educational progress. When educational expectations were accounted for, only a limited number of socialization sources exerted a direct influence on educational progress, as part of the socialization effect was conveyed indirectly through educational and, particularly, completion expectations. As specific for the METTE students in the study, although the normative context based on programs of study does not matter to transfer expectations, for completion expectations, programs of study do make a difference, with students in manufacturing and engineering programs reporting significantly lower completion expectations. I offer two plausible explanations for the significantly lower completion expectations reported by students enrolled in METTE programs. First, given the higher level of math and science technology course requirements in manufacturing and engineering programs as compared to other programs (Washbon, 2013), students could experience added academic challenges, thus lowering their expectations to complete the program on time. An alternative reason could be related to the higher demand for skilled workers trained in manufacturing and engineering programs, which may “norm” students in these programs into the idea of “jobbing out,” contemplating the prospect of landing employment in the field by acquiring the necessary skills without having to complete an educational credential. Obviously, these are only plausible explanations that warrant a separate study in the future.

This study illuminates the critical need to differentiate among different kinds of educational expectations of two-year college students and understand the different socialization processes shaping these expectations. Furthermore, given the close and positive link between educational expectations and progress, and the salient mediating role of expectations in conveying the impact of socialization on progress, two-year college leaders may benefit from approaching their students’ success through the lens of cultivating positive educational expectations and beliefs, as well as assisting students with the right paths aligned with their expectations. This study suggests the applicability of socialization theory in a two-year college context, and reveals a number of interesting

findings regarding the link among socialization sources and educational expectations and progress. As concern grows for two-year colleges and their efficacy in the student transfer and degree attainment process, this study adds to the much needed knowledge base on what is truly ailing 2-year institutions and their student population to move further toward realizing their educational goals. This study has been accepted for publication and is forthcoming in *Teachers College Record* (citation: Wang, X. (Accepted). The role of socialization in educational expectations and progress of community college students. *Teachers College Record*.)

Study 4-Our fourth study is “The Role of Interaction in the Academic Achievement of Two-Year Technical College Students in Manufacturing.” This research looks at the role of motivation underlying interaction with faculty and peers in relation to student learning and outcomes, particularly two-year technical college students in manufacturing-related programs. Acknowledging the different types of interaction that may occur on two-year college campuses based on the motivation, this study examines the varying interactions and the motivating factors that have the potential to affect student outcomes. Specifically, the study looks at what kinds of interaction do students in manufacturing-related programs engage in at two-year technical colleges, and in what ways do different forms of interaction relate to educational outcomes for these students. The sample consists of students in manufacturing-related programs from the four WTCS schools. Data are collected from the CCSSE. The dependent variable is cumulative GPA and retention/graduation status one-year after the CCSSE administration, obtained from students’ transcript and National Student Clearinghouse data prepared by the WTCS. The independent variables are types of interaction, enrollment intensity, cumulative credits, need for developmental education, and demographic background. A confirmatory factor analysis, multiple regression analysis, and logistic regression analysis are performed using the previously described variables. The results of the study show that interaction in relation to academic matters required by the curriculum is negatively associated with a cumulative GPA. On the other hand, interaction that is likely self-initiated for educational engagement results in a positive association with GPA. Non-traditional aged students tend to have higher GPAs. In terms of student retention or graduation, married students have higher graduation rate. The need for developmental math is negatively associated with GPA. This study informs the METTE project in the sense that other measures may need to be taken in order to ensure student success, especially considering remedial class is negatively related to GPA. Other policy measures involving interaction, or encouraging self-initiated interaction may actually have a more positive impact on GPA. It is important to examine other underlying or indirect factors that may have a positive influence on GPA in the METTE program. This study was able to provide an insight to other potential educational avenues to explore at two-year technical colleges in order to alleviate any score cutoffs or program persistence and completion issues involved with the METTE program. This study also contributes to theory building by providing a new framework regarding the nature of interaction and its relationship with academic success among manufacturing students at two-year technical colleges. (citation: Chan, H., & Wang, X. (Accepted). What drives the relationship between interaction and academic achievement? An analysis of students in manufacturing programs at two-year technical colleges. *Community College Review*.)

Study 5—In 2013, this study was requested jointly by one of the WTCS Presidents and one of the WTCS State Board staff members. In a METTE Research Brief entitled *Jobbing Out: A Preliminary Analysis of Student Attrition in METTE Programs in Wisconsin*, Dr. Janet Washbon described a preliminary analysis of student attrition in a small sample of METTE programs at Fox Valley Technical College. The preliminary analysis examined the enrollment behavior of 1,068 students in three manufacturing technician programs in 2009, 2010, and 2011 at FVTC in Appleton, Wisconsin. This analysis indicates that regardless of the type of program (associate degree, one- or two-year diploma), about 30% of these students left school without completing their studies. To better understand student attrition, we examined enrollment behavior, course-taking patterns, and characteristics of two subgroups of these students—“persisters” who continue taking courses beyond the first year and “leavers” who abandon their studies prior to graduation. In addition, we examined labor market outcomes for leavers as compared to program graduates.

After completing the preliminary analysis of factors associated with persisting and leaving, the full-scale analysis was undertaken for all WTCS campuses. Using data from a cohort of first-time students enrolled in 16 public Wisconsin Technical Colleges this phase of the study examined patterns of and influences in student attrition in 116 manufacturing technician and engineering technology (METTE) programs, which culminated in 1- and 2-year technical diplomas or associate of applied science degrees.

Two research questions were addressed:

1. Are there differences in demographic, educational attainment, work status, and economic background between students who leave and those who persist into Year 2 of a program?
2. Can we identify a set of empirically-based indicators of enrollment behavior, academic achievement, and course-taking behavior that differentiate leavers from persisters?

Administrative and transcript records were examined for the 3,273 full and part-time students who were first enrolled in a METTE program in FY2010. About one-third of these students left prior to receiving an academic credential in FY2011.

With the exception of an elevated likelihood of leaving for black students, this study found no significant difference in student demographics and other personal characteristics between and persisters. However, our findings point to patterns of enrollment, academic achievement, and course-taking behavior that could be useful to administrators seeking to identify students at risk of leaving and in modeling successful behavior for students who persist or complete their degree or diploma in the first year of study. That is, for this relatively heterogeneous group of students enrolled in manufacturing and engineering programs, it is not as important who the students are as what they do and achieve in their studies.

Throughout our analysis we have sought to identify significant differences between the behavior and academic achievement of leavers and persisters occurring in their first year of program enrollment. By highlighting these differences, we were able to develop a series of easily operationalized measures of student behavior and academic achievement that could be used by college instructors, academic advisors, and administrators to identify students at risk of leaving prior to program completion.

The results from this study were presented at the April 2014 meeting of the Council for the Study of Community Colleges in Washington, DC. The paper, *A Cohort Analysis of Student Attrition in Manufacturing and Engineering Technologist and Technician Education Programs* is posted on the METTE website under the Research tab.

Study 6—This study, entitled “Assembling a career: Labor market outcomes for manufacturing program students in two-year technical colleges,” is a joint publication effort largely based on the dissertation work by Dr. Chris Matheny, Vice President for Instruction at FVTC (one of our partner institutions). This study is an important contribution to research on labor market outcomes for METTE students. In this study, we explored how types of credential earned are related to employment outcomes four years post enrollment for students in METTE programs. We drew upon administrative and wage data on over 6,000 first-time students matriculating into manufacturing-related programs at Wisconsin’s technical colleges between July 1, 2007 and June 30, 2009. Using ordinary least squares and logistic regression, we investigated the association between types of credentials earned and labor market outcomes while controlling for the sample’s socio-demographic background and academic experiences. Our analyses revealed that students, particularly males, who completed an associate degree or a two-year technical diploma were at an advantage in both rates of employment and earnings. White male students also enjoyed a stronger likelihood of being employed and earned higher annual wages than their ethnic minority counterparts. These advantages were not as manifest among female students. Our study indicates that, in order to advance the employment prospects of technical college students, it is critical to expand institutional efforts to support longer-term credential attainment. Our findings did not support the popular jobbing-out myth lingering in manufacturing education at the two-year college level. This study has been accepted for publication in *Community College Review* (citation: Matheny, C., Chan, H., & Wang, X. (2015, September). Assembling a career: Labor market outcomes for manufacturing program students in two-year technical colleges. *Community College Review*.)

Study 7—This study is entitled “Turning Math Remediation into “Homeroom”: Contextualization in Remedial Math Courses and its Influence on Community College Student Learning and Motivational Beliefs.” Under-preparedness in math has been a roadblock for many of the METTE students in our project. As indicated earlier, based on

data we collected from MATC's contextualization efforts, this study explores contextualized instruction in remedial math courses within METTE programs at MATC. Drawing upon interview, observation, survey, and administrative data, we examined students' experiences within contextualized remedial math classes and how these experiences influence students' motivational beliefs about math and future success. Data collected through our observations, surveys, and interviews reveal the incremental process by which contextualization can help enable this transformation and construct this larger motivational environment for underprepared METTE students in remedial math. Results of the study show that through bridging math and real-world situations, contextualized instruction helps underprepared students overcome their initial fear of math and develop their confidence in math, which translates into an overall sense of efficacy in their future academic and professional careers. In its totality, our study points to the vast promise contextualization holds for reinventing remedial math instruction within and beyond METTE programs. Appropriately and thoughtfully adopted, contextualization can turn the remedial classroom from a barrier into a "homeroom," a point of access, and a jumping-off place from which two-year college students can start building their success. This study is currently under review. (Citation: Wang, X., Sun, N., & Wickersham, K. (under review). Turning remedial math classes into "homeroom": Contextualization in community college remedial math offerings and its influence on student learning and motivation.)

Study 8– This study focused solely on student veterans in manufacturing programs, which is one of the areas that attract many student veterans in postsecondary education, and explored how their college readiness and military experience are related to their academic success (i.e., retention, graduation, and transfer) given the financial aid from GI Bill exclusively available to them. The study population consisted of student veterans who were enrolled in WCTC between summer 2005 and spring 2012 for the first time and utilized the GI Bill benefit. Transcript and administrative data from these 409 program student veterans between summer 2005 and fall 2014 were analyzed. Results from logistic regression showed that the successful course completion rate (courses completed with a C or above) is the strongest predictor of the probability of retention, graduation, or transfer. Student veterans who had a higher Compass score in pre-algebra were more likely to be retained, graduated, or transferred. Female or younger student veterans also tended to have higher probability of retention, graduation, and transfer than their male or older counterparts. The findings emphasize the predictive power of academic preparation in math on student veterans' academic achievement in public two-year colleges context. As more soldiers are coming back from battlefields, this study offers some insights for practitioners to prepare for these student veterans returning to school and the key factors that are linked to a positive academic outcome. (citation: Chan, H.-Y. (under review). The academic achievement of student veterans in a public two-year college. *Community College Journal of Research and Practice*)

Study 9 – This study, “Math Requirement Fulfillment and Educational Success of Community College Students: A Matter of When,” examines the timing of college-level math requirement fulfillment in relation to the longer-term success of two-year college students. Utilizing CCSSE data and students records at MATC, we investigated how the precise academic terms in which students complete math requirements, taking into account other student behaviors, are related to academic performance and credential completion. For the purpose of our study, we further retained participants who were new students in an academic program during the school year of 2012 and had math course requirement(s) to graduate from their programs, resulting in a final analytical sample of 415 students. Findings reveal that first term math requirement completion is significantly and positively associated with academic performance, while completing math requirements within the first three terms of enrollment is significantly and positively related to credential completion. In addition, findings from this study illuminate active and collaborative learning as a promising approach that could contribute to both academic performance and credential completion for community college students. In light of this empirical evidence, colleges should consider implementing pedagogies that actively engage students in the learning process. To invite and support faculty members in adopting innovative teaching approaches, professional development of instructors represents a particularly viable and essential approach. Going beyond whether students complete math requirements, this study examined the timing of when students fulfilled their required math and how that related to their academic performance and credential completion. In doing so, we present a more contextual and nuanced understanding of math offerings and related student behaviors in connection with student progression and completion. This study is currently under review (citation: Wang, X., Wang, Y., Wickersham, K., Sun, N. (under review.) Math requirement fulfillment and educational success of community college students: A matter of when.)

Study 10 – This study features the in-depth dual credit research analysis focused on FVTC and 20 feeding high schools. Entitled *Exploring the Relationship of Career and Technical Education Dual-Credit Course Completion with Students’ College and Labor Market Success*, this study examined the college and labor market success of the 2008-10 high school graduation cohorts (n=2,295). Three kinds of high school dual credit experiences were examined and results documented to describe and predict the extent to which dual credit and non-dual credit students were successful at FVTC and in the labor market by age 22-23. This study is currently under review (citation: Phelps, L.A. and Chan, H.Y. (under review.) Exploring the relationship of career and technical education dual-credit course completion with students’ college and labor market success).

Study 11 – This study examined the early results from an innovative partnership between the technical college and a local network of manufacturers. In 2013, Moraine Park Technical College, working with area manufacturers, began an initiative to build stronger connections between area manufacturers and METTE students. This outreach effort is referred to as the Forming Alliances to Cultivate Talent (FACT) Initiative. As part of FACT, students are provided opportunities to participate in plant tours or company tours, attend industry-based Manufacturing Expos, and attend in-classroom presentations by industry experts. FACT also provides performance-based stipends funded by area manufacturers to METTE students for continuous enrollment and high performance. Administrative student records and student survey data for two beginning METTE cohorts (2013-14, 2014-15) provided the evaluation database. This evaluation suggests that while FACT is already having a positive impact on retention, it could have a greater impact on retention and program completion if instructors help students make more explicit connections between what they are learning in the classroom and insights about the labor market, working conditions, and employment prospects that the employer community can provide. Co-authored by the Dr. Janet Washbon and two members of the MPTC Local Leadership Team, the research brief is entitled: *Improving METTE Student Success through Greater Student Engagement: MPTC Research Brief*. This brief is published on the METTE website under the Research tab.

Goal 2, Objective C: Support the Development and Work of four Networked Improvement Communities.

FVTC

At the close of Year 1, the FVTC NIC priorities centered on expanding the number of high schools and teachers offering transcribed credit or advanced standing courses aligned with METTE programs.

As described in previous annual reports, the FVTC-LLT has centered its efforts on improving the level of METTE student recruitment and the success of early/entering METTE students. From the outset, the FVTC METTE faculty members have been committed to working with high school instructors to create and improve dual credit opportunities (specifically introductory Machine Tool and Electronics transcribed credit and advanced standing courses). Started in 2012, the Career Jump Start project has expanded from two high schools to ten in 2014-15. Three major METTE career pathways (Machine Tool, Welding, and Electronics/Automation) are now the central programmatic focus of the Career Jump Start project. Across the 10 Career Jump Start high schools, 168 students successfully completed FVTC-METTE courses in 2014-15, a substantial increase from prior years.

The \$10,000 Year 2 METTE sub-award for Career Jump Start has been expanded to a \$150,000 investment in 2014-15 using state funds. The expanded funding now provides released time (1.4 FTE) for FVTC instructors to work with high school instructors on teaching the introductory courses, using the on-line METTE instructional resources

created by FVTC instructors, setting up work-based learning experiences with local industry, and acquiring and using new equipment, digital instructional applications, and precision instruments. The discussions and plans for these expanded high school partnerships have been guided in part by the METTE project's data collection and analysis, which began in 2012. Examining the Fall 2011 new student reports indicating the high schools attended in 2008-10 by beginning METTE students, program leaders and instructors could identify targets of opportunity, such as high schools with good facilities and well-trained instructors but relatively few students opting to attend FVTC. Since 2012, summer institutes for high school METTE instructors, school counselors, and principals have been offered. The audiences and career pathways examined have been expanded to support more dual credit high school/FVTC partnerships. Such efforts are designed to make career jump start/dual credit technical learning options available to a broader segment of high schools and substantially more high school students.

Since Year 2, the FVTC LLT and NIC teams have been guided by two burning research questions that drive our student success optimization efforts:

- (a) In what ways do school-level and student-level characteristics influence students' early success at FVTC?
- (b) Do school-level measures have an effect above and beyond their corresponding student-level measures?

By framing the driving questions in this way, we hoped to identify both individual and school level factors associated with FVTC student success. Since students are situated in specific high schools with different characteristics and expectations (e.g. small, non-diverse student groups, different graduation requirements, etc.), looking at the interaction between student characteristics (e.g. gender and ethnicity, placement test scores, etc.) and school characteristics, is important. With this analysis, one can understand how changes or differences in student profiles, as they are moderated by school characteristics (e.g., proportion of teachers with master's degrees), are influencing students' college and early labor market success. The converse analysis is also possible—to examine how school characteristics and factors (e.g., total enrollment, graduation requirements), when moderated by student differences, are increasing or limited graduates' success at FVTC. The second guiding question helps us look beyond individual student and school level factors and their interaction to examine the influence of major school-level factors (such as graduation requirements that include completion of 3 or 6 dual credits, or the completion of college success courses in high school). By including the second question, we are able to look at the evidence as high schools begin to scale-up college going practices.

Early in Year 3 we completed the analysis of longitudinal data from 20 public high schools across the graduating classes of 2008-11. A series of three documents were produced: an 8-page research brief, 2-page info-graph (Attachment A), and 20 FVTC High School Success Reports. Each of these documents were mentioned often in the ongoing conversations with/presentations to high school leaders, instructors, and prospective FVTC students and parents aimed at showing benefits of high school dual credit courses.

As we prepared national presentations and manuscripts for publication featuring our dual credit findings, the continuing reviews of the literature revealed that *relatively little is known about how and why dual credit instruction works*. While Transcribed and Advanced Standing course completion is a strong predictive factor in advancing student success and labor market outcomes at FVTC, but little is known dual credit students' motivation, the content of the courses, or the teaching methods and learning experiences in these courses. Conversations during METTE research briefings at three FVTC-sponsored 2014 Summer Summits for high school dual credit instructors and high school leaders confirmed a substantial interest in expanding the FVTC dual credit high school partnerships and delving more deeply into the puzzle.

Additionally, the adoption of a state technical college performance funding system, including a performance measure associated with the proportion of students entering with dual credit, heightened the importance of the study at the state level.

The Year 4 activities and accomplishments advanced by METTE goals (advancing knowledge regarding student success factors and predictors and improving the capacity of technical colleges and their partners to generate research-guided innovations).

In the discovery arena, the LLT:

1. Designed and conducted an on-line survey for the 645-650 students in our database who completed one or more dual credit courses during 2008-11 and before graduating from high school. The anonymous survey included 9 questions (including two open-ended response questions) aimed at exploring how students' dual credit experiences were helpful as they prepared for and entered college. The survey was pilot tested in January, revised slightly, approved by the IRB, and distributed via email by the FVTC Vice President for Academic Affairs in February. After two follow-up emails over a 14-day period, 37 complete responses were provided. A brief, preliminary summary report was shared with the LLT and participants in the June FVTC Data and Innovation Summit.
2. Constructed a preliminary descriptive analysis that examined the relationship between early METTE momentum variables and METTE student retention, graduation, and labor market success. Inspired by the FVTC dual credit study but using the full array of METTE data sets (specifically the 2011-14 WTCS student records and the Spring 2012 CCSSE data), this analysis examined the 3-year outcomes for METTE students who initiated their enrollment in 2011-12. More specifically, we used a sample of 139 early METTE students to explore three questions:
 - a. To what extent do first-year students with focused and intensive pre-college career exploration experiences and career plans achieve greater success in college and in the labor market?

- b. To what extent do first-year students who experience high levels of early career-focused instruction and advising achieve greater success in college and in the labor market?
- c. Among four patterns of “working while continuously enrolled”, which pattern is associated with greater success in college and in the labor market?

Several CCSSE items were used to document the two independent variables (pre-college career exploration experiences and initial-year career focused instruction and advising). The wage record data for the sample of 139 early METTE students used to estimate the dominant patterns of part- and full-time college enrollment and working during 2012-14.

Chi-square test and correlations did not reveal positive statistical associations between the retention or graduation status (vs. dropping out) for early METTE students and independent constructs for high pre-college career exploration and intensive, early career-focused instruction and advising in 2011-12. For students who reported being highly focused on METTE high school courses and extracurricular experiences but different in academic success status, they did not differ in the levels of engagement using the CCSSE benchmarks (e.g., active and collaborative learning, student-faculty relationships, etc.) Two observations emerged from this problematic study. First, as noted elsewhere in this report (see CCSSE Validation Study section), we had difficulty generating robust METTE oversamples on the four campuses. Our target sample of METTE students for this study (n=192 who completed 0-23 credits in 2011-12) is small and doesn't provide much demographic variation. Second, when the CCSSE data was analyzed initially, the responses failed to cluster around the five CCSSE benchmarks, which raised questions about the predictive validity of the benchmarks for exploring students' academic and social engagement within the WTCS METTE programs. As noted on in the discussion of the CCSSE Validation Study, subsequent factor analysis work failed to produce a robust configuration of predictive factors and items for the CCSSE data collected in Spring 2012.

In the capacity building and dissemination arena, the FVTC LLT generated a number of national and state-level conference presentations, local summit presentations, and some publications.

1. As described in Section 4 Outreach Activities, members of the FVTC-LLT and WCER Research Facilitator (PI-Allen Phelps) prepared with delivered presentations at the following conferences:
 - a. 2014 ATE Principal Investigator Conference, Washington DC, October 23, 2014. *Expanding Research Collaboration in ATE Projects: Two Case Studies Anchored in Improving Manufacturing Student Success*. Presenters: Allen Phelps and Xueli Wang (UW-Madison), Laura Waurio (FVTC), and Lawrence Gross (MATC).

- b. National Career Pathways Network Conference, Orlando, October 11, 2014
Systematic Improvement of Student Success in Programs of Study: A Data-Driven Partnership. Presenters: Allen Phelps, Mary Hansen (FVTC K-12 Partnerships Director), Dan Valentyn (Principal, Little Chute High School)
 - c. WTCS and DPI State Agency Staff Meeting, Madison, WI, January 26, 2015
Systematic Improvement of Student Success in Programs of Study: A Research Briefing. Presenter: Allen Phelps
 - d. WTCS T&I (Engineering Technology and Manufacturing) Deans Workshop, Superior WI, July 23, 2015. *Using Data and Evidence to Improve Student Success in Engineering and Manufacturing Pathways: High School Partnerships*. Presenters: Dan Valentyn (Principal, Little Chute High School), Steve Straub (FVTC Dean), and Allen Phelps)
2. Beginning in October and ending in early July 2015, the FVTC-LLT designed and conducted a METTE Data and Innovation Summit experience. Meetings were hosted at FVTC in October and late January to: (a) provide briefings on the dual credit research findings, and (b) jointly plan and develop an intensive professional learning opportunity for teams from local high schools. The primary Summit goal was to support high school teams as they conducted Deep Dive Projects designed to improve the early college success of their graduates. The Summit opened on March 24 with a 4-hour orientation and overview meeting. Teams from 8 high schools attended. By May 1, teams from 5 high schools submitted a Deep Dive Project plan, which outlined how they would merge and use longitudinal data from the METTE project, FVTC, and the National Student Clearinghouse to improve graduates' readiness and early success in career and college pathways. The Summit convened for 4 half-day sessions in June and 1 full-day wrap-up meeting on July 8 at FVTC. Mini-lectures with experts and discussions guided the each team's Deep Dive Project activities, including data collection, analysis, review of the research evidence, and promising high school/community college practices. Each of the 18 Summit participants received a stipend and 7 also received 2-graduate credits from UW-Madison for completing a post-Summit reflective essay describing the future plans, as well as current capacities, school priorities, and options for advancing data-driven innovation within teacher and school wide practices. A detailed report for the FVTC Data and Innovation Summit can be found as Attachment B, and a local media story on the Summit is available at:

<http://www.postcrescent.com/story/news/education/2015/08/05/fox-valley-education-summitt/31181469/>

MATC –

As described in previous annual reports, MATC's NIC team opted to focus on preparing METTE-aspiring students who fall under the math cutoff scores for full admission. To accomplish this, some preliminary ideas were generated from the METTE data retreat during Year 2 of the METTE project, which we described in great detail in the Year 2 annual report. Since then, MATC's NIC team, which includes METTE deans, instructors, institutional researchers, and UW-Madison researchers, met numerous times to further operationalize the ideas that resulted in the current two specific instructional innovations: The first is a new one-credit companion course (WELDTEC-195) to MathGen-110 that contextualizes math learning, using examples from manufacturing to support Associate Degree students who are in the prepared-learner level math course. The second project is a program specific math course with support from adult basic education (ABE) and hands-on learning, such as blueprint and shop courses. Since Fall 2013, these two new offerings, developed by instructors on the MATC NIC team, have been consistently implemented during each academic term.

Closely coupled with these instructional innovations has been on-going research to gauge their efficacy. To assist the MATC NIC team earlier in the process, UW-Madison researchers are the main driver of related research efforts. More specifically, to help understand how initial pilots of these offerings worked, Xueli Wang and Amy Prevost developed a survey specifically measuring contextualization and student motivation, with substantive input from METTE instructional staff and leaders, as well as Dr. Yan Wang, MATC's institutional research director. In addition, Xueli Wang worked with two of her doctoral students, Ning Sun and Kelly Wickersham, to collect and analyze data from classroom observations, surveys, and interviews with students and instructors across several piloted sessions across several terms during Year 3 and 4. We found that, from all three sources of data, students seemed to benefit from contextualization to a great extent. When making contextualization their main focus, the welding and machine tooling instructors teaching remedial math purposefully drew linkages between math concepts and their real-world settings, approached mathematical ideas in myriad ways, and encouraged the pursuit of multiple solutions. The close connection between math skills and the METTE subjects (i.e., welding and machine tooling), thus made possible, situated math with future METTE careers to which students aspire. As a result, students became eager to apply math as they saw its role in the workforce they desire to enter. This increased interest and motivation was evident from both observations and interviews with students involved in the pilot offerings. These findings provided initial validation to MATC's innovation efforts, and these new contextualized courses are now being offered on a regular basis.

Year 4 also marked the successful transition of the research efforts from a UW-Madison researcher-driven model to an increasingly internally-driven model. Seeing the value of integrating research with innovation, the institutional research office at MATC is now regularly implementing the contextualization survey instrument (initially developed by Xueli Wang and Amy Prevost and coded and analyzed by UW-Madison researchers) in the contextualized classes and conducted subsequent analyses in-house. Their on-going

analyses of the relationship between contextualization and students' performance in Welding and Machine Tool courses continue to show better performance of students in the contextualized courses. In addition, inspired by the partnership, institutional researchers at MATC will also incorporate their Student Success Assessment Tool (SSAT) into METTE to determine risk factors for METTE students not being successful and will plan to provide interventions to students using the combined results. Also related to building internal capacity to improve METTE student outcomes is MATC NIC's effort to train faculty and staff in using empirical data. With the support from METTE during Year 4, Dr. Yan Wang developed and offered SPSS training sessions to 24 faculty and staff on campus to learn how to analyze, understand, and use data collected from METTE projects.

During Year 4, we also worked on dissemination efforts related to the MATC NIC projects. To begin, we presented the empirical findings indicating the positive influence of contextualization at the annual conference of the Association for the Study of Higher Education and submitted this work to the *Review of Higher Education*. Also, per invitation from the editors of the *New Directions for Community Colleges* who are interested in this particular partnership, we developed a chapter (under contract) describing this partnership and related takeaways. Finally, responding to MATC's interest in the timing of math requirement fulfillment in general, we analyzed students' math requirement and fulfillment data. Results showed the importance of completing the math requirement early on in order to be successful. Dr. Yan Wang shared these findings at MATC to inform advising. We also presented this work at the Council for the Study of Community Colleges.

MPTC —

The NIC project at Moraine Park Technical College focuses on improving student course completion and retention for postsecondary students enrolled in the college's METTE programs. The project is piloting the development of retention strategies for five of the college's manufacturing programs: three associate of applied science programs in Mechanical Design, Process Engineering, Fabrication Technologies, and two one-year technical diploma programs in Welding and Metal Fabrication. The MPTC NIC project team is led by the dean of manufacturing programs and includes active participation by program faculty, academic advising, adult education program staff, and institutional researchers at the college.

Most models of student success posit that active participation by students in the learning process through engagement with college faculty and staff, with other students, and with course material can improve student outcomes such as academic achievement, persistence, and completion (See CCSSE, 2014). In Year 4 of the METTE project, the MPTC team chose to focus on improving two aspects of student engagements--active and collaborative learning and student support. In particular, MPTC's NIC team explored the impact on term-to-term retention of student participation in a college initiative to extend learning outside of the classroom for METTE students.

Working with area manufacturers in 2013, MPTC began an initiative to build stronger connections between area manufacturers and METTE students. This outreach effort is referred to as the Forming Alliances to Cultivate Talent (FACT) Initiative. As part of FACT, students are provided opportunities to participate in plant tours or company tours, attend industry-based Manufacturing Expos, and attend in classroom presentations. FACT also provides performance-based stipends funded by area manufacturers to METTE students for continuous enrollment and high performance (See FACT brochures for student and manufacturers). In addition to student and employer participation in FACT activities and the provision of stipends, MPTC restructured its student academic support activities into a Manufacturing Skills Lab that provided focused developmental and remedial mathematics and communications instruction targeted to METTE students. Nine thousand manufacturers in Wisconsin provide employment to a workforce of more than 460,000 employees. Term-to-term retention is key to successful completion of the technical college programs in manufacturing or engineering technology that lead to entry-level employment as a skilled technician or job advancement in manufacturing.

The results of MPTC's analyses suggest that efforts to increase student engagement through building partnerships with area employers can have a positive impact on student success through active and collaborative learning opportunities for manufacturing and engineering technology students.

Our examination of factors associated with increasing term-to-term retention suggests that two-year colleges should:

- Ensure students master academic challenges including basic skills and occupationally supportive math;
- Encourage student engagement within the classroom and with the employer community;
- Provide students access to financial aid; and
- Build strong ties to regional manufacturers that can provide insights into industry training needs and new technology, strengthen the appeal of manufacturing careers, and provide access to the pool of future employees.

Our evaluation of the FACT Initiative at MPTC suggests that while FACT is already having a positive impact on retention, it could have a greater impact on retention and program completion if instructors help students make more explicit connections between what they are learning in the classroom and insights about the labor market, working conditions, and employment prospects that the employer community can provide.

The FACT Initiative evaluation findings are published on the METTE website as a research brief, entitled: *Improving METTE Student Success through Greater Student Engagement* (Washbon, Konruff & Arndt, 2015). This brief is also included as Attachment C to this report.

Year 4 also marked successful a partial transition of the research efforts from a UW-Madison researcher-driven model to an increasingly internally-driven model at MPTC. To begin to evaluate the impact of the FACT Initiative on term-to-term retention, the NIC team working with Dr. Washbon and project graduate student Brittany John, designed and administered a pilot survey to 33 students representing a cross-section of students enrolled in METTE programs at MPTC. MPTC's institutional research staff collected the data from the students, assigned anonymous student identifiers to the data and provided the surveys to Ms. John to code. She then returned the coded data to MPTC, which then used SPSS to create frequency data for each question. The team then worked together to select response data that was most useful to MPTC in characterizing the success or shortcomings of the initiative.

In addition, as part of MPTC's Year 4 work, the institutional researcher who participated as a member of the NIC team conducted several additional analyses of administrative data collected by MPTC to explore whether NIC team efforts to improve retention through increased student engagement could be associated with increased term-to-term retention. In addition, the institutional research office at the college conducted analyses of student enrollment and course-taking behaviors that had been previously identified by Dr. Washbon's system-wide research into indicators of attrition and retention to determine which indicators might usefully be included in the college's executive dashboard (See Study 5). This effort was designed to assist administrators in identifying students for whom intervention might effectively be useful in increasing term-to-term retention.

During Year 4, the MPTC NIC team participated in several dissemination efforts related to the team's projects. In March 2015, Mr. Konruff also made an extended presentation on the executive dashboard to another national audience at the annual conference of the Higher Learning Commission, the body that accredits degree-granting postsecondary educational institutions in the North Central region of the United States. In April 2015, Mr. Konruff and Dr. Washbon presented a roundtable presentation on the development of the executive dashboard with its retention indicators to a national audience at the annual conference of the Council for the Study of Community Colleges. In July, 2015 Associate Dean Arndt provided briefings about the NIC team findings on the impact of the student engagement efforts and the results of pilot survey evaluation of the FACT Initiative to METTE faculty and college administrators. Members of the NIC team including the associate dean, the institutional researcher, and faculty members presented the results of its work to its peers at the WTCS T&I (Engineering Technology and Manufacturing) Deans Workshop, Superior, Wisconsin, July 23, 2015. Finally, Dean Arndt anticipates sharing these results with industry partners as a means of increasing employer involvement in student engagement efforts such as the FACT Initiative.

WCTC --

In 2012-13, the WCTC-LLT began to develop two new initiatives, namely (a) an early alert system through which students and staff are alerted to concerns about student progress and (b) a mandatory new student orientation program for all students. These two initiatives were part of a new Academic Master Plan being launched at WCTC. The

METTE Research Group worked intensively with members of the WCTC-LLT to undertake research, evaluation, and innovation activities designed to document and describe student success.

During the 2013-14 academic year, the METTE Research Group assisted in the WCTC-LLT in examining and exploring several options for advancing both of these student success improvement projects. In the spring of 2013, METTE team completed a review of related literature and empirical studies for both initiatives and both reports are shared with WCTC. These reviews show that both initiatives are aligned with practices that have been found to contribute to student persistence and success by familiarizing incoming students with campus resources and academic requirements, as well as informing instructors and staff of signs of risks and later directing students to proper campus services and resources. The METTE team also completed a baseline study using CCSSE data with WCTC sample, and statistical analyses show that students who indicated that they had participated in then optional orientation programs tended to have higher levels of academic engagement and to be more satisfied with on-campus services and resources. This baseline study provided the WCTC with an approach to measuring the effectiveness of the mandatory orientation program, and provides an overview of students' past experiences to inform future findings.

In the fall of 2013, a METTE-focused session was piloted as a part of the new student orientation, and the participation of the new student orientation was required for students in the electronics program. In addition to the school-wide session, METTE students and parents had an opportunity to tour the workshop classrooms. They also had a chance to talk to METTE faculty directly. If students were not able to attend any session of the new student orientation in summer, they were asked to attend a one-on-one orientation with the academic counselor Beth Felch to fulfill the prerequisite of enrollment in any class. However, for students enrolled in the architecture program, attendance to the new student orientation was optional. In the mean time, the faculty members compiled a list of early alerts (e.g., absence in the first three weeks of a new semester, late assignments). An early alert system was constructed and tested so that faculty and counselors can record the early alerts and track how students were helped.

In the spring of 2014, students in the electronic programs were invited to participate in an hour-long interview with Todd Lundberg to share their experiences of the new student orientation, as well as how the participation of the orientation, either in the group format or one-on-one setting, helps with their academics. A number of instructors and counselors also participated in the interview to share their observation of the effectiveness of the mandatory new student orientation and early alert system. The interviews were recorded and transcribed, and later analyzed by Todd Lundberg. The findings were shared with WCTC's METTE team members and used to guide the design and development of the 2014-15 NIC project.

Starting in summer 2014, the mandatory new student orientation was expanded to include students enrolled in electronics, mechanical design, mechanical engineering, and electrical engineering programs. These programs were targeted because they require proficiency in algebra and calculus. During the orientation, instructors and advisors were present to discuss program expectations, including math instructors. One of the sessions was allocated for a program-based hands-on activity so that students learn what they will learn in the program. Finally, the instructors walked students through online course registration system. Students generally liked these sessions, according to the post-orientation survey. If students did not participate in the new student orientation, they were required to attend a mini orientation focused on their program of study.

Also starting in the 2014-15 academic year, the early alert system has advanced to a completely online format. Instructors submit an early alert form electronically and specified what challenges (i.e., the alert) the students might experience. Students' information is also incorporated within the system. Students who receive an alert have to meet with the counselor so that they can register for the next semester. Based on faculty members' comments, instructors would like to know if other instructors file an alert for the same student, and instructors should encourage all instructors to adopt the new system to file early alert.

Finally, during 2014-15 the METTE Research (Hsun-yu Chan) and two WCTC staff members engaged in supporting returning veteran students undertook an internal study to identify the factors influencing veterans' success in METTE programs. This study explored how their college readiness and military experience are related to their academic success (i.e., retention, graduation, and transfer) given the financial aid from GI Bill exclusively available to them. The study population consisted of student veterans who were enrolled in WCTC between summer 2005 and spring 2012 for the first time and utilized the GI Bill benefit. Transcript and administrative data from these 409 program student veterans between summer 2005 and fall 2014 were analyzed. Results from logistic regression showed that the successful course completion rate (courses completed with a C or above) is the strongest predictor of the probability of retention, graduation, or transfer. Student veterans who had a higher Compass score in pre-algebra were more likely to be retained, graduated, or transferred. Female or younger student veterans also tended to have higher probability of retention, graduation, and transfer than their male or older counterparts. The findings emphasize the predictive power of academic preparation in math on student veterans' academic achievement in public two-year colleges context. As noted in the following section, this study (Study 8) was presented at the 2015 American Educational Research Association conference in Chicago. Currently, the manuscript is under review with the editors of the *Community College Journal of Research and Practice*.

Significant Results: Goal 1

Several important and useful findings continue to emerge from the comprehensive METTE database, which now spans the 2005-2014 WTCS student records. Key initial findings are emerging from both project-wide and campus-level NIC analyses. More specifically, Studies 5-11 and our recent NIC activities yield the following key findings:

- a. As indicated in our previous reports, mathematics proficiency and early student program choices are significant challenges for METTE programs and students. Accordingly, we examined the magnitude and complexity of these challenges through several empirical studies (e.g., Study 2, 7, 8, 10 and 11). These studies revealed the importance of contextualizing the METTE math curriculum, helping students complete math requirements early, and selected factors and practices associated with high school dual credit course completion. Based on these findings, several promising innovations have been implemented on the partner technical college campuses. Along with the innovations and practices, several instruments, new resources (such as on-line data explorer tools), and data analysis and reporting protocols were developed to support the local systematic implementation and continuous improvement of the evidence-based innovations and practices. For example, MATC has systematically revamped several math courses within METTE programs. In WCTC's renovated new student orientation program, as part of the NIC project, a session is devoted to the importance of math, math requirements in METTE programs, and available campus resources. At FVTC, several high schools have created or expanded dual credit courses, technical or career pathway academies, and transition supports (such as student advisory sections) to strengthen early student success for their graduates at FVTC.
- b. To date, 11 studies of METTE student success have been completed. From these studies, we have published articles in 2 peer-reviewed journals, 2 manuscripts have been accepted for publication, 4 manuscripts are under review, and a couple of manuscripts are being finalized. When the editorial decision involves an invitation to revise, we will make the necessary methodological and substantive revisions suggested by reviewers for the journals to which we submitted our work.
- c. For policy makers and educators concerned about METTE programs and two-year colleges, the research studies we developed collectively illuminate the complexities and nuances in defining and promoting METTE student success, and shed light on specific points of potential inventions, as indicated earlier. Similarly, our studies pinpoint the need for educators and policy makers to engage students' educational goals, motivation, behaviors, and pathways instead of applying a superficial yardstick for success. Given the often messy and non-linear nature of two-year college student enrollment patterns and pathways to future education and careers, traditional approaches to studying these students often fall short of generating highly informative data. Keeping these in mind, we approached our empirical studies in a highly purposeful, robust, and contextualized manner, which is evident in the comprehensiveness of our data sources (often integrating survey and administrative data, notably Study 3, 4, 7, 9, 10), sophisticated and detailed-level analyses (notably study 2-10), and constant involvement of LLT partners to participate in the studies and make sense of the findings (notably study 5-11). While evaluation of research is far from straightforward, these studies' rigor and effectiveness

can be gleaned through their high conference and journal acceptance rates, specifically described earlier, as well as LLT's and the larger technical college system's use and appreciation for the findings, also indicated above. For researchers engaging in this line of work, we believe the METTE research portfolio has provided new perspectives for guiding scholars interested in adopting nuanced approaches to tease out the many complexities surrounding this student population.

Significant Results – Goal 2:

- d. Technical college faculty and program leaders are delving more deeply into existing and longitudinal data to learn about their students and practices or factors associated with success in METTE pathways. The NIC teams at two of the four campuses have expanded since the program innovation projects were launched in Year 2. At MATC for example, the NIC team has expanded to eight administrators and full-time instructors who are involved with METTE programs, institutional research, and developmental education. At FVTC, the NIC now includes several high school principals, counselors and high school manufacturing instructors who are actively collaborating in efforts to improve early student success at FVTC. Also, the MATC student success projects have used the 2012 CCSSE to isolate student engagement perspectives that indicate the conditions under which contextualized math instruction is beneficial to METTE students. Generally speaking, the METTE project has expanded the capacity of the partner technical colleges to integrate a wider array of data sets, to conduct focused and advanced analytical work using quantitative and qualitative inquiries, and to isolate the root causes, key factors, student behaviors, and practices that predict student success in and attrition from METTE pathways.
- e. As noted in our previous reports and in the external evaluator's report, the quality and depth of the relationship between the university METTE research group and the NIC teams has expanded and addressed a larger number of factors potentially associated with METTE student success. Over the four years of partnership, a considerable number of NIC members at the partner institutions increasingly acknowledge the importance of collecting and using data to inform decision-making. They are committed to trying new strategies and letting the data "show them the way."

Key Outcomes and Other Achievements

For policy makers and educators concerned about METTE programs and two-year colleges, the research studies we developed collectively illuminate the complexities and nuances in defining and promoting METTE student success, and shed light on specific points of potential interventions, as indicated earlier. Similarly, our studies pinpoint the need for educators and policy makers to engage students' educational goals, motivation, behaviors, and pathways instead of applying a superficial yardstick for success. Given the often messy and non-linear nature of two-year college student enrollment patterns and pathways to future education and careers, traditional approaches to studying these students often fall short of generating highly informative data. Keeping these in mind, we approached our empirical studies in a highly purposeful, robust, and contextualized manner, which is evident in the comprehensiveness of our data sources (often integrating survey and administrative data, notably Study 3, 4, 7, 9, 10),

sophisticated and detailed-level analyses (notably study 2-10), and constant involvement of LLT partners to participate in the studies and make sense of the findings (notably study 5-11). While evaluation of research is far from straightforward, these studies' rigor and effectiveness can be gleaned through their high conference and journal acceptance rates, specifically described earlier, as well as LLT's and the larger technical college system's use and appreciation for the findings, also indicated above. For researchers engaging in this line of work, we believe the METTE research portfolio has provided new perspectives for guiding scholars interested in adopting nuanced approaches to tease out the many complexities surrounding this student population.

* What opportunities for training and professional development has the project provided?

We supported a doctoral student (also full-time administrator at one of our partner colleges) in the Department of Educational Leadership and Policy Analysis at UW-Madison. Effective January 2015, he has successfully completed and defended his dissertation, which used the METTE data base to examine the economic returns to METTE programs in Wisconsin. In addition, two graduate students from Educational Leadership and Policy Analysis and one graduate student from Educational Psychology at UW-Madison have been involved in our research activities that provide valuable research training and experience for these students.

In addition, several graduate students are assisting the METTE research team with the development of research protocols, the collection and analysis of data, and drafting summary documents.

Local Leadership Team meetings, which were held annually in Fall and Spring, served as a forum for intra-project feedback and accountability. Each of the LLTs reported on methodologies used, findings generated to date, and future directions. LLTs also fielded questions from other teams, which helped refined and advance the research and innovation work on each campus. During 2014 and 2015, METTE data retreats were held in the Summer and Winter to provide the LLTs with in-depth data analysis and professional learning opportunities. Retreat agendas included keynote addresses, feedback from our advisory board members, and detailed analyses of how METTE research fits into the wider context of the research landscape within two-year institutions.

* How have the results been disseminated to communities of interest?

Our most recent findings were shared with researchers and practitioners in state and national conferences. During Year 4, seven research presentation proposals were submitted and accepted at the following conferences:

- four research studies at the American Educational Research Association
- two studies at the Council for the Study of Community Colleges
- one study at the National Career Pathways Network conference.

In addition, we also presented a concurrent and a showcase session at the 2014 ATE PI meeting in Washington, DC.

From the 11 METTE studies, we have published articles in 2 peer-reviewed journals, 2 manuscripts have been accepted for publication, 3 manuscripts are currently under review, and a couple of manuscripts are being finalized. We have also shared the findings from research of smaller scale on our public website in the format of research briefs.

Finally, we have added information and links describing our conference papers, journal publications, research briefs, and presentations at local and state meeting to our public website, which will be maintained for an indefinite period. See: <http://mette.wceruw.org/>

Products

Books

Book Chapters

- a. Wang, X., Prevost, A., & Wang, Y. (Under contract). Reinventing math remediation through contextualization: Lessons learned from a researcher-practitioner partnership. *New Directions for Community Colleges*.

Conference Papers and Presentations

- a. 2014 ATE Principal Investigator Conference, Washington DC, October 23, 2014. *Expanding Research Collaboration in ATE Projects: Two Case Studies Anchored in Improving Manufacturing Student Success*. Presenters: Allen Phelps and Xueli Wang (UW-Madison), Laura Waurio (FVTC), and Lawrence Gross (MATC).
- b. National Career Pathways Network Conference, Orlando, October 11, 2014. *Systematic Improvement of Student Success in Programs of Study: A Data-Driven Partnership*. Presenters: Allen Phelps, Mary Hansen (FVTC K-12 Partnerships Director), Dan Valentyn (Principal, Little Chute High School)
- c. WTCS and DPI State Agency Staff Meeting, Madison, WI, January 26, 2015 *Systematic Improvement of Student Success in Programs of Study: A Research Briefing*. Presenter: Allen Phelps
- d. WTCS T&I (Engineering Technology and Manufacturing) Deans Workshop, Superior, Wisconsin, July 23, 2015. *Using Data and Evidence to Improve Student Success in Engineering and Manufacturing Pathways*. Presenters: Allen Phelps, Xueli Wang, Hsun-yu Chan, and Janet Washbon.
- e. Washbon, J. L. & Konruff, B. (2015, March). Using Longitudinal Databases to Support and Implement Research on Student Success. Roundtable presentation. 57th Annual Meeting of the Council for the Study of Community Colleges, April 9-11, 2015, Fort Worth, TX.
- f. Chan, H.-Y., & Seyfert, J. (2015, April). *The academic achievement of veteran students in public two-year colleges*. Poster presented at the 2015 American Educational Research Association Annual Meeting. Chicago, IL, USA.

- g. Phelps, L. A., & Chan, H.-Y. (2015, April). *Exploring the influence of career and technical education dual-credit course completion on college success*. Poster presented at the 2015 American Educational Research Association Annual Meeting. Chicago, IL, USA.
- h. Wang, X., Wang, Y., Wickersham, K., Sun, N. 2015. "Math Requirement Fulfillment and Educational Success of Community College Students: A Matter of When." Presentation at the 2015 Annual Conference of the Council for the Study of Community Colleges, Fort Worth, Texas.
- i. Wang, X., Sun, N., & Wickersham, K. 2014. "Turning Remedial Math Classes into "Homeroom": Contextualization in Community College Remedial Math Offerings and its Influence on Student Learning, Motivation, and College Success." Presentation at the 39th Annual Conference of the Association for the Study of Higher Education, Washington DC.
- j. Washbon, J. L. (2014, May). A Cohort Analysis of Student Attrition in Manufacturing and Engineering Technologist and Technician Education Programs. Paper presented to the 56th Annual Meeting of the Council for the Study of Community Colleges, May 3 – May 5, 2014, Washington, D. C.
- k. Chan, H.-Y., Wang, X. (2014, April). *Relationship between interaction and academic achievement among students in manufacturing programs in two-year technical colleges*. Paper presented at the 2014 American Educational Research Association Annual Meeting. Philadelphia, PA, USA.

Inventions

Journals

- a. Wang, X., Chan, H., Phelps, A., & Washbon, J. (2015). Fuel for success: Academic momentum as a mediator between dual enrollment and educational outcomes of two-year technical college students.. 43. (2). *Community College Review*, 43. 165. DOI. 10.1177/0091552115569846.
- b. Wang, X. (in press). The role of socialization in educational expectations and progress of community college students. *Teachers College Record*.
- c. Chan, H., & Wang, X. (accepted). What drives the relationship between interaction and academic achievement? An analysis of students in manufacturing programs at two-year technical colleges. *Community College Review*.
- d. Chan, H.-Y. (under review). The academic achievement of student veterans in a public two-year college. *Community College Journal of Research and Practice*.
- e. Wang, X., Sun, N., & Wickersham, K. (under review). Turning remedial math classes into "homeroom": Contextualization in community college remedial math offerings and its influence on student learning and motivation. *Research in Higher Education*.
- f. Phelps, L.A. and Chan, H.Y. (under review). Exploring the relationship of career and technical education dual-credit course completion with students' college and labor market success. *Career and Technical Education Research*.

- g. Matheny, C., Chan, H., & Wang, X. (2015). Assembling a career: Labor market outcomes for manufacturing program students in two-year technical colleges. *43. Community College Review.*, 43. 380. DOI. 10.1177/0091552115597999.
- h. Wang, X., Wang, Y., Wickersham, K., Sun, N. (under review). Math requirement fulfillment and educational success of community college students: A matter of when. *Community College Review.*

Licenses

Other Products

Appleton Post-crescent

Fox Valley educators put research into practice-- Research shows high school students who take college-level credit are more likely to succeed at FVTC. August 5, 2015

<http://www.postcrescent.com/story/news/education/2015/08/05/fox--valley--education--summitt/31181469/>

Other Publications

- Phelps, L.A. *Five things to know about FVTC, high schools in region.* November 13, 2014, Post-Crescent Media. <http://www.postcrescent.com/story/money/companies/state-of-opportunity/2014/11/13/five-things-know-fvtc-high-schools-region/18986001/>
- Phelps, L.A., Chan, H-Y., & Waurio, L. (2014, September). *Dual Credit Research Brief: Completing dual credit, college engagement, labor market outcomes: Factors that predict success.* This 15-page research brief examines the influence of three types of METTE dual credit offerings on six student success outcomes: dual credit completion, course completion rates in college, second year retention rates, three year graduation rates, labor market participation at age 22, and annual earnings at age 22.
- Washbon, J.L. (2014). *Jobbing Out: A Preliminary Analysis of Student Attrition in METTE Programs in Wisconsin. Working Draft.* The final technical report will be comprehensive student attrition analysis for 25-28 METTE Programs. It will examine several factors associated with the impact of partial program completion on students' retention in the manufacturing and goods producing sectors.
- Washbon, J.L., Konruff, B., & Arndt, M. (2015, August). *Improving METTE Student Success through Greater Student Engagement.* Madison, WI: Wisconsin Center for Education Research, University of Wisconsin-Madison. This report describes and summarizes the early evaluation data for two cohorts of METTE students participating in the FACT (Forming Alliances to Cultivate Talent) initiative. As part of FACT, students were provided with

stipends for academic achievement and participation in plant tours or company tours, attending industry-based Manufacturing Expos, and attending in classroom presentations.

Patents

Technologies or Techniques

Thesis/Dissertations

- Matheny, Christopher J. *Economic returns to sub-baccalaureate technical education: a study of labor market outcomes for Manufacturing Engineering Technologist and Technician Education (METTE) programs in the Wisconsin Technical College System*. (2014). University of Wisconsin-Madison. Acknowledgement of Federal Support = Yes
- Websites
METTE Improving Educational Outcomes in Manufacturing Technology and Technologist Programs
<http://mette.wceruw.org>

This is the second iteration of our public website, which provides better access of our research reports, important information for the METTE community and allows us to share more clearly the models that are emerging for improving student success in METTE programs.

Impacts

What is the impact on the development of the principal discipline(s) of the project?

The project results encourage and guide colleges within the Wisconsin Technical College System as their leaders and educators increase the use of data to inform decisions about improving student success. With this database, as well as the development, implementation and analysis of several Networked Improvement Community projects, leaders and practitioners have both the tools for data mining, as well as the capacity to design, implement, and evaluate effective interventions.

Other impacts include informing and clarifying the role of mathematics competence for entering METTE students, and the identification of factors predicting the retention and attrition of METTE students. Our findings have informed the development and implementation of early alert systems, which are essential for tracking students' status and academic progress. Additionally, these indicators are helpful in developing metrics that admissions and recruitment staff, as well as educators, advisors, and student service personnel can use in their work with students.

What is the impact on other disciplines?

Nothing to report.

What is the impact on the development of human resources?

Findings from each of the 11 METTE studies undertaken in the project provide implications for improving education and human resource development in STEM and other fields of postsecondary education. Most notably, the predictive findings on the value of dual credit technical courses completed in high school suggest clearly that completion of these courses fuels postsecondary academic momentum directly (with significant increases in 4-term retention or graduation), and indirectly by encouraging students to enroll directly after high school completion and in summer courses before and after their first year in college.

What is the impact on physical resources that form infrastructure?

Nothing to report.

What is the impact on institutional resources that form infrastructure?

In our external evaluation design, our evaluator administered an on-line survey with key technical college administrators to determine the extent to which the METTE project has improved the institution's capacity or maturity to use data analytics to improve student success and reach institutional performance benchmarks. The following sentences are taken from External Evaluation Report (See Attachment E).

As noted in the Year 3 external evaluator's report, an Institutional Data Usage survey was administered in the Fall, 2013 as one way to measure LLT members' perceptions around key aspects of data usage on their campuses. Results from the Fall 2013 Institutional Data Usage survey were shared with LLT members during a cross-campus meeting in the spring of 2014 as one component of a larger discussion around lessons learned regarding data usage on METTE campuses. This proved to be a useful way to stimulate conversation within and across LLTs around major accomplishments of their work as well as challenges encountered.

The survey itself was adapted from the Analytics Maturity Index (AMI) instrument developed by EDUCAUSE (a non-profit organization that provides information technology support to institutions of higher education), and asks respondents to rank their agreement (on a 1-5 scale, with 1 indicating strong disagreement and 5 indicating strong agreement) with 32 different statements around six major analytics and data usage categories, or domains: Governance and Infrastructure, Data/Reporting/Tools, Investment, Expertise, Process, and Culture. LLT members from each campus were again invited (via email link) to participate in the survey in the spring of 2015. The initial (Fall 2013) survey was sent to 45 potential respondents (LLT members and others that they nominated on their campus), with 33 completing it (for a response rate of 73.3%), whereas the Spring 2015 survey was sent to 52 potential respondents, with 18 completed for a response rate of 34.6%. It is important to note that survey results are not directly comparable from one year to the next at either an overall (cross-campus) level or by individual

campus, since both the total number of respondents as well as which specific staff completed the survey changed).

Several key themes related to the Institutional Data Usage survey are noted below, particularly those that help inform key accomplishments and challenges described above over the course of the METTE project:

- The grand mean (average of all six domains) on the survey was 3.48 for Fall 2013 and 3.63 for Spring 2015. Again, these means are not directly comparable over time since the number of respondents and which specific respondents' views are reflected in survey results differs, but the grand mean can loosely be translated to a moderately high level of agreement with statements about institutional data usage capacity. A grand mean score of 4, for example, would indicate that, on average, respondents selected "Agree" across the six domains on the survey, whereas a 3 would indicate that respondents were, on average, neutral.
- Domain-level mean scores on the Fall 2014 survey ranged from a low of 3.30 (in the Investment domain) to a high of 3.96 (in the Governance/Infrastructure domain; for the Spring 2015 survey, domain-level mean scores ranged from a low of 3.14 (for Investment) to a high of 3.71 (for Data/Reporting/Tools).
- In the Spring 2015 survey, small modest gains were noted from the Fall 2014 survey in three domains (e.g., Governance/Infrastructure, .27 to 3.96; Expertise, .26 to 3.54, and Culture, .14 to 3.65).

What is the impact on technology transfer?

Nothing to report.

What is the impact on society beyond science and technology?

Nothing to report.

Changes/Problems

Changes in approach and reason for change

Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them

Nothing to report.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use or care of biohazards

Nothing to report.

Special Requirements

Responses to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.

Nothing to report.