Determining an Appropriate Value-Index Model for Career and Technical Education Programs

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Sean Owen, PhD
Alexis Nordin
Young Bin Lim

MISSISSIPPI STATE UNIVERSITY
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Sean Owen, Ph.D.
Mississippi State University

Alexis Nordin
Mississippi State University

Young Bin Lim
Mississippi State University

This study examined the efficacy of a Value Index Model (VIM) designed to compare the impact of the career and technical education (CTE) Career Pathways that reside within career and technical education programs. The primary purpose of the exploration of a viable VIM is to aid local, state, and national decision-makers with information that could guide CTE funding and CTE program design and implementation. Datasets from 2010-2012 were utilized for the calculation of the VIM z-score variables, which were actual regional demand, regional demand percent, three-year statewide technical skills assessment averages, student population, cost per student, and equipment costs. Results from the VIM showed that the Health Sciences and Manufacturing Career Clusters returned the highest index value denoting a higher return on investment. Further exploration showed that Career Clusters index values statewide do not always correlate to local index values. This model's design should be limited to comparison of Career Pathway index values within school districts, which provide value to local and state leaders.

KEYWORDS: career and technical education, Career Clusters, Value Index Model, Career Pathways, student demographics, return on investment

Introduction and Background

Like many other states, the Mississippi Department of Education (MDE) is exploring the tangible value in career and technical education (CTE) programs implementation in the educational organizations in the state. The researchers' goal in this study was to examine developed models of an operationalization of secondary Career and Technical Education (CTE) VIMs that propose to determine the impact and usefulness these programs have on student success, preparation, placement into postsecondary education, and placement into the workforce. The researcher developed a model that builds on the existing accountability model mandated by the Carl D. Perkins Act of 2006 (2006) by analyzing longitudinal data and incorporating fiscal investments into these programs from the national, state, and local levels.

To better prepare K–12 students for competing in today's knowledge- and skills-based economy, educators must have an understanding of research-based practices that positively impact student outcomes, and they must implement professional development that evidence indicates will produce the results they desire (Killion, 2011). By researching the efficacy of a VIM, local, state, and national decision makers and policy makers could have a nationally validated model accompanied with a data dictionary and implementation guidelines. The potential of a validated model could drive CTE professional development guides and program models that could be used to transform low-performing CTE programs to high-performing programs that meet the needs of a growing, highly-skilled, flexible economy.

In an effort to develop CTE VIMs that have the capability of broad impacts and research the efficacy of these models, the researchers wanted to develop a model designed to use longitudinal data from the Mississippi Student Information System (MSIS). Findings from this study will immediately impact more than 28,000 Mississippi secondary students, 1,000 teachers, and all Mississippi school districts. The National Center for Education Statistics (Institute of Education Statistics, 2009) reported that there are approximately 18,000 public high schools in the U.S. and that 35.5% of high school students earned at least two CTE graduation credits from a CTE occupational area. The study will have broader benefits at a national level regarding how CTE programs are evaluated, delivered, and funded and could potentially impact all of the nation's high school students.

Variables in the VIM for this study included: (a) cost of program per student, (b) regional industry demand, (c) technical skills assessment score, (d) student population in program, (e) equipment cost, (f) teacher cost, and (g) student completion and placement into postsecondary education or industry. All of these variables were combined to produce one VIM score for each Career Pathway at the school district, community college region, and statewide levels.

The information gathered from the VIM will allow researchers to target follow-up surveys, interviews, focus group meetings, and observations of school districts in order to determine positive and negative characteristics that impact and test the validity of the VIM score in future work. Once those characteristics are identified, information can be shared with stakeholders, policy makers, and decision makers so that schools can improve their CTE systems and offerings.

Purpose of Study

In this study, we sought to develop an efficacious VIM that was clearly designed for secondary career and technical education programs. The expected outcomes were to provide the statewide CTE community a systematic, valid, and reliable VIM; determine characteristics that impact the VIM score; and ascertain a roadmap to refine the initial drafts of the CTE VIM to a workable model that is generalizable to the national CTE community. An effective VIM will contribute scientifically-based program evaluation evidence that has the ability to positively impact the governance and allocation of fiscal resources to secondary CTE programs. Improved CTE programs can increase the quality and quantity of students entering a highly skilled, flexible workforce (Morrison, DeRocco, Maciejewski, McNelly, Giffi, & Gardner, 2011).

Literature Review

CTE Background Information

CTE is helping our nation meet the very real and immediate challenges of economic development, student achievement, and global competitiveness. Fourteen million students are enrolled in CTE, encompassing every state with programs in nearly 1,300 public high schools and 1,700 two-year colleges (Phelps, Parsad, Farris, & Hudson, 2001). CTE programs are organized by 16 Career Clusters. Each Career Cluster provides a vital structure for organizing and delivering quality CTE programs through learning and comprehensive programs of study. The overall purpose of a Career Cluster is to provide students with the essential skills and knowledge they need to navigate their way to greater success in college and careers (National Association of State Directors of CTE Consortium, 2011).

CTE offers a complete range of career options for students, helping them discover their interests and an educational pathway that can lead to success in high school, college, and their chosen career or profession. Nationwide, CTE programs are changing, evolving, and innovating to create an environment of opportunity within our nation's schools. In 2009–2010, the Office of Vocational and Adult Education reported to Congress that the average high school graduation rate for students concentrating in CTE programs is 90.18% compared to an average national freshman graduation rate of 74.9% (U.S. Department of Education, 2010). High school students completing three or more CTE Carnegie credits are less likely to drop out than those taking between zero and one CTE credits (Aliago, Stone, Kotamraju, & Dickinson, 2011). Seventy percent of students concentrating in CTE areas stayed in postsecondary education or transferred to a four-year degree program, compared to an average state target of 58%. Experts project 47 million job openings in the decade ending 2018. About one-third will require an associate's degree or certificate, and all will require real-world skills that can be mastered through CTE (Pathways to Prosperity, 2011).

While these findings seem to report the positive effect that CTE has on students, CTE is still recognized as a large community consisting of "islands of excellence" where success is not the norm, and our nation's high schools are not pushing students to higher education and postsecondary education (Duncan, 2011). Unfortunately, a comprehensive return on value model aligning CTE student success at the secondary level to student success at the postsecondary and industry levels has not been conducted, and given current policy and budget pressures, a model showing the effectiveness and impact of CTE should be calculated (Kotomraju, 2011).

Accountability in CTE

CTE is seen as a vital component in the nation's economic recovery and is essential in recruiting students into tomorrow's workforce; however, there is little quantitative evidence about the effectiveness and impact that secondary CTE has on students' successful preparation for postsecondary education or placement in the workforce. Additionally, there is no true calculation of the return on value of the federal (Carl D. Perkins Act) and state funding related to CTE, no proof that it is producing a positive return on value and investment (Kotamraju, 2011). The Carl D. Perkins CTE Improvement Act of 2006 was signed into law with the intention of strengthening the focus on responsiveness to the economy by integrating academic and technical skills standards into Career Clusters. The federal law requires states to report data on six indicators for secondary schools: (a) academic attainment, (b) technical skills attainment, (c) secondary school completion, (d) student graduation rate, (e) secondary placement rate, and (f) nontraditional participation and completion rate.

Each state sets its success target for each indicator and reports the data to the federal government without taking into account the net impact of the performance indicators on an overall evaluation model. A prime example can be found in a report by the Manufacturing Association that described a significant gap in America's industry between the talent the association needs to keep growing its businesses and what it can actually find. Understanding how to best evaluate CTE programs and use the data to improve practices and offerings to students is essential to meeting the needs of a highly skilled, flexible workforce (Morrison, DeRocco, Maciejewski, McNelly, Giffi, & Gardner, 2011). The researchers hope the results of this study will add to the body of research that will produce scientifically based products that will meet this need from the national community.

National Need for Highly Skilled CTE Workers

Demand for highly skilled CTE workers in Mississippi and the United States has increased in recent years. The term "highly skilled" refers to individuals working within an occupation requiring a postsecondary certificate or an associate's degree (Rothwell, 2013).

There has been a great deal of attention placed on the need for career-ready employees with four-year and advanced degrees; however, the inability to fill CTE positions requiring two-year degrees or less has received only a modicum of attention. Not only is there a demand for CTE employees and leaders in positions that often require a bachelor's degree or other advanced degree, but there is also a need for technicians and skilled CTE laborers that is not being met (Morrison, et al., 2011).

Table 1 illustrates the need for CTE workers at a national level. The data were assessed using Economic Modeling Specialists Inc.'s (EMSI) web-based data tool, Analyst, and data have been filtered in the table based on occupations within the following career areas that required an associate's degree or a one-year postsecondary certificate.

Proposed Impact of Value-Index Models

Although there is literature that suggests best practices in the implementation of CTE at the secondary level, there is, to date, little research that informs the education community of CTE's positive return on value. This study allowed the researchers to document and evaluate the translation of research findings into a model that could potentially be replicated in other states and at the national level. Understanding what characteristics impact student placement into postsecondary and industry will allow educators to improve practices and encourage more students to enroll in Career Pathways, in turn, filling a gap of skilled workers needed in technical professions. Additionally, this project is expected to guide policymaking and the design of CTE programs.

Methodology

The setting for this research included datasets from all 152 Mississippi school districts that offer secondary CTE programs. Approximately 28,000 student records and 152 school district records were analyzed as a component of the model. The MSIS dataset used in the analysis is currently owned by MDE and housed at the Research and Curriculum Unit (RCU) of Mississippi

State University. A memorandum of understanding giving permission for the researchers to conduct analysis for this data is currently in place. The dataset contained student-level information consisting of demographic characteristics and coursework characteristics of the individual students. A second dataset came from standardized assessment data from the Mississippi Career Planning Assessment System, Version 2 (MS-CPAS2) for the students in the cohort. The Mississippi Career Planning Assessment System is used to deliver statewide assessments to secondary and postsecondary CTE students who are enrolled in courses in Career Pathways in the sixteen Career Clusters. The assessments are used as the measure of technical skills attainment for the state's Perkins requirements. The two datasets were combined internally by the Business Applications Systems department of the RCU for the purposes of clarity and efficiency.

The scope of the MSIS dataset consisted of students in grades 9-12 who took secondary CTE courses between 2010 and 2012. The researchers selected that three-year span in the combined dataset since it was the most complete span of time for all the variables that were used for the model. The timespan was selected to provide enough data for the VIM's student level variables that use three-year averages.

The total high school CTE student population was calculated based on cross-referencing the course codes on each student record to the MDE list of approved courses that identified CTE courses (Mississippi Department of Education, 2013). In Mississippi, CTE courses are identified in two ways. The MDE identifies a course as CTE if it is aligned to a Classification of Instructional Programs (CIP) code (Career and Technical Education, 2013) and receives funding earmarked for CTE funds. These courses may or may not be courses categorized in career and technical education Career Pathways. The RCU classification scheme identifies CTE students as those enrolled in courses categorized in career and technical education Career Pathways. For this study, we selected students who took courses that are included in the classification scheme for CTE education created by the RCU (RCU, 2013). An example of a Career Pathway CTE course is Concepts of Agriscience. An example of a non-Career Pathway CTE course is Family Dynamics.

For the scope of the years explored in this study, a student might have taken several courses in CTE. In the event of this occurrence, a student might be counted several times if the student took more than one course. Thus, the student population of each cluster in school district represents a non-unique number of students who took the courses of the particular cluster during the years. This method of counting ensures that Career Clusters have accurate counts based on enrollment during that three-year period.

The drive of this study was to devise a CTE VIM that allowed comparison of all Career Pathways within a secondary school district without needing to compare characteristics of individual school districts that might influence the results of the VIM. As shown in Figure 1, the model for this study consists of the variables Career Pathway regional demand, Career Pathway regional demand percentage, Career Pathway 3 year MS-CPAS2 average, Career Pathway student population, Career Pathway equipment costs, and Career Pathway cost per student. These VIM variables were standardized for comparative purposes and have been operationally/ formulaically defined in Table 2 and in the data dictionary in Table 3.

The Career Pathway regional demand *z* score was calculated by dividing the standard deviation of the regional demand percentage of all the Career Pathways in the school district by the mathematical difference between the regional demand percentage for the one specific Career Pathway and the average regional demand percentage of all the Career Pathways in the school district. To calculate the Career Pathway regional demand, data were obtained from EMSI's web-based data tool, Analyst. From the tool, we recorded the number of jobs in the Career Cluster in each specific Career Pathway in Mississippi in 2002 and expected number of jobs in the Career Cluster for each specific Career Pathway in Mississippi in 2022. The Career Pathway regional demand is the difference of numbers between 2002 and 2022. The Career Pathway regional demand percent is the percentage increase or decrease in the number from 2002 to 2022. The regional demand percent values were also disaggregated per county and applied to the Career Pathway that each school district resides.

To calculate the three-year MS-CPAS2 average *z* score, the researchers used the final MS-CPAS2 Career Pathway score of the students rather than a preliminary first year MS-CPAS2 score because of the variability in the program implementations across the state. Therefore, the MS-CPAS2 final score was not downsized due to the lack of information.

Exploratory analysis of the datasets yielded a few issues that required decisions for the student population variable. Within secondary school districts, three clusters emerged among CTE programs: began career pathways prior to the study, began the Career Pathways at some point during the three years, or did not have the Career Pathways. Moreover, the student population amounts in the districts decreased because we used a three-year average population.

The cost per student variable required CTE teachers' salary information, which was obtained based on teacher identification (IDs) numbers from the MDE teacher database. From MSIS, the course code and ID of the teacher who taught the course were collected. From a merge of these two datasets, it was possible to identify who taught a specific CTE course in a specific district in a specific school year. After identifying the teachers' IDs, the teacher salary information was applied to the teacher ID. If a school district opened a Career Pathway during the timespan, the teacher's salary variable may not have been based on the entire three year timespan, meaning the teacher taught from one to three years. The cost per student variable was calculated by this formula: salary/student population.

For the equipment costs variable, the MDE provided the equipment costs for implementing the Career Pathways. Based on this information, the cost of opening one course in a specific district in a specific year could be applied to the variable. If the same course did not open in the next year, the cost was not applied as a cost to the district. Using this methodology, the three-year average equipment cost of each Career Pathway in each school district was calculated.

School districts' VIM results were disaggregated by rurality using National Center for Education Statistics codes to see if the VIM patterns for Career Pathways remained constant independent of school size and rurality. The researchers sought to explore VIM scores within a Career Cluster. VIM scores were aggregated by Career Cluster. Using the Career Cluster VIM scores, a spatial analysis using ESRI's ArcGIS product was calculated to identify general geographical impact patterns across the state.

Findings

For the purpose of exploring the efficacy of the VIM, the model results were for school districts with small, medium and large student populations. The Institute of Education Sciences (2013) categorizes school districts by rurality. For Mississippi, the school districts with the largest student populations have a midsize city designation (population less than 250,000 and greater than or equal to 100,000). School districts with medium student populations have a fringe town designation (territory inside an urban cluster that is less than 10 miles from an urban area). School districts with small student populations have a distant rural designation (territory more than five miles but less than or equal to 25 miles from an urban area). For brevity, one school district for each category is reported in Tables 4, 5 and 6. Tables 4, 5 and 6 show the VIM results for school districts with small, medium and large school district student populations, respectively. School district identifiers have been removed for confidentiality purposes. Inspection of the school district VIM tables indicates that the VIM works independently of school district size or rurality. This determination can be made by reviewing the trends among Career Pathways across all three district sizes in Figure 2. For example, for Career Cluster 7, small, medium and large school districts have positive VIM scores, and for Career Cluster 8, small, medium and large school districts have negative scores. Prior to inspection of the VIM results, it was hypothesized that school districts with larger CTE student populations would return higher value than school districts with smaller CTE student populations. These tables are examples of observations across the state.

For visual purposes, the researchers performed a spatial analysis using ArcGIS. Figure 3 shows an example of a spatial analysis of one Career Cluster. School district and Career Cluster identifiers have been removed for confidentiality purposes. Caution should be used when viewing Career Cluster results because this particular VIM was not designed for Career Pathway or CTE Program comparisons across district lines. Decision and policy makers can use this VIM's results to infer in which geographical regions of the state a Career Cluster may have greater impact.

Conclusions

Although the study's dataset was more limited than its initial vision, the researchers were still able to achieve their initial objective of creating a VIM for the purposes of providing evaluative information to CTE decision and policy makers. The VIM that was created based on the initial design yielded varying values of Career Pathways within a district. Comparison of the VIM scores with district onsite observation notes confirmed what has been seen in recent years. Results of the spatial analysis of the Career Clusters indicate a need for further research on VIM design and exploration of comparisons across school district and community college region lines.

The reader should use the results of this study with caution, noting the scope was limited to a single VIM design in its initial research and development stages. Further exploration will occur in this area spanning more years and possibly adding other variables and weighting variables to current VIM variables. Qualitative results of current RCU studies regarding teacher quality, principal quality, and program quality in CTE programs could produce a source of variables for future study.

The results of this study are useful in the promotion of Career Pathways' influence on the overall value of CTE programs in school districts in the state of Mississippi. Effective programs of study in career and technical education at the secondary level have the potential not only to increase graduation rates but also to create a college and career ready individual, if implemented appropriately (Achieve, 2011). Curriculum specialists and CTE directors could utilize VIM results using this model to improve the probability of success in implementing a CTE Career Cluster or Career Pathway. A successful implementation will play a significant role in boosting graduation rates for students as Hill found in his 2012 study. Research is needed to further validate this VIM model and its derivatives to improve data analysis for decision and policy makers to inform the future development, design, and integration of CTE and academic curricula for school districts nationwide.

Limitations

The researchers initially recognized that the VIM model should consist of economic and education factors. The potential exists for decision makers to manipulate single factors (e.g., decreasing teacher salary) that may not positively impact students to simply increase the overall VIM score. This is beyond the scope of the model's design and should be discussed in more detail with local, state, and national advisory boards that choose to apply VIMs to their programs.

Recommendations

In future studies, researchers should replicate this process in other states to determine generalizability. Future work should be done on other VIMs. Models will be needed to allow comparison of all Career Pathways within a single community college region, all Career Pathways within the state, and like pathways within a single community college region. The results of future VIM studies should be correlated with the characteristics and practices of administrators, teachers, community, and students. Regression studies are needed to identify the characteristics and practices of administrators, teachers, community, and students that predict positive VIM scores. Finally, more research is needed to determine if VIM results are useful for informing effective professional development and CTE program implementation.

References

Aliago, O. A., Stone, J. R., III, Kotamraju, P., & Dickinson, E. (2001). *Engaging students in high school: An examination of the positive role of career and technical education.* Louisville, KY: National Research Center for Career and Technical Education, University of Louisville.

Alliance for Excellent Education. (2009). *The high cost of high school dropouts: What the nation pays for inadequate high schools*. Washington, DC: Alliance for Excellent Education.

Boser, U. (2011). *Return on educational investment: A district-by-district evaluation of U.S. educational productivity*. Washington, DC: Center for American Progress.

Carl D. Perkins CTE Improvement Act of 2006. (2006). The Library of Congress. Retrieved August 3, 2013, from http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_bills&docid=f:s250enr.txt.pdf

Career and technical education program areas. (2013). Retrieved from http://www.mde.k12.ms.us/career-and-technical-education/career-and-technical-education-program-areas

Duncan, A. (2011, February 2). The new CTE: Secretary Duncan's remarks on Career and Technical Education [Web blog message]. Retrieved from http://www.ed.gov/news /speeches/new-cte-secretary-duncans-remarks-career-and-technical-education

Garfinkel, H. (1967). *Studies in ethnomethodology*. Englewood Cliffs, NJ: Prentice Hall

Hollenbeck, K. (2011). *Conducting return on investment analysis for secondary and postsecondary CTE: A framework*. Louisville, KY: National Research Center for Career and Technical Education, University of Louisville.

Institute of Education Sciences. (2009). Most recent secondary/high school level tables. *Career/Technical Education (CTE) Statistics*. Retrieved from http://nces.ed.gov/surveys/ctes/tables/index.asp?LEVEL=SECONDARY

Institute of Education Sciences. (2013). School Locale Definitions. *Rural education in America*. Retrieved from http://nces.ed.gov/surveys/ruraled/definitions.asp

Killion, J. (2008). *Assessing impact: Evaluating staff development*. Thousand Oaks, CA: Learning Forward.

Kirkpatrick, D. L. (1994). *Evaluating training programs.* San Francisco, CA: Berrett–Koehler Publishers, Inc.

Kotamraju, P. (2011). Measuring the return on investment for CTE. *Techniques*, *86*(6), 28–31.

Learning Forward. (2013). *Standards for professional learning*. Retrieved from http://www.learningforward.org/standards/standards.cfm

Lee, H., & Munk, T. (2008). Using regression discontinuity design for program evaluation. Paper presented at the American Statistical Association Joint Statistical Meeting, Denver, CO.

Marvasti, A. (2004). *Qualitative research in sociology*. London, England: Sage.

Mississippi Department of Education. (2013). *Approved Courses for the Secondary Schools of Mississippi 2012-2013*. Office of Curriculum and Instruction. Retrieved from https://districtaccess.mde.k12.ms.us/curriculumandInstruction/ApprovedCoursesManual/Forms/AllItems.aspx

Morrison, T., DeRocco, E. S., Maciejewski, B., McNelly, J., Giffi, C., & Gardner, C. (2011). *Boiling point?: The skills gap in U.S. manufacturing*. The Manufacturing Institute and Deloitte. Retrieved from http://www.themanufacturinginstitute.org/~/media/A07730B2A798437D98501E798C2E13AA/2011_Skills_Gap_Report.pdf

National Association of State Directors of Career and Technical Education Consortium. (2011). *Career clusters at-a-glance*. Retrieved from http://www.careertech.org/career-clusters/glance/

Pathways to prosperity: Meeting the challenge of preparing young Americans for the 21st century. (2011). Rep. Harvard Graduate School of Education. Retrieved from http://www.gse.harvard.edu/news_events/features/2011/Pathways_to_Prosperity_Feb2011.pdf

Phelps, R. P., Parsad, B., Farris, E., & Hudson, L. (2001). *Features of occupational programs at the secondary and postsecondary education levels.* (NCES 2001018). U.S. Department of Education, Office of Educational Research and Improvement. Retrieved from http://nces.ed.gov/pubs2001/2001018.pdf

RCU > curriculum > curriculum download. (2013). Retrieved from https://www.rcu.msstate.edu/Curriculum/CurriculumDownload.aspx

U.S. Department of Education, Office of Vocational and Adult Education. (2010). *Carl D. Perkins Career and Technical Education Act of 2006: Report to Congress on state performance, program year 2007–2008*. Author.

U.S. Department of Education, Office of Vocational and Adult Education. *Perkins consolidated annual reports, 2009-2010*. Author.

About the Authors

Sean Owen, Ph.D., is the Data Manager for the Research and Curriculum Unit's Mississippi Assessment Center at Mississippi State University and is an Associate Research Professor at Mississippi State University. **Alexis Powe Nordin** is a Research Associate III at the Research & Curriculum Unit at Mississippi State University. **Young Bin Lim** is a Graduate Assistant at the Research & Curriculum Unit at Mississippi State University and is pursuing a doctorate in sociology.

Table 1

Annual and National Openings

Cluster	MS Openings	MS Annual Openings	National Openings	National Annual Openings	% Growth
Agriculture, Food, and National Resources	49,191	4,919	4,422,967	442,297	6%
Architecture and Construction	28,979	2,898	2,913,523	291,352	13%
Arts and Audio Visual	7,262	726	1,176,424	117,642	10%
Information Technology	1,501	150	321,780	32,178	13%
Manufacturing	26,145	2,615	2,591,018	259,102	14%
STEM	2,961	296	482,938	48,294	15%
Transportation	68,505	6,851	7,397,266	739,727	12%

**Note: Regional data is used in the VIM model. The purpose of this chart is to show annual state and national growth in CTE areas that will be impacted by effective VIMs.*

Table 2

Value Index Model Variable Formulas

Variables
Regional Demand Z = (Regional Demand Actual for specific Career Pathway – AVG Regional Demand Actual) / Standard Deviation of Regional Demand for ALL Career Pathways in the school district
Regional Demand Percent Z = (Regional Demand Percent for specific Career Pathway – AVG Regional Demand Percent) / Standard Deviation of Regional Demand Percent for ALL Career Pathways in the school district
3 Year MS-CPAS2 AVG Z = (3 YR MS-CPAS2 AVG – 3 YR MS-CPAS2 AVG of ALL students) / Standard Deviation of 3 YR MS-CPAS2 AVG of ALL students in the school district
Student Population Z = (3 YR AVG of Student Population – 3 YR AVG of Student Population in ALL of the school district's Career Pathways) / Standard Deviation of 3 YR AVG of Student Population in ALL the pathways in the school district
Cost Per Student Z = (Career Pathway Cost per Student – AVG Career Pathway Cost per Student) / Standard Deviation of Career Pathway Cost Per Student
Equipment Costs Z = (Career Pathway Equipment Costs – AVG Equipment Cost in ALL of the school district's Career Pathways) / Standard Deviation of Equipment Cost of all Career Pathways in the school

Value Index = (Regional Demand Z) + (Regional Demand Percent Z) + (3 YR CPAS AVG Z) + (Student Population Z) - (Equipment Costs Z) - (Cost per student Z)

Figure 1

Value Index Model Formula

Table 3

Value Index Model Data Dictionary

Parent Variable	Term	Operational Definition
Cost per student Z	*Pathway Cost per Student*	Salary / Student Population in the specific pathway within the given school district
	AVG Pathway Cost per Student	SUM of ALL Career Pathway Cost per Student / TOTAL number of Career Pathway Cost per Student data points
	Standard Deviation of Pathway Cost per Student of the ALL Career Pathways within the school district	Standard deviation is measured as the measure of the dispersion of a set of data from its mean
Regional Demand Percent Z	*Regional Demand Percent for specific Career Pathway*	This data point will reflect the increase in the percentage of demand, in the number of workers, the community college region is forecast to realize with respect to the given Career Pathway.
	AVG Regional Demand Percent	SUM of ALL Regional Demand Percent of all Career Pathways in the school district / TOTAL number of Regional Demand Percent data points
	Standard Deviation of Regional Demand Percent for ALL pathways in the school district	Standard deviation is measured as the measure of the dispersion of a set of data from its mean
Regional Demand Z	*Regional Demand Actual for specific Career Pathway*	This data point will reflect the increase in the amount of actual demand, in the number of workers, the community college region is forecast to realize with respect to the given Career Pathway.
	AVG Regional Demand Actual	SUM of ALL Regional Demand of all Career Pathways in the school district / TOTAL number of Regional Demand data points
	Standard Deviation of Regional Demand for ALL pathways in the school district	Standard deviation is measured as the measure of the dispersion of a set of data from its mean
3 YR AVG MS-CPAS2 Z	*3 YR MS-CPAS2 AVG*	SUM of ALL MS-CPAS2 scores of students in a SPECIFIC pathway within the school district over the 3 year period / TOTAL number of MS-CPAS2 scores in that 3 year period
	3 YR MS-CPAS2 AVG of ALL students	SUM of ALL MS-CPAS2 scores of students in ALL of the Career Pathways within the school district / TOTAL number of MS-CPAS2 score data points in that 3 year period of ALL students in pathways within the school district
	Standard Deviation of 3 YR MS-CPAS2 AVG of ALL students in the school district	Standard deviation is measured as the measure of the dispersion of a set of data from its mean
Student Population Z	*3 YR AVG of Student Population*	SUM of ALL Student Populations in a specific Career Pathway within the school district over the 3 year period / TOTAL number of Student Populations in the same specific Career Pathway in that 3 year period
	3 YR AVG of Student Population in ALL Career Pathways	SUM of ALL Student Populations in ALL of the Career Pathways within the school district over the 3 year period / TOTAL number of Student Population data points in ALL of the pathways within the school district over the 3 year period

Parent Variable	Term	Operational Definition
	Standard Deviation of 3 YR AVG of Student Population in ALL the pathways in the school district	Standard deviation is measured as the measure of the dispersion of a set of data from its mean
Equipment Costs Z	*Career Pathway Equipment Costs*	This data point reflects the minimum equipment costs required for the Career Pathway.
	AVG Equipment Cost	SUM of equipment costs in ALL of the Career Pathways within the school district over the 3 year period / TOTAL number of equipment cost data points in ALL of the pathways within the school district over the 3 year period
	Standard Deviation of Equipment Cost of all pathways in the school district	Standard deviation is measured as the measure of the dispersion of a set of data from its mean

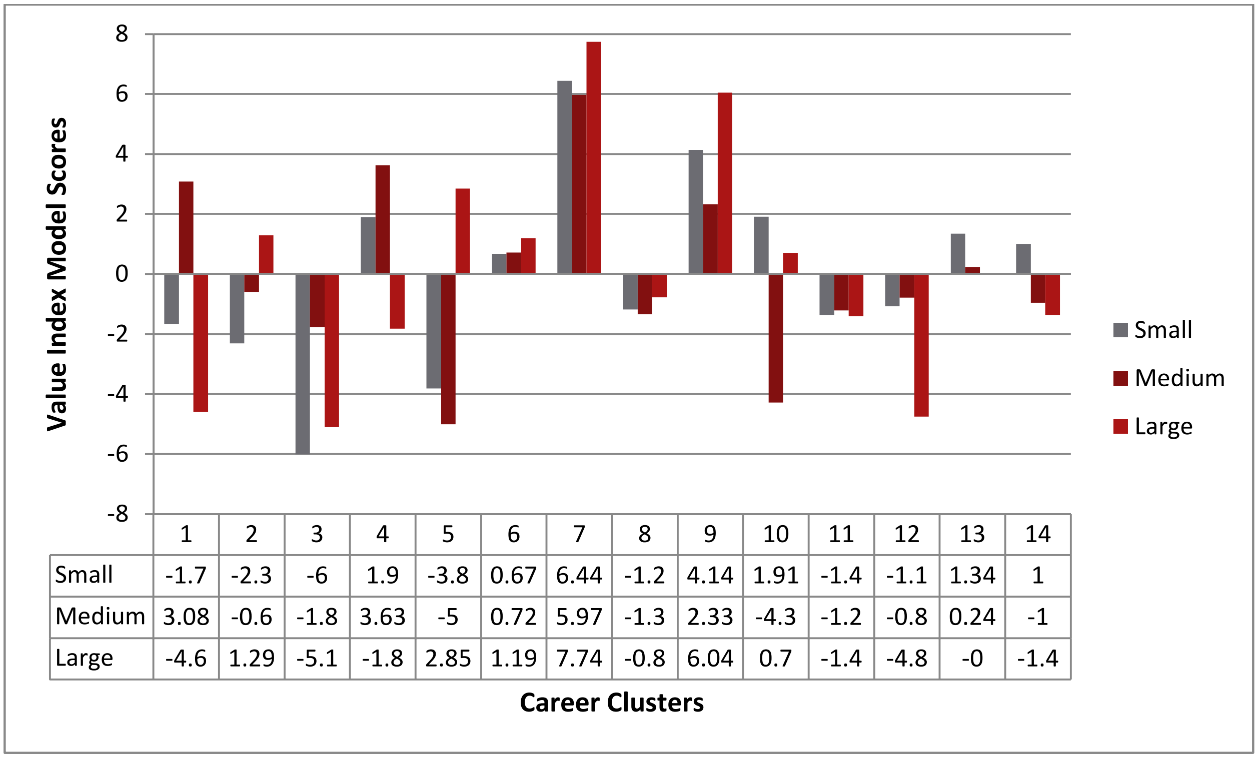

Figure 2
Value Index Model Results for Three School District Size Examples

Table 4
Value Index Model Results – Small School District

Career Cluster	1	2	3	4	5	6	7	8	9	10	11	12	13	14
VIM Score	-1.66	-2.31	-6.01	1.9	-3.81	0.67	6.44	-1.18	4.14	1.91	-1.36	-1.08	1.34	1

Table 5
Value Index Model Results – Medium School District

Career Cluster	1	2	3	4	5	6	7	8	9	10	11	12	13	14
VIM Score	3.08	-0.6	-1.77	3.63	-5.01	0.72	5.97	-1.34	2.33	-4.28	-1.21	-0.79	0.24	-0.96

Table 6
Value Index Model Results – Large School District

Career Cluster	1	2	3	4	5	6	7	8	9	10	11	12	13	14
VIM Score	-4.59	1.29	-5.10	-1.82	2.85	1.19	7.74	-.78	6.04	.70	-1.40	-4.75	-.01	-1.36

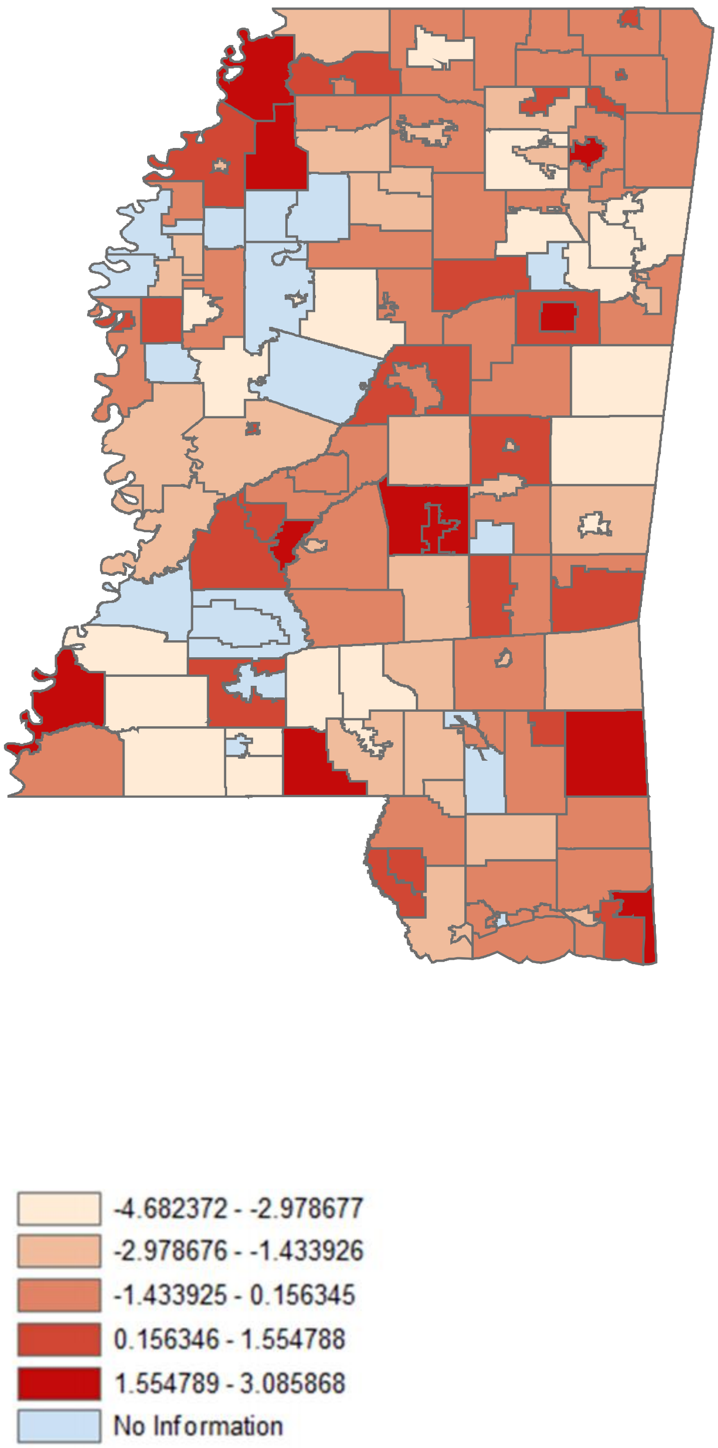

Figure 3
Spatial Analysis of a Career Cluster