National Research Center for Career and Technical Education

A New Typology for Career and Technical Education (CTE): Measuring Engagement, Achievement and Transitions of CTE Students

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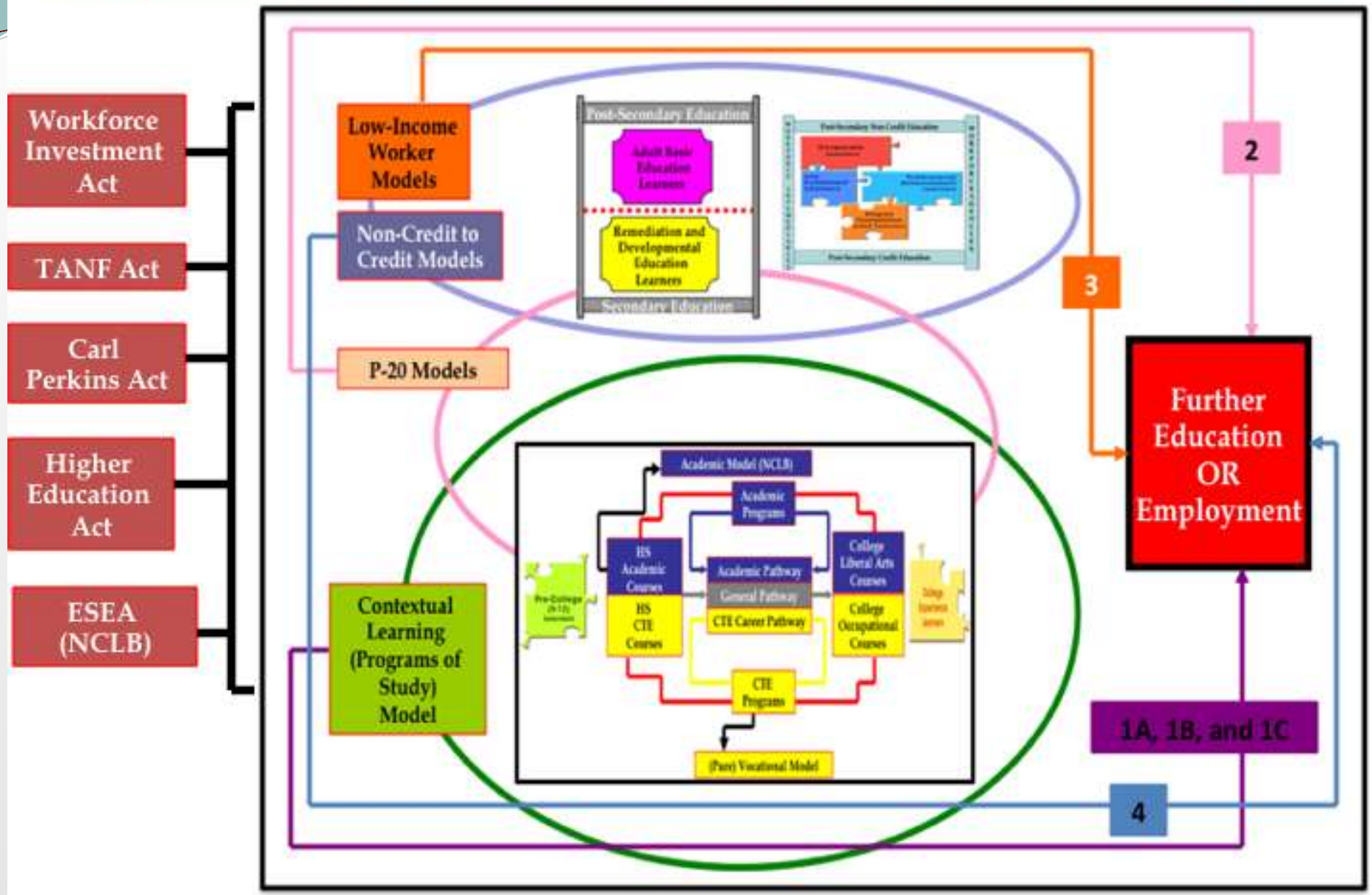
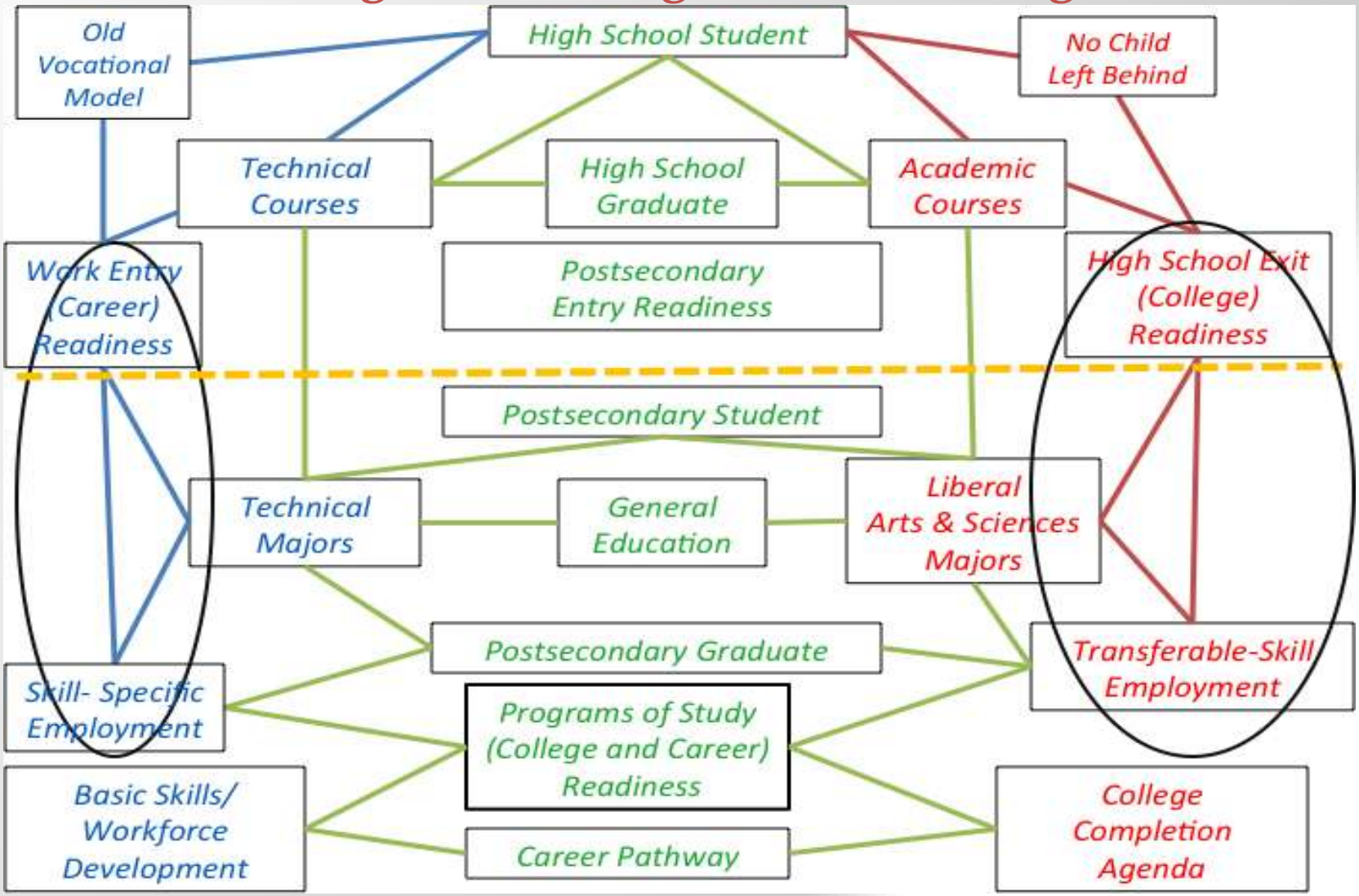
NRCCTE National Research Center for Career and Technical Education

Conceptualizing Paths to Employment or Further Education for Improving Student and Worker Outcomes: Multiple Interactions between Federal Legislations, Underlying Structural Models, and Learner Segments



A Methodological Rationale for Measuring, Accounting, and Evaluating CTE



Discussion Point Number One

- Suppose you have three elements to classify CTE students. These elements are:
  - ✓ The total number of CTE credits enrolling and completing
  - ✓ The total number of occupational areas enrolling and completing
  - ✓ The total number of credits in any one occupational area
- Based on the above elements, how many different types of CTE students can you identify?

Defining the CTE student

- Different denominations: concentrator, participant, investor …
- "Traditional" classification in large surveys:
  - Academic track
  - Vocational track
  - Neither and both (dual)—as defined in the NCES sample survey
- NCES: Fulfillment of an occupational area if 3 or more credits are taken in that area ("occupational concentrator")
- Different levels, different goals

Reformulating CTE Course Taking

- Traditionally, CTE includes only the total number of CTE credits enrolled and completed either across all areas or within one area to identify the extent of participating or concentrating in CTE. A three-credit threshold is used to divide CTE students into participants and concentrators
- The NRCCTE has begun exploring, examining, and analyzing credits taken within an occupational area, across all occupational areas, and the number of occupational areas in which high school graduates participate and concentrate
- The source of the data is the US Department of Education sample survey data, specifically the 2005 NCES High School Transcript Studies (HSTS) data and the Education Longitudinal Study (ELS) data

Reformulating CTE Course Taking

- The purpose is to understand, the level, mix, and intensity of CTE course-taking within and across different occupational areas.
- The NRCCTE has expanded the participant-concentrator dichotomy by creating a taxonomy that more accurately represents CTE course-taking.
- Using the Classification of Secondary School Courses (CSSC) different parts of the high school graduates' transcripts are analyzed

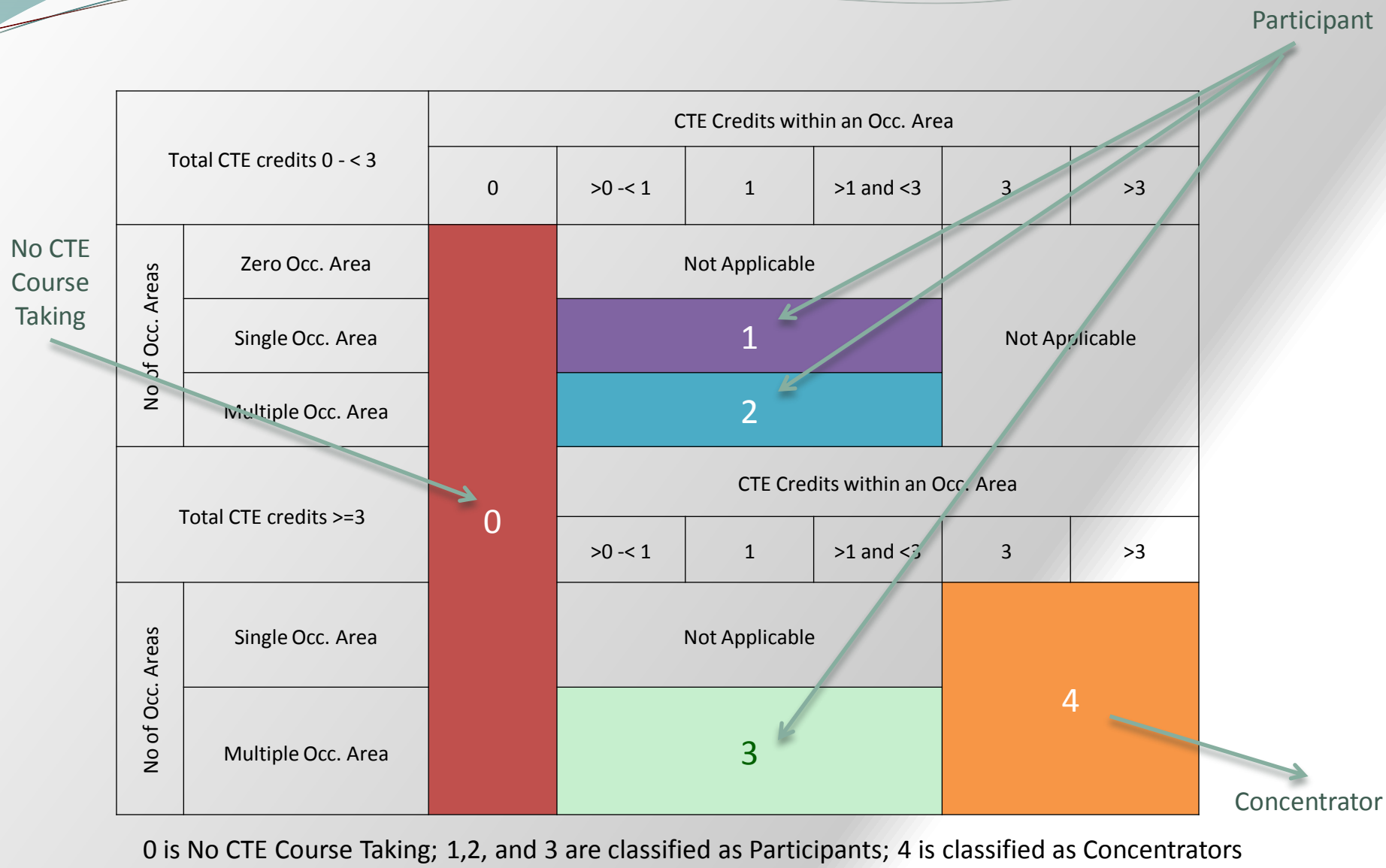
Reformulating CTE Course Taking

- Following along the lines of NCES, the basic steps are as follows:
  - Identify CTE and Academic courses
  - Divided CTE into 13 occupational areas
  - Divided Academic into different subject areas, including Math and Science
  - Categorized Math & Science courses by three levels: Less than Basic, Basic, and Advanced
  - Identified Academic and CTE courses which are in sequence and further divided by No Sequence/Sequence
  - Determined the last grade year Math & Science course taken

Reformulating CTE Course Taking

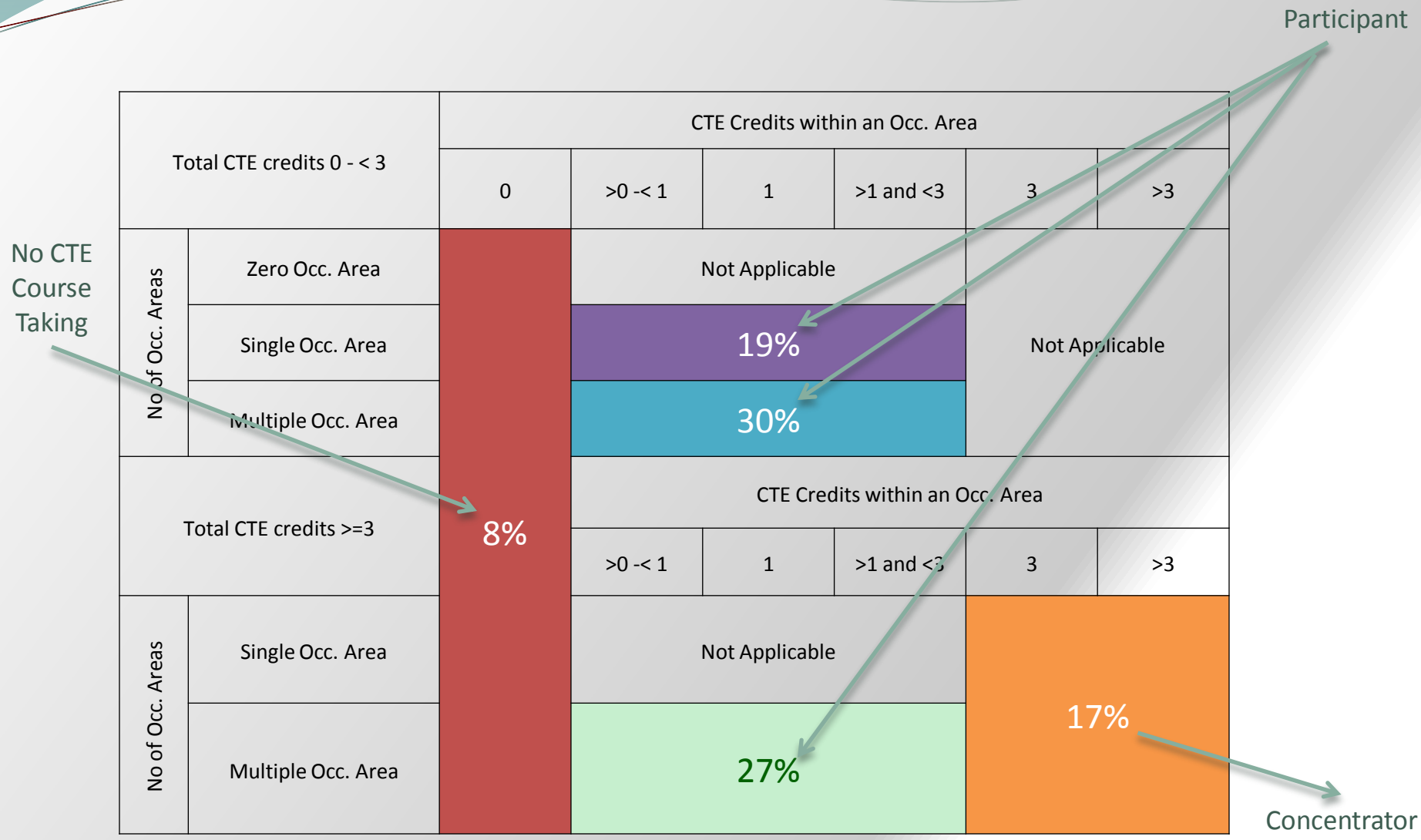
- Dividing CTE course taking patterns of high school graduates (students) into three facets:
  - Identify how many credits high school graduates takes and completes within each occupational area
  - Determine the total number of CTE credits enrolled and completed across all occupational areas
  - Count the number of occupational areas in which each graduate enrolls and completes courses
- A crosstab has been built that relates the above three facets creating the following (shown on the next slide)

Reformulating CTE Course Taking



0 is No CTE Course Taking; 1,2, and 3 are classified as Participants; 4 is classified as Concentrators

Reformulating CTE Course Taking



0 is No CTE Course Taking; 1,2, and 3 are classified as Participants; 4 is classified as Concentrators

Reformulating CTE Course Taking

	Number of Occupational Areas		
		ZERO	ONE OR MORE
Total Number of Credits	<3		
	>=3		

Reformulating CTE Course Taking

	Number of Occupational Areas		
		ZERO	ONE OR MORE
Total Number of Credits	<3	INVESTOR	EXPLORER
	>=3	ENTREPRENEUR	CONCENTRATOR

Discussion Point Number Two

- Now that you have the four different ways of defining CTE course-taking, how about their academic course-taking, specifically Math and Science? Can be discussed in terms of the following:
  - ✓ Math & Science course-taking sequence
  - ✓ Grade in which last Math & Science course taken
  - ✓ Highest Math & Science course taken
- What might be the Math & Science course-taking for each of the four groups of CTE students?

SAMPLE

The data used for the statistical analysis in this paper is drawn from the **2005 High School Transcript Study (HSTS**), which is a representative sample of all high school graduates in the United States. The sample chosen for the study was based on the following criteria:

- Only public high school students graduating from comprehensive high schools are included
- Only students who have enrolled in both CTE courses and academic courses are included, having completed at least a standard academic curriculum
- All public high graduates leaving with a standard regular diploma after meeting 100% of the graduation requirements
- The graduate has a transcript for all four years of high school, restricted to credit earned in courses in which the graduate has received an A-F grade
- The minimum number of academic credits is 13 and the minimum number of CTE credits is one

After accounting for missing values, the total sample size was equal to just over 18,280. The sample was a representative of approximately 1.9 million public high school graduates, who met the above criteria.

ACADEMIC COURSE TAKING REQUIREMENTS

Defining curriculum levels

In this report, three curriculum levels are used to report on the coursetaking patterns of graduates: standard, midlevel, and rigorous. The curriculum levels are based on the number of credits and the types of courses graduates completed. For example, a standard curriculum level consists of four credits of English; three credits each of social studies, mathematics, and science; and no foreign language credits. Figure 2 describes the course credits graduates need to complete to be classified at each curriculum level.

FIGURE 2 Course credit requirements to attain specified curriculum levels

	STANDARD	MIDLEVEL	RIGOROUS
ENGLISH	4	4	4
SOCIAL STUDIES	3	3	3
MATHEMATICS	3	3 (including geometry and algebra I or II)	4 (including precalculus or higher)
SCIENCE	3	3 (including at least two of biology, chemistry, and physics)	3 (including biology, chemistry, and physics)
FOREIGN LANGUAGE	0	1	3

NOTE: This is a modified version of curriculum levels used by Laura Horn and Lawrence K. Kojaku (*High School Academic Curriculum and the Persistence Path Through College*, National Center for Education Statistics, NCES 2001–163, U.S. Department of Education, Washington, DC: 2001). The standard curriculum level is equivalent to what Horn and Kojaku refer to as a core curriculum; the nomenclature used in this report is different to avoid confusion with core credits also discussed in this report. One difference between this report and the classification by Horn and Kojaku is that to be considered as having completed a rigorous curriculum, this report does not require graduates to have taken an AP or honors course. This modification was made to ensure that HSTS data for earlier years are consistent with data for 2005.

CTE Course Taking Intensity and Math/Science Course Taking Sequencing

	Math			Science	
CTE Categories	No Sequence	Sequence		No Sequence	Sequence
Investor	29%	71%		80%	20%
Explorer	32%	68%		81%	19%
Entrepreneur	31%	69%		82%	18%
Concentrator	28%	72%		83%	17%
All CTE Taking Graduates	30%	70%		82%	18%

Sequence is defined as taking both lower- and higher-order sequenced courses in Math or Science

CTE Course Taking Intensity and Math/Science Course Taking Levels

	Math				Science		
CTE Categories	Less than Basic	Basic	Advanced		Less than Basic	Basic	Advanced
Investor	0%	38%	62%		1%	48%	52%
Explorer	0%	45%	55%		1%	52%	48%
Entrepreneur	1%	53%	46%		1%	58%	41%
Concentrator	1%	57%	42%		1%	61%	37%
All CTE Taking Graduates	1%	50%	50%		1%	56%	44%

Less than Basic: Courses that are generally not part of Academic Curriculum Standards; Basic: Courses like Algebra, Geometry, and Trigonometry are usually part of academic curriculum standards; Advanced: Courses like Calculus, AP Math, AP Science etc. that are taken by graduates committed to seeking entry into postsecondary, usually four-year universities

CTE Course Taking Intensity and Grade Level in which Last Math/Science Course Taking

	Math				Science		
CTE Categories	10th Grade	11th Grade	12th Grade		10th Grade	11th Grade	12th Grade
Investor	2%	24%	74%		3%	35%	62%
Explorer	2%	28%	70%		4%	37%	59%
Entrepreneur	3%	34%	63%		6%	43%	51%
Concentrator	4%	40%	57%		7%	48%	45%
All CTE Taking Graduates	3%	32%	65%		5%	42%	53%

Grade levels are when the high school graduate has taken their last Math and Science course

Results

- CTE Course-taking Intensity and Math/Science Sequencing
  - Many more graduates participate in Math sequencing than they do in Science sequencing
  - As CTE Course-taking intensity increases, there is no clear-cut relationship with Math sequencing; but with Science sequencing there is a negative relationship
- CTE Course-taking Intensity and Math/Science Levels
  - Nearly all graduates participate in at least at the Basic Math and Basic Science course-taking levels regardless of CTE course-taking intensity
  - As CTE Course-taking intensity increases, graduates are more likely to take and complete Basic courses in Math and Science than they are Advanced Math and Science

Results

- CTE Course-taking Intensity and Last Grade in which Math/Science Courses are taken
  - A very small proportion of graduates take their last Math and Science course in the 10th grade
  - Not surprisingly, given academic requirements, Math and Science course-taking is typically not completed before the 11th grade
  - As CTE Course-taking Intensity increases, graduates are more likely to complete their Math and Science requirements by the 11th grade

Preliminary Conclusions and Implications

- Not taking Science courses in sequence might be problematic since the occupations of the future (e.g., allied health care) are requiring Science courses to be taken more in the form of a sequence. This is particularly relevant when increasing CTE course-taking intensity implies specialization in occupational areas such as heath and engineering technologies
- The unclear Math sequencing relationship to CTE course-taking intensity may be indicative of Math avoidance. It could also be because may of the occupational areas may not require higher level math course. This further is reinforced by those graduates with increasing CTE course-taking intensity, who stop taking higher order Math courses in the 11th grade.

Preliminary Conclusions and Implications

- Seeking substitutes for higher-sequenced Math and Science courses, specifically those concentrating in one or more occupational areas, and going for a substantial period without taking Math may result in a lack of preparedness when it comes to postsecondary entry.
- Missing Math and Science course-taking during the entire 12th grade is problematic. However, it raises the possibility of creating more Math and Science courses that are applied, but at the same time, more relevant and rigorous. Such courses should help narrow the chasm that now exists between high school exit and postsecondary entry.

Discussion Point Number Three

- With the four different ways of defining CTE course-taking, what is the likelihood that high school graduates will:
  - ✓ Not drop out of high school
  - ✓ Be college and career ready
  - ✓ continue their program into postsecondary
- Which of the four CTE groups are likely to continue in the same occupational area that they started in high school (programs of study)

METHODOLOGY

- Data: Education Longitudinal Study of 2002, 12th grade Cohort (2004)
- Base Year, 1st Follow-up, and 2nd Follow-up (2006) and transcript (restricted) data
- In addition to applying CSSC taxonomy, CTE student enrollment in sets of CTE occupational areas were identified, the number of occupational areas CTE students enroll, and whether or not each student met the 3-credit threshold within each occupational area

METHODOLOGY

- Sample restricted to high school graduates who took both CTE and academic courses, graduating from comprehensive high schools, and were enrolled in postsecondary CTE programs within two years of graduation
- Each graduate CTE enrollment level in each occupational area identified as “not enrolled,” “not fulfilled”, and “fulfilled”
- For each graduate, an occupational area combination variable is developed to indicate which occupational areas a graduate enrolls in, and which of the three levels --- not enrolled,” “not fulfilled”, and “fulfilled” --- the graduate chooses
- The top ten occupational area combinations are extracted for each graduate enrolled using the CTE typology developed by the NRCCTE

Frequencies of CTE Credit Categorizations (n=2,698,609)

CTE Credit Categorization	%
No CTE credits	8.0
More than 0 and less than 1 CTE credits, no occupational area fulfilled	7.5
1 CTE credit, no occupational area fulfilled	10.7
More than 1 and less than 3 CTE credits, no occupational area fulfilled	29.9
3 CTE credits, no occupational area fulfilled	7.6
More than 3 CTE credits, no occupational area fulfilled	19.6
3 CTE credits, 1 occupational area fulfilled	0.8
More than 3 credits, at least 1 occupational area fulfilled	16.0

Frequencies of Gender, Race and Socioeconomic Status by CTE Credit Categorizations for Public High School Students

	0	1	2	3	4	5	6	7	Weighted n
Female	9.0	8.1	11.4	30.8	7.6	18.4	0.9	13.8	1,378,033
Male	6.9	6.8	9.9	28.9	7.6	20.8	0.7	18.3	1,320,577
White	8.3	7.4	10.1	27.8	7.1	21.2	0.8	17.4	1,633,287
Black	8.0	5.7	8.9	33.5	7.8	17.9	1.3	16.9	379,133
Hispanic	7.7	9.2	12.2	31.6	8.8	17.7	0.8	12.1	421,325
Asian	10.3	9.8	17.0	34.9	7.2	12.0	0.3	8.4	122,181
Other	7.5	9.8	21.0	70.2	16.5	46.8	1.3	26.7	142,684
SES-Q1 (Low)	5.9	6.0	9.7	29.5	7.8	20.6	0.9	19.6	640,172
SES-Q2	5.7	6.6	8.6	28.9	7.2	23.6	0.5	19.0	687,844
SES-Q3	8.7	6.4	10.3	30.7	8.2	19.5	0.8	15.3	703,344
SES-Q4 (High)	11.7	11.0	14.1	30.4	7.1	14.5	1.0	10.2	667,249

Group 0: No CTE credits
Group 1: More than 0 and less than 1 CTE credits, no occupational area fulfilled
Group 2: 1 CTE credit, no occupational area fulfilled
Group 3: More than 1 and less than 3 CTE credits, no occupational area fulfilled
Group 4: 3 CTE credits, no occupational area fulfilled
Group 5: More than 3 CTE credits, no occupational area fulfilled
Group 6: 3 CTE credits, 1 occupational area fulfilled
Group 7: More than 3 credits, at least 1 occupational area fulfilled

Preliminary Results

- Students taking more than 3 CTE credits, with or without a focus on an occupational area, are 36% to 59% less likely to drop out of high school than those taking fewer CTE credits.
- Students who have taken 3 or more CTE credits, fulfilling the requirements of an occupational area or not, are at least 43% more likely to attend 2-year colleges than those taking fewer CTE credits.
- Based on high school graduate transcripts that describe CTE and academic course taking, and using conventional definitions of college, career, and college and career readiness, early estimates for each are 42%, 28%, and 18%, respectively.

CTE Group	High School CTE AREA	Postsecondary Program
Occupational Area Not Fulfilled (Less than 3 Credits One Occupational Area) {1}	Consumer Services; Business support and management; Computer and information science; Communications and design	Business/management/marketing/related; Engineering technologies/technicians: Arts--visual and performing; Health professions/clinical sciences; Education

- High school graduates take CTE courses in "newer" CTE clusters
- Enrolling in postsecondary programs that have some degree of "marketability"
- With CTE credits averaging around one and high school CTE enrollment in only one occupational area, how are secondary and postsecondary programs related and connected?

CTE Group	High School CTE AREA	Postsecondary Program
Occupational Area Not Fulfilled (Less than 3 Credits More than One Occupational Area) {2}	Consumer Services; Computer and information science; Business support and management; Communications and design; Business Finance	Business/management/marketing/related; Health professions/clinical sciences; Education

- High school graduates take CTE courses in "newer" CTE clusters
- Enrolling in postsecondary programs that have some degree of "marketability" but choices appear to be narrowing
- With CTE credits averaging around 1.80 and CTE enrollment in more than one occupational area, will the case for secondary and postsecondary programs linkages be better defined?

CTE Group	High School CTE AREA	Postsecondary Program
Occupational Area Not Fulfilled (More than 3 Credits and more than one occupational area but not reaching the 3-credit threshold for an occupational area) {3}	Communications and design; Business support and management; Consumer Services; Computer and information science; Business Finance; Marketing	Business/management/ marketing/related; Engineering technologies/technicians: Health professions/clinical sciences; Education

- High school graduates take CTE courses in "newer" CTE clusters but mix and match occupational areas but not enough to concentrate in any one
- Enrollment in postsecondary programs appear to link back to high school CTE enrollment
- With CTE credits averaging around almost four and CTE enrollment in more than one occupational area, are these CTE students laying a foundation for a program of study?

CTE Group	High School CTE AREA	Postsecondary Program
Occupational Area Fulfilled (at least 3 credits in one occupational area) {4}	Health Sciences (F); Communications and design (F); Computer and information sciences (F); Consumer Services (F); Agriculture and natural resources (F); Business support and management; Engineering technologies	Business/management/ marketing/related; Engineering technologies/technicians: Arts--visual and performing; Health professions/clinical sciences; Education

- High school graduates take CTE courses in "newer" CTE clusters but mix and match occupational areas but concentrate in at least one occupational area
- Enrollment in postsecondary programs appear to link back to high school CTE enrollment
- With CTE credits averaging over four and a half and graduate fulfills at least one occupational area, are these CTE students making their program of study at the high school level itself?

Stakeholder Contacts: Publications

- Kotamraju, P. (2011, June). *A new taxonomy of high school career and technical education (CTE): Describing the engagement, achievement, and transitions of CTE students.* Paper presented at the 15h Annual Career Clusters Institute, Atlanta, GA.
- Kotamraju, P. (in press—expected publication date, Summer 2011). Vocational education and training quality and evaluation: Its place in the U.S. community college. In A. Barabasch & F. Rauner (Eds.), *The art of integration: Work and education in America*. Berlin, Germany: Springer Verlag Press.
- Kotamraju, P. (2011). Meeting the 2020 American Graduation Initiative (AGI) goal of increasing postsecondary graduation rates and completions: A macro perspective of community college student educational attainment. *Community College Journal of Research and Practice*, *35*(1-2), 1-18.
- Kotamraju P., Richards, A., Wu, J., & Klein, S. (2010, April). *A common postsecondary data dictionary for Perkins accountability.* Louisville, KY, and Berkeley, CA: National Research Center for Career and Technical Education, University of Louisville, and MPR Associates, Inc. Retrieved from http://136.165.122.102/UserFiles/File/Tech_Reports/Postsecondary_Data_Dictionary_Report_WEB.pdf

Stakeholder Contacts: Paper Presentations

- Kotamraju, P. (2011, May). CTE Measurement, Accountability and Evaluation: The NRCCTE's Comprehensive Strategy for Technical Assistance. Paper To Be Presented at the National Association of Career and Technical Education Information annual Meeting, Philadelphia, Pennsylvania.
- Kotamraju, P. (2011, May). A New Taxonomy for Career and Technical Education (CTE): Measuring Engagement, Achievement, and Transitions of CTE Students. Paper To Be Presented at the National Association of Career and Technical Education Information annual Meeting, Philadelphia, Pennsylvania.
- Kotamraju, P. (2011, April). Getting Timing and Sequencing of Math and Science Course-Taking Right: A Possible Answer to the College and Career Readiness of High School Graduates Concentrating on Career and Technical Education (CTE). Paper presented at 2011 Council for the Study of Community Colleges Annual Conference. New Orleans.
- Aliaga, Oscar. (2011, April). Career and Technical Education Graduates and Enrollment in 2-Year Colleges. Paper presented at the annual meeting of the Council for the Study of Community Colleges. New Orleans, Louisiana.
- Kotamraju, P. (2011, April). The college and career readiness of U.S. high school graduates: From concept to measurement. Paper to be presented at the annual convention of the American Educational Research Association. New Orleans, LA.

Stakeholder Contacts: Paper Presentations

- Kotamraju, P. (2010, December). A tool kit for measuring CTE effectiveness using return on investment and other related techniques: A basic introduction. Paper presented at the annual convention of the Association for Career and Technical Education, Las Vegas, NV.
- Kotamraju, P. (2010, October). Meeting the 2020 AGI completion goal: The role of the community college. Paper presented at the annual convention of the National Council of Workforce Education, Washington, DC.
- Kotamraju, P. (2010, June). Building a Technical Skills Inventory Database One State at a Time," 14th Annual Career Clusters Institute, Denver, Colorado.
- Kotamraju, P. (2010, May). A Cross-State Comparison of Postsecondary CTE Student Graduation Rates and Completions: Determining the Efficacy of Using IPEDS Data for Perkins Reporting," National Association of Career and Technical Education Information Annual Meeting, St. Louis, Missouri.
- Kotamraju, P. (2010, May). Building a Useable Inventory Template for Collecting State and Local Information for Meeting the Technical Skills Accountability. National Association of Career and Technical Education Information Annual Meeting, St. Louis, Missouri.
- Kotamraju, P. (2010, April). A Cross-State Comparison of Postsecondary Student Graduation Rates: A Macro Perspective of Educational Attainment," Annual Meeting, Council for the Study of Community Colleges, Seattle, Washington.

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- Kotamraju, P. (2009, December). The Minnesota FastTRAC Project: Solving the Career Pathways Puzzle. 15th Annual Data Quality Institute, Baltimore, Maryland.
- Kotamraju, P. (2009, December). Building a Technical Skill Inventory Database One State at a Time," 15th Annual Data Quality Institute, Baltimore.
- Kotamraju, P. (2009, May). A Repository Template of Technical Skills Assessment: Collecting, Accessing, Reporting and Using Information and Resources for Meeting the Perkins Technical Skill Attainment Indicator," National Association of Career and Technical Education Information Albuquerque, New Mexico.
- Kotamraju, P. (2009, May). Building a Data Dictionary Template from State Administrative Record Data Systems," Albuquerque, New Mexico.

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