



# **A PATHWAY TO POSTSECONDARY EDUCATION IN STEM FIELDS: EFFECTIVENESS OF PROJECT LEAD THE WAY IN IMMEDIATE COLLEGE PERSISTENCE**

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# BACKGROUND

- Expanding the pool of engineers and scientists has been a focus for the U.S. higher education in the past decades.
- Project Lead The Way (PLTW)
  - Aims to provides middle school and high school students with a seamless path to college and career success in STEM-related fields.
  - Aims to expand the proportion of students who persist in STEM fields.

# PROJECT LEAD THE WAY ROBOTICS



## PROJECT LEAD THE WAY

- Sequence of year-long pre-engineering courses for secondary students.
- Problem-based/Project-based Learning (PBL) approach to increase engagement & performance.
- Provides “dual-credit” for students in either CTE or A&S areas depending upon performance.

# RESEARCH QUESTIONS

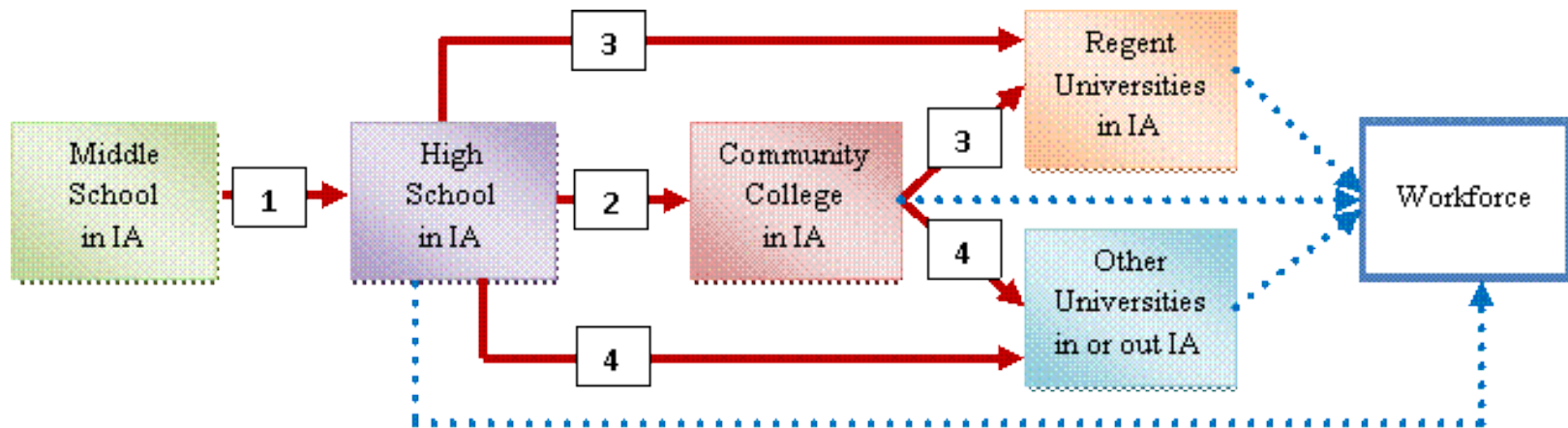
- What demographic and achievement factors (e.g., ethnicity, gender, social economic status, PLTW participation, attendance, ITED math and science scores, etc.) predict PLTW and non-PLTW student persist to 2- or 4-year institutions?
- To what extent do PLTW and non-PLTW students persist to 2-year institutions?

# THEORETICAL FRAMEWORK

- Student Learning and Cognitive Development (Pascarella, 1985)
  - student background and precollege characteristics
  - structural and organization characteristics of the institution
  - institutional environment
  - interactions with socializing agents
  - quality of student effort
- Conceptualization of Student Retention (Hagedorn & Cepeda, 2004; Hagedorn, Moon, Cypers, Maxwell & Lester, 2006; Hagedorn, Cypers & Lester, 2008)
  - students' academic success lead to a likelihood of transfer to a postsecondary education institution and have positive influence on student retention in college.

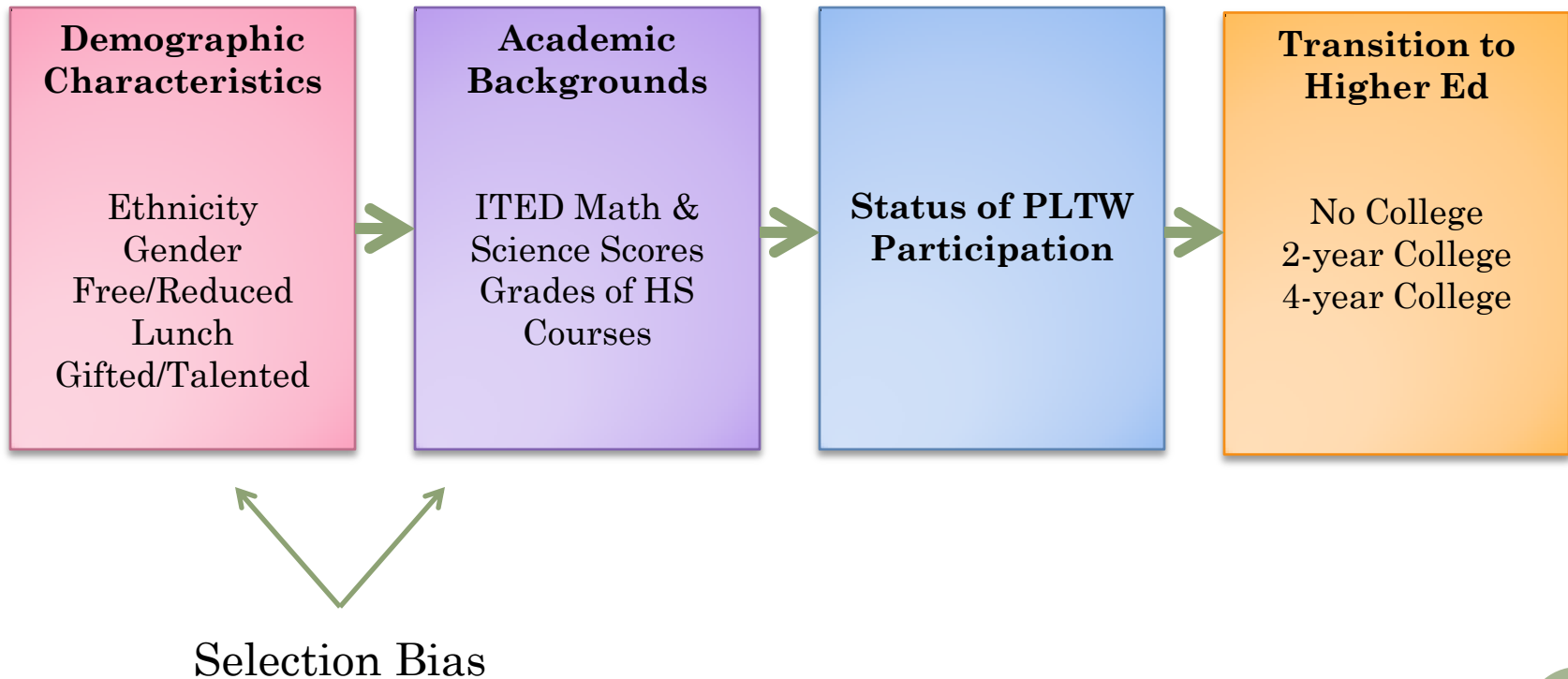
# DATA SOURCES & METHODS

- A part of a large-scale, statewide research project
- PLTW and non-PLTW students who graduated from high schools in Iowa in 2009
- Data sources



1: Iowa Dept. of Ed. K-12 Data; 2: Community College MIS  
3: Regent University Partnership; 4: National Student Clearinghouse

# HYPOTHETICAL MODEL





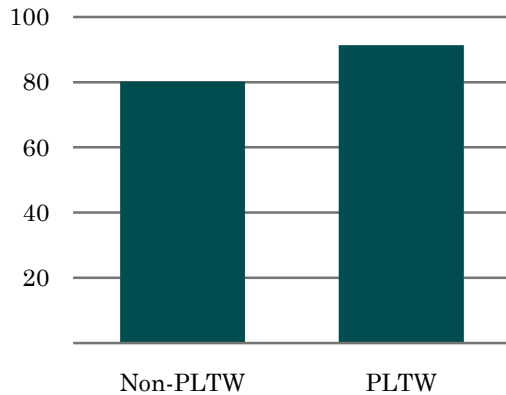
# RESULTS – TRANSITION TO HE

Table 1. *Transition of PLTW and Non-PLTW Students to Higher Education*

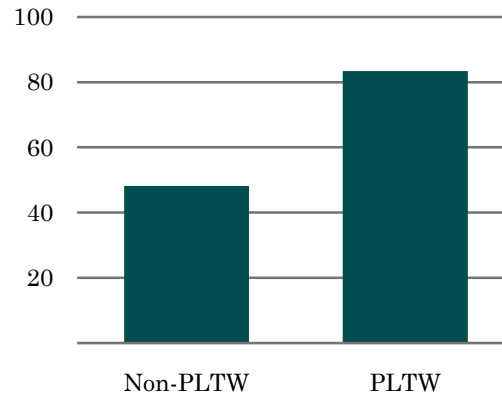
Postsecondary Enrollment	PLTW Participation				Total
	Non-PLTW		PLTW		
	n	%	n	%	
4-year	4,132	28.74	295	33.33	4,427
2-year	3,299	22.95	336	37.97	3,635
No College	6,944	48.31	254	28.70	7,198
Total	14,375	100.00	885	100.00	15,260

# IMBALANCE – DEMOGRAPHICS

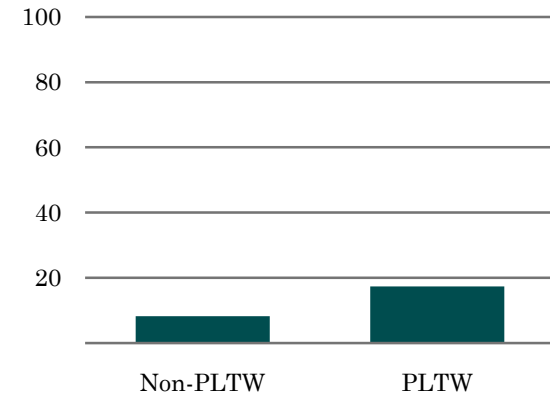
**Caucasian**



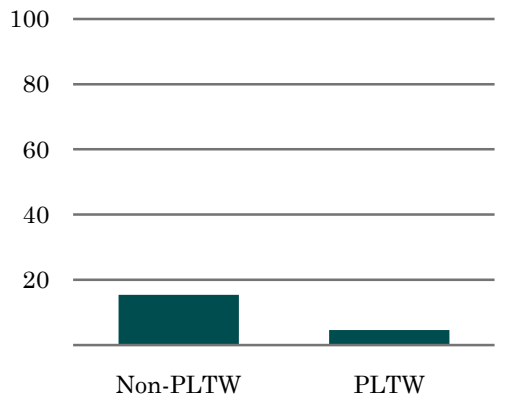
**Male**



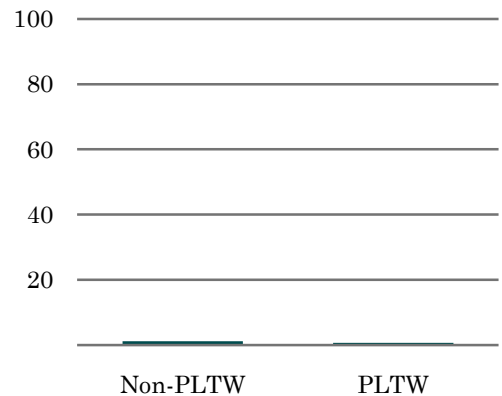
**Gifted & Talented**



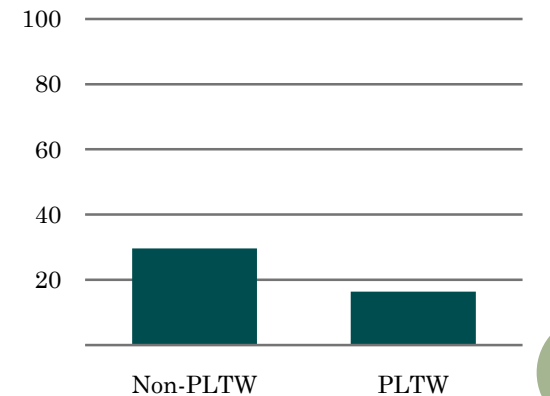
**IEP**



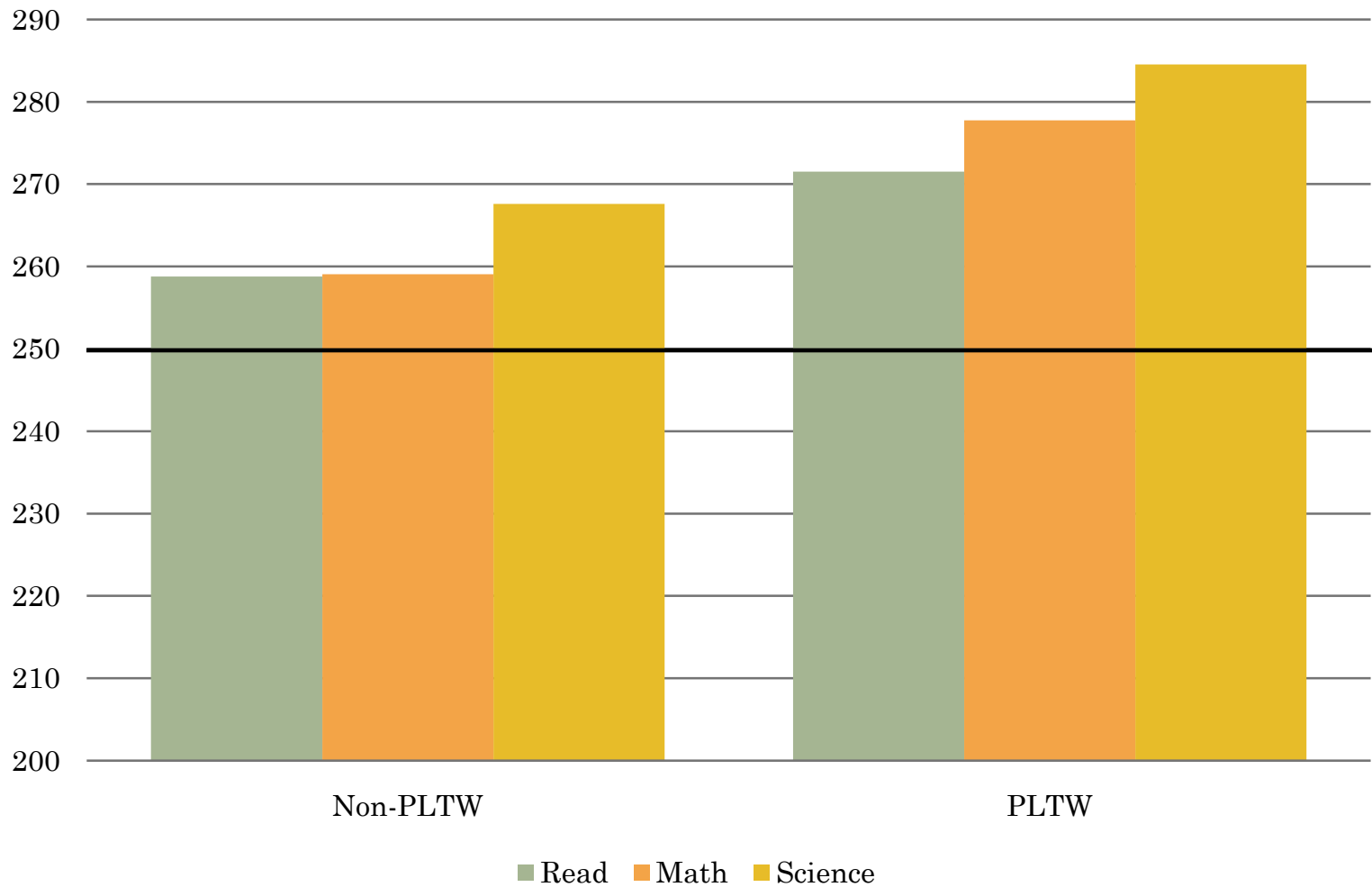
**Section 504**



**Free/Reduced Lunch**



# IMBALANCE – 8<sup>TH</sup> GRADE ITS SCORES



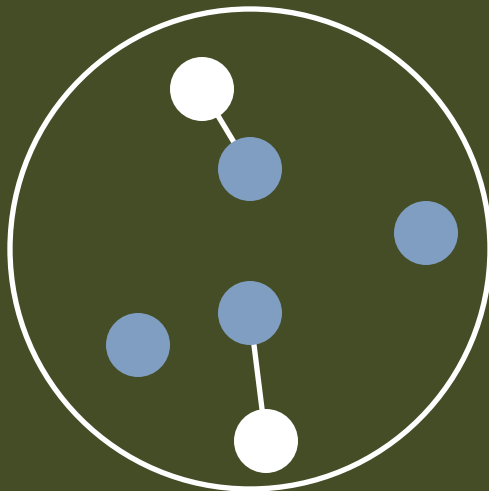
# PROPENSITY SCORES

$$\tau = \varphi(\alpha + \beta\mathbf{X} + \varepsilon)$$

- Race/Ethnicity
- Free/Reduced Lunch
- IEP / Section 504
- Gifted & Talented
- 8<sup>th</sup> Grade ITBS subtest in Math, Science, & Reading

# MATCHING METHODS

## NEAREST NEIGHBOR



● Non-participants  
● Participants

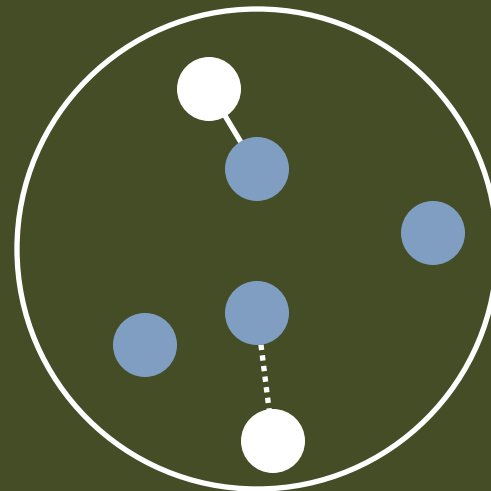
Local minima

$$d_{\text{NN},i} = \|x_{\tau,i} - x_{\tau',i}\|$$

$$\mathbf{D} = \sum d_i$$

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## GENETIC ALGORITHMS



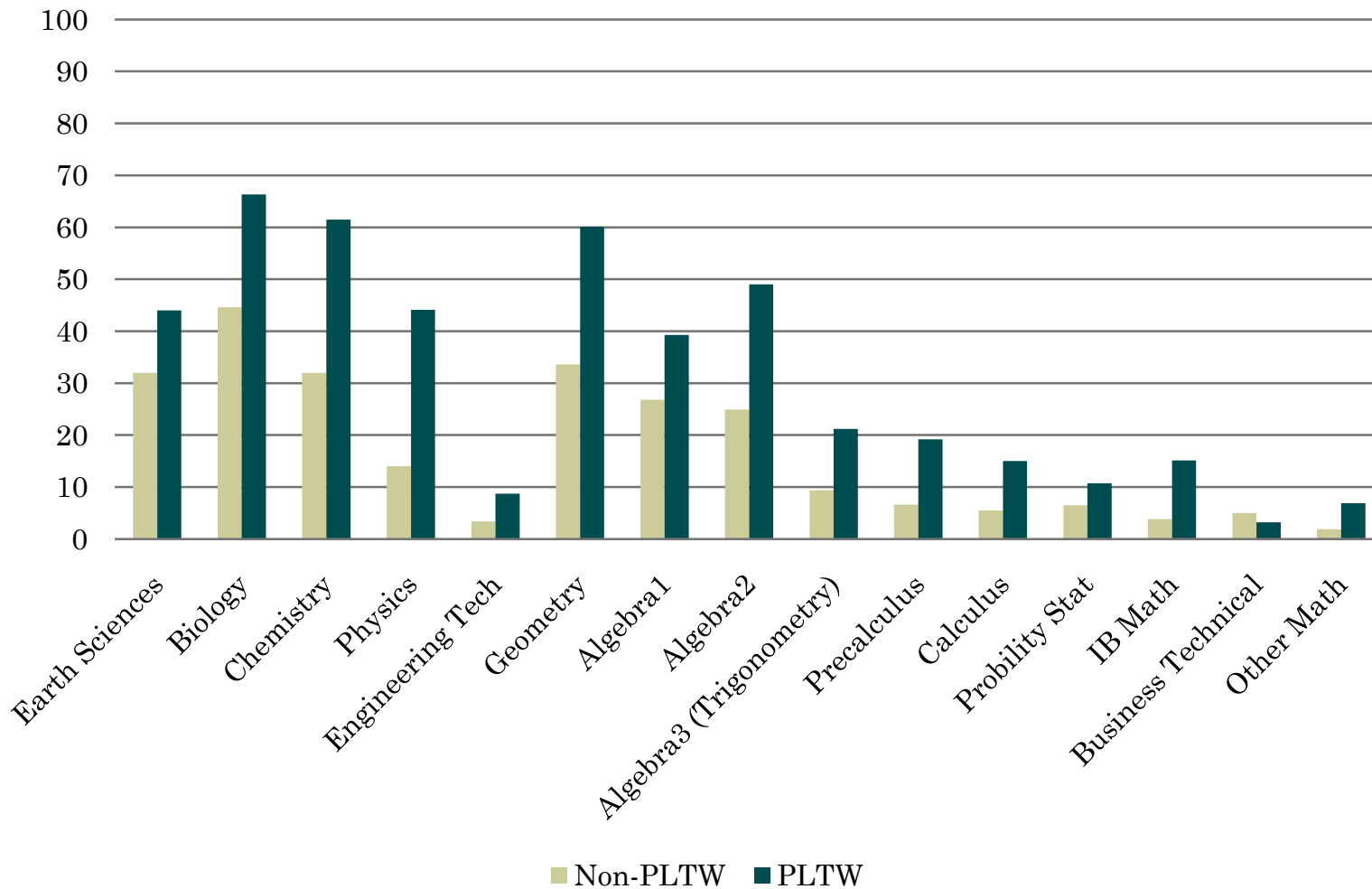
Global minima

$$d_{G,i} = w_i \|x_{\tau,i} - x_{\tau',i}\|$$

$$\mathbf{D} = \sum d_i$$

$$\mathbf{w} = \{w_1, \dots, w_n\}$$

# EX-POST – COURSE TAKING IN HS



# MULTINOMIAL REGRESSION

	Pr(2-year College) / Pr(No College)		Pr(4-year College) / Pr(No College)	
	Odds Ratio	t-value	Odds Ratio	t-value
<b>PLTW</b>	<b>1.57</b>	<b>2.30</b>	0.94	-0.30
Black	1.27	0.43	0.84	-0.24
Asian	1.14	0.23	0.72	-0.49
<b>Hispanic</b>	1.10	0.16	<b>3.79</b>	<b>2.11</b>
<b>American Indian</b>	<b>7.79E-07</b>	<b>-8.75E+07</b>	<b>3.59E-07</b>	<b>-1.05E+08</b>
<b>Male</b>	<b>0.58</b>	<b>-2.15</b>	<b>0.64</b>	<b>-1.74</b>
<b>FreeLunch</b>	<b>0.48</b>	<b>-2.56</b>	<b>0.35</b>	<b>-2.90</b>
Reduced Lunch	0.88	-0.35	0.50	-1.54
<b>IEP</b>	1.08	0.15	<b>0.74</b>	<b>-2.45</b>
<b>Section504</b>	<b>2.77</b>	<b>1.53</b>	<b>0.18</b>	<b>-10.41</b>
Gifted/Talented	0.82	-0.62	0.76	-0.99
<b>Homeless Status</b>	<b>0.82</b>	<b>-3.21</b>	<b>0.67</b>	<b>-8.42</b>
<b>8th Grade ITS_Nat_Standard_Read</b>	1.00	0.68	<b>1.02</b>	<b>3.08</b>
<b>8th Grade ITS_Nat_Standard_Math</b>	1.00	0.44	<b>1.01</b>	<b>2.19</b>
8th Grade ITS_Nat_Standard_Science	1.00	-0.83	1.00	-0.64
<b>Course_Science_EarthSciences_Cumulative</b>	<b>1.38</b>	<b>2.39</b>	1.07	0.45
Course_Science_Biology_Cumulative	1.04	0.28	1.01	0.07
<b>Course_Science_Chemistry_Cumulative</b>	<b>1.47</b>	<b>2.06</b>	<b>2.16</b>	<b>3.63</b>
<b>Course_Science_Physics_Cumulative</b>	1.02	0.11	<b>1.64</b>	<b>2.74</b>
<b>Course_Science_SciEngTech_Cumulative</b>	1.38	1.01	<b>2.25</b>	<b>2.34</b>
Course_Math_Geometry_Cumulative	0.94	-0.33	0.82	-0.86
Course_Math_Algebra1_Cumulative	1.06	0.35	0.86	-0.78
<b>Course_Math_Algebra2_Cumulative</b>	<b>0.61</b>	<b>-2.65</b>	1.09	0.42
<b>Course_Math_Alg3Trig_Cumulative</b>	<b>1.69</b>	<b>2.25</b>	<b>2.15</b>	<b>3.30</b>
Course_Math_Precalculus_Cumulative	1.23	0.72	1.49	1.45
<b>Course_Math_Calculus_Cumulative</b>	<b>2.53</b>	<b>3.07</b>	<b>4.87</b>	<b>5.44</b>
Course_Math_ProbStat_Cumulative	1.05	0.21	0.72	-1.23
<b>Course_Math_IBMath_Cumulative</b>	0.78	-0.66	<b>2.01</b>	<b>1.20</b>
Course_Math_BusinessTechnical_Cumulative	0.90	-0.40	0.50	-1.30
<b>Course_Math_Other_Cumulative</b>	<b>0.46</b>	<b>-2.09</b>	1.07	0.22
<b>EASIER_GraduationStatusN</b>	<b>0.18</b>	<b>-4.23</b>	<b>0.02</b>	<b>-9.69</b>
EASIER_GraduationStatusY	1.98	2.01	0.15	-5.14

# RESULTS – MULTINOMIAL REGRESSION

- Propensity Score Matching
  - Nearest Neighbor
  - Genetic One treatment-to-One Control
  - Genetic One treatment-to-Two Control

Table 2. *Odds Ratio and t-Statistics of PLTW Participation by Methods of Propensity Score Matching (No College is Reference)*

		Nearest Neighbor	Genetic 1-to-1	Genetic 1-to-2
2-year Entry	Odds Ratio	1.64	1.62	1.57
	t-statistic	2.29	2.12	2.30
4-year Entry	Odds Ratio	1.08	1.04	0.94
	t-statistic	0.33	0.17	-0.30



# CONCLUSION

- PLTW were more likely to be high ability, white, and male – a subset of the population already likely to enter STEM fields. (Sax, Jacobs, & Riggers, 2010)
- A higher percentage of PLTW students transitioned to higher education immediate after graduation.
- PLTW seems to “cause” an increase in students attending community college, but not 4-year universities.
- PLTW students were 57 percent more likely to transition to 2-year colleges compared to not attending any types of higher education institutions than non-PLTW students.

# IMPLICATIONS

- First results with causal interpretation of PLTW's impact on college transition.
- Adds to the growing body of (conflicting) literature on the effectiveness of PBL.
- To the extent evaluated, PLTW seems to partially achieve a goal of increasing postsecondary attainment.
- Applied, high-quality application of SLDS data in research

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Institutional Effectiveness and Accountability

Iowa Department of Education