Title: A multifaceted examination of deeper learning in PBL elementary schools: school culture, critical thinking, and access to opportunity

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Abstract

Background/Context:

> Healthy reform would develop a cadre of well-trained teachers who are bolstered
> by access to ample learning tools and other resources. These teachers and others
> involved with schools would move forward with a deep understanding of
> students' diversity, bridging the injurious communicative divides among and
> between students and teachers who differ in areas such as race, ethnicity, culture,
> and socioeconomic status. By creating and maintaining a culture of high
> expectations for all students, by developing critically conscious and historically
> accurate pedagogy and curricula, and by vigilantly preventing new forms of
> segregation within schools, these educators would work to ensure that all students
> have equal opportunities to learn. – (Carter & Welner, 2013, p. 226).

The nexus of pedagogy, school culture, and access to opportunity is critical to building an
educational system that will work for all students and address the "educational debt" (Gloria
Ladson-Billings, 2006) accumulated from centuries of inequitable education. It has been
documented in the extant literature that student centered approaches are more common in
schools that serve affluent and middle-class students than those serving students from
disadvantaged backgrounds (Friedlaender, Burns, Lewis-Charp, Cook-Harvey, and Darling-
Hammond, 2014). Increasing access to deeper learning is a pathway for creating more equitable
schools. Zeiser et al (2014) examined deeper learning outcomes in a high school context and
recent research by Nell Duke and Anne- Lise Halvorsen (2017) has documented positive
academic outcomes in one approach to deeper learning, project-based learning, in an elementary
school context. Deeper learning is complex, and its impact is not readily evident in many data
sources regularly collected from schools. However, for schools to move forward enabling
deeper learning evidence is necessary. Examining how evidence from inherently multifaceted
practices and processes can be used to inform implementation in systems that rely on codified
processes warrants further investigation. It is the aim of this study to provide evidence that can
inform this discussion.

Purpose/Objective/Research Question:

Building on the research examining deeper learning in high schools and academic outcomes in
PBL elementary schools, this research examines the impact of a deeper learning instructional
model built around PBL in public elementary schools nationwide. How have elementary schools
provided opportunities for students to develop deeper learning competencies and what is the
relationship to student outcomes? It was hypothesized that the PBL instructional model would
enable students to acquire deeper learning competencies while positively impact school culture,
and that the interaction between access to deeper learning and positive school culture would
impact overall student outcomes.

Setting:

The research was conducted in subsets of 17 elementary schools, with each phase including 6-7
elementary schools representing a diverse student population from the Northwest, Southeast, and
Midwest of the United States. Schools were urban, rural, and suburban.

Population:

School is the unit of analysis for this research. The individual school demographics range is displayed in Table 1.

Table 1
Participating Schools Demographics

	Min	Max
American Indian/Alaska Native	0	<1%
Asian or Asian/Pacific Islander	<1%	24%
Hispanic	3%	66%
Black	0%	40%
White	2%	90%
Hawaiian Nat./Pacific Isl.	0	<1%
Two or More Races	5%	7%
Free and Reduced Lunch	64%	100%

The sample size at each school was between 54 and 366.

Intervention

The elementary schools are implementing the New Tech Network PBL model. New Tech Network (NTN) is one of ten school networks included in the nationwide "Deeper Learning Network" organized around the competencies outlined by The Hewlett Foundation (see Zeiser, Taylor, Rickles, Garet, & Segeritz, 2014). The NTN model is centered around pillars aligned to deeper learning (interpersonal, interpersonal, PBL, and culture).

Research Design:

A concurrent mixed methods research design (Greene, 2007) was used with design and statistical controls to account for school background factors when applicable.

Data Collection and Analysis:

Data was collected during the AY 2017-18. Data sources included:

A. Two tools with a pre/post design with Fall and Spring data collection:
   1. The Insight Assessment Educate Series (formerly the California Critically Thinking Skills Test) developed by Facione (1990) for 4th grade with testing for statistical significance in the change scores
   2. NTN Student Culture Survey (Bergeron, Bennie, Boesche-Taylor, & Gehrke, 2018) for grades 3-6 with descriptive statistics
B. The Youth Truth (Youth Truth, 2018) survey post-only Spring data collection:
   1. Youth Truth Survey (Youth Truth, 2018) for grades 3-5 with comparative analysis using ordinal regression
C. Observational notes from site visits in Fall and Spring
   a. Site visit reports with qualitative coding

Findings:

Critical Thinking

A comparison of mean scores for each Critical Thinking skills domain demonstrated statistically significant gains from pretest to posttest for all six metrics: Analysis, Inference, Evaluation, Induction, Deduction, and Numeracy (Table 2).

Table 2
Descriptive Statistics - CT Skill Metrics (Matched Pairs Sample)

	N	Range	Min.	Max.	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Analysis Score Pretest	193	30	60	90	70.06	.379	5.260	27.669
Analysis Score Posttest	193	30	63	93	72.27	.417	5.795	33.586
							$[F(1,192) = 20.959, p<.000]$	
Inference Score Pretest	193	31	60	91	75.35	.468	6.499	42.240
Inference Posttest	193	35	60	95	77.45	.510	7.079	50.113
							Inference $[F(1,192)= 10.444, p<.001]$	
Evaluation Pretest	193	31	60	91	70.63	.448	6.223	38.723
Evaluation Posttest	193	34	60	94	73.14	.513	7.122	50.725
							Evaluation $[F(1,192)= 23.558, p<.000]$	

Induction Score Pretest	193	32	60	92	73.24	.496	6.888	47.446
Induction Score Posttest	193	36	60	96	76.00	.518	7.200	51.833
				Induction [F(1,192)= 22.873, p<.000]				
Deduction Score Pretest	193	28	60	88	71.05	.400	5.561	30.920
Deduction Posttest	193	32	60	92	72.60	.422	5.864	34.387
				Deduction [F(1,192)= 7.950, p<.005]				
Numeracy Score Pretest	193	36	60	96	68.15	.496	6.897	47.562
Numeracy Posttest	193	40	60	100	70.78	.542	7.533	56.747
				Numeracy [F(1,192)= 16.654, p<.000]				

Culture

The PBL student culture showed strengths in two constructs (Peer Relationships and Learning Experiences) across schools (Table 3).

Table 3
Merged analysis of school culture responses from the NTN School Culture Survey

School	Responses	Response Rate	Culture: Learning Experiences (percent positive)	Culture: Peer Relationships (percent positive)
School A	323	94	94	95
School B	110	NA	90	93
School C	340	57	91	89
School D	366	82	94	91
School E	323	94	94	95
School F	116	59	90	100
Range			90-94	89-100

A series of ordinal regressions were used to assess differences between students' perceptions at New Tech schools and those at non-New Tech schools on the Youth Truth Survey. Overall, students at New Tech schools rated statistically significantly higher than did students at non-New Tech schools on 16 items (Table 4).

Table 4
Ordinal Regression Results Summary Table

Factors	Items	t statistic NewTech	p-value	Odds Ratio
Student Engagement				
	Does your teacher want you to do your best?	1.727	0.084*	1.279
	Does your teacher let you explain your ideas?	4.378	1.20E-05***	1.267
	Do you like coming to your class?	-3.742	1.83E-04***	0.820
Personal Relationships				
	Is your teacher fair to you?	2.073	0.038**	1.136
	Does your teacher give you extra help if you need it?	2.667	0.008***	1.154
	Does your teacher tell you that you can do well if you work hard?	2.416	0.016**	1.164
	Does your teacher treat you with respect?	3.784	1.55E-04***	1.340
	Do you like the way your teacher treats you when you need help?	0.379	0.704	1.025
Relevance				
	Do you think your teacher cares about you?	4.769	1.85E-06***	1.415
	Does what you learn in class help you outside of school?	1.586	0.113	1.080
	Does your teacher ask you about your life at home?	8.370	5.78E-17***	1.506
	Do you learn interesting things in class?	-1.086	0.277	0.943
Classroom Culture				

	Can you find the things you need in your classroom?	0.277	0.782	1.016
	Does your class stay busy and not waste time?	-3.254	0.001***	0.839
	Do students behave well in your class?	-3.966	7.31E-05***	0.794
	Do students in your class treat the teacher with respect?	-5.231	1.68E-07***	0.765
Academic Rigor & Expectations				
	Does the work you do in this class make you really think?	0.339	0.735	1.018
	Does your teacher explain things in ways you can understand?	2.453	0.014**	1.150
	Does your homework help you learn?	-0.931	0.352	0.952
	Do you learn a lot in your class?	1.960	0.050**	1.135
Instructional Methods				
	Does your teacher ask you if you understand what you are learning?	1.435	0.151	1.083
	Does your teacher explain things in ways you can understand?	2.453	0.014**	1.150
	Does your teacher ask you to show your work?	2.762	0.006***	1.190
	When you make a mistake, does your teacher help you correct it?	4.302	1.69E-05***	1.258
Student Motivation				
	Do you care about how much your classmates learn?	0.384	0.701	1.023
	Can you concentrate in class?	0.253	0.800	1.015
	Do you explain your work to other students?	2.211	0.027**	1.143
	I know what it takes to get good grades in school.	2.834	0.005***	1.278
	Do you help other kids in class when they don't know what to do?	2.325	0.020**	1.148
	Do you do your schoolwork, even if no one tells you to?	4.046	5.22E-05***	1.278

Can you remember things you learn in school?	-1.667	0.096*	0.906
I believe I can learn new things, but I can't really change how smart I am.	6.330	2.45E-10***	1.465
My teachers think I can succeed if I try.	-0.653	0.514	0.942

PBL Implementation

Qualitative coding of site visit reports suggests PBL implementation and fidelity with variation in PBL indicators.

Conclusions:

The 4 data sources suggest that PBL implementation did develop deeper learning competencies, specifically in critical thinking and collaboration. To best use the evidence generated from this study and similar studies it is recommended that findings from large-scale studies such as this and the seminal work by Zeiser et al. (2014) be used to create a Deeper Learning Implementation Rubric/spectrum of development that schools can employ as needed to document deeper learning outcomes and implementation. Similar to the tools available to STEM schools (see North Carolina Department of Public Instruction STEM Education Schools and Programs NC STEM Attribute Implementation Rubric, 2013).

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