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RESEARCH ARTICLE

A Public-Private Partnership Designed to Improve Student Soft Skills: The Johnson & Johnson Bridge-to-Employment Program

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In this paper we describe a corporate-education partnership between Johnson & Johnson and disadvantaged public schools called Bridge-to-Employment (BTE) and examine the program's impact on student acquisition of soft or non-cognitive, school-to-career transition skills. We model the differences in the attainment levels of eight soft skills in a sample of 236 BTE and 308 Comparison students from 10 BTE program sites in Pennsylvania, New Jersey, and Delaware. Using cross-site trajectory analysis, we find that BTE participation had a positive impact on BTE students' communication skills, perceived readiness for an immediate job, readiness for career, teamwork, and persistence in pursuing a task/goal (grit). BTE did not have an impact on students' problem solving skills, readiness for college or ability to set long-term goals. We discuss the possible reasons for these mixed results and the need for encouraging more direct business-public school partnerships to address the growing knowledge and skills gaps facing our nation.

Keywords: school-to-work transition, non-cognitive skills, corporate-community partnership, multilevel models

A recent report issued by the Business Roundtable (2017) points to a troubling picture of a U.S. workforce with too few workers possessing STEM and other technical skills and, perhaps more alarming, an increasing number of job applicants lacking work readiness, i.e., fundamental employability skills such as the ability to "communicate effectively, read simple instructional manuals, work successfully in teams and participate in complex problem solving "(p.1). This set of skills identified by the Business Roundtable along with clarity of oral expression, listening skills, self-confidence, perseverance and ability to set and maintain clear work objectives are believed by many labor economists and business leaders to comprise a constellation of "soft," social or non-cognitive skills that are just as important as math, science, mechanical, and other technical skills and knowledge for successful career development and labor force attachment (Manufacturing Institute, 2017; National Science Foundation, 2016; Committee on Highly Successful Schools or Programs, 2011; Heckman, Stixrud and Urzua, 2006; Ibarraran, 2014).

A litany of blue ribbon panels and white papers identify our public schools as the primary reason why students graduating high school "are not job ready." In 1983, the National Commission on Excellence in Education noted that 13 percent of all 17 year olds graduating high school were functionally illiterate individuals, and that this proportion among minority students approached 40 percent (National Commission on Excellence in Education, 1983). In *A Nation Accountable* written some twenty-five years later, the U.S. Department of Education declared that while some progress had been made, many students, especially students from the inner cities are exposed to "a curriculum smorgasbord with diluted content, hiding behind inflated course names" (U.S. Department of Education, 2008, p.4). The report goes on to discuss how this absence of rigor manifests itself in extensive remedial education in colleges and costly remedial training in business/industry and in the military. If anything has changed since this 2008 report it is that the skills gap has opened wider (Business Roundtable, 2017; Graf, Fry and Funk, 2018; DeSilver, 2017; Muhlhausen, 2017). In a promising development there has been an increased receptivity for businesses to become more directly involved with public schools in school-to-career endeavors to help prepare a workforce for the future (Business Roundtable, 2017; Schuler, 2017; Associated Press, 2017).

In this paper we examine the impact of a school-to-career program called Bridge-to-Employment (BTE) on the soft skills development of 236 disadvantaged high school students from 10 program sites located in New Jersey, Delaware, and Pennsylvania. Since 1992, Johnson & Johnson has designed, funded, and supervised over 80 BTE programs in 19 countries with the principal objective of enabling students from minority or under-privileged backgrounds to successfully pursue higher education and careers in STEM and in the healthcare industry. We employ a quasi-experimental design, measuring the soft skills growth trajectories over a three year period, of BTE students and a matched comparison group of 308 students drawn from the high schools where the BTE programs were located.

In our analyses we attempt to answer two research questions involving the enhancement of specific soft skills:

(1) Does the BTE program promote four behaviors, i.e., teamwork, problem solving, written communication and goal setting – behaviors that are highly valued in the labor market.
(2) Does the BTE program help develop two personality traits, i.e., confidence in job/career/college readiness and perseverance in goal pursuit (referred to by some researchers as 'grit') that have also been linked to success in the work setting.

THE IMPORTANCE OF SOFT SKILLS

Cognitive ability whether measured as student grades, IQ, or standardized achievement tests like SAT, ACT, or NAEP has been firmly established as *sine qua non* for workforce success, especially in the pursuit of STEM careers (Fayer, Lacey and Watson, 201; Cunha and Heckman, 2006; Graf, Fry and Funk, 2018; Carneiro and Heckman, 2003; Heckman, Humphries and Kautz, 2014). One of the earliest definitions of cognitive skills can be found in the Armed Services Vocational Aptitude Battery (ASVAB) which uses five measures, i.e., arithmetic reasoning, word knowledge, paragraph comprehension, mathematical knowledge and coding speed (Heckman, Stixrud and Urzua (2006). While necessary, however, cognitive ability in mathematics, science and other technical disciplines are insufficient explanations for why some individuals with adequate levels of technical education/training demonstrate labor force readiness and/or long term economic success while others with equivalent levels fall short. There is a growing consensus in both the economics and child development literatures that a set of "soft" or non-cognitive skills are also valued in the labor market, school and other sectors of public life (Heckman, Humphries and Kautz, 2014; Garcia, 2014; Gutman and Schoon, 2013; Galloway et al., 2017), and serve as indispensable complement to a set of strong cognitive skills (Stewart, 2018; Carneiro and Heckman, 2003).

Discussions of soft skills have been advanced under a variety of rubrics. Ibarraran et al. (2014) refers to "life skills," Attanasio, Megher and Nix (2017) to "social-emotional development," Carneiro and Heckman (2003) and Putnam (1993) to "civic skills," and Coleman (1990) to "social capital." Each of these labels refers to a broad set of skills, behaviors, and personal qualities that Galloway et al. (2017) maintain, "enables people to effectively navigate their environment, relate well to others, perform well and achieve their goals" (p.10). Coleman (1990) notes that social capital resides in the relations among individuals and typically exhibits a dynamic complementarity with cognitive skill development. Heckman, Stixrud and Urzua (2006) and Attanasio, Meghir and Nix (2017) also make the point that soft skills are crucial to the acquisition of cognitive knowledge, skills and abilities.

While there is a broad consensus on the importance of soft skills for labor market success, there is less agreement regarding the specific skills that comprise this skill set. In their review of the literature in economics, sociology, education and psychology, Soares et al. (2017) identify seven soft skill clusters, viz., positive self-concept, self-control, social skills, communication skills, critical thinking and problem solving, goal orientation, and empathy. Judge et al. (1999) trace career success to five personality traits that fit into the definition of soft skills provided earlier, i.e., lack of neuroticism, extroversion, readiness to experience new stimuli, agreeableness, and conscientiousness. Carneiro and Heckman (2003) report that the soft skills indicated by self-esteem, self-discipline, persistence, reliability, trustworthiness, perseverance and dependability are highly valued school and job traits that very often signal academic and economic success. In assessing the soft skills that have exhibited the strongest relationships to workforce success, Galloway et al. (2017) report three skills, higher order thinking (indicated by problem solving), self-control, and positive self-concept as most important; with communication, responsibility and positive attitude of somewhat less consequence.

On many lists of vital soft skills is the quality of "grit," identified as a personality trait that characterizes an individual's passion and perseverance for a longer-term goal (Duckworth et al., 2007; Duckworth and Yeager, 2015). Research by Heckman and associates (Heckman and Kautz, 2012; Carneiro and Heckman, 2003; Heckman, Stixrud and Urzua, 2006) suggests both high school dropouts and General Equivalency Diploma (GED) recipients lack persistence and determination in a variety of tasks in life. This deficit in grit manifests itself in the labor market as lower wages, more frequent exits from employment and poorer job performance than in the case of high school graduates.

Leaders from the business and industry community have discussed soft skills under the general rubric of "work readiness." The term has been defined by an amalgam of personality traits and competencies that includes trustworthiness, modesty, empathy, cooperation, general agreeability, communication skills, ability to work in a team, higher order thinking capability, and a strong work ethic (Business Roundtable, 2017; Casner-Lotto and Barrington, 2006; FHI-360, 2015; Glaeser et al., 2000).

In summary, it would appear safe to conclude that while there is broad agreement that soft skills are important, there is less consensus on how they should be measured. Soland et al. (2019) in their report Measuring 21st Century Competencies describe a "dizzying array of options" that have and continue to be used to operationalize the term soft skills (p.9).

Notwithstanding the differing definitions of what personality traits and behavior constitute soft skills, school-to-work and school-to-career initiatives have been shown to positively influence many of the skills we have listed. In an evaluation of the School-to-Work Opportunities Act (STWOA) of 1994 (U.S. 103rd Congress, 1994), which many attribute to accelerating the school-to-work movement, Larson and Vandergrift (2000) found that programs that integrated academic instruction and work-based learning helped students better define career goals, increase their confidence in undertaking new tasks and increased self-reported capacity to problem solve and make reasoned decisions. Ibarraran et al. (2014), using a randomized experiment, report that an integrated school-to-work program called Active Labor Market Programs (ALMP) was able to increase levels of grit, communication competence, teamwork, leadership qualities and empathy in a sample of 5,914 disadvantaged youth. Evaluations of the Career Academies Program (Kemple and Willner, 2008) and the Early College High School Institute (ECHSI) (Berger et al., 2013), both targeting disadvantaged youth populations and both employing randomized experiments, also report some evidence that these school-to-career programs had some significant impacts on the enhancement of job and career readiness, communication skills, teamwork, goal setting and problem solving. Quality after-school work experiences have also been reported to have a positive effect on student problem solving abilities, capacity to work in groups, and oral and written communication skills (Baker, 2013; Durlak and Weissberg, 2013; and Garcia, 2014).

THE JOHNSON & JOHNSON BRIDGE-TO-EMPLOYMENT PROGRAM: A COLLABORATIVE STAKEHOLDER MODEL

The core mission of BTE is to introduce high school students with disadvantaged and minority backgrounds to the expanding array of high skills careers in healthcare that are science and/or math based (Bzdak, 2007). The vehicle used to carry out this mission is the community-corporate partnership comprising a Johnson & Johnson local operating company, a secondary public school, and an institution of higher education. Other partners from local government, the business community, and healthcare providers are also encouraged to participate. As noted above, Johnson & Johnson has used this collaborative stakeholder approach to fund over 80 locally run BTE programs in the U.S. and around the world (FHI-360, 2017). The BTE model distinguishes between school-to-work and school-to-career, placing emphasis on the educational pathways provided by college degree programs that lead to higher paying healthcare occupations. BTE also stresses the importance of the programs as a structure within which J&J employees can mentor and tutor students and demonstrate their own sense of social responsibility (Aakhus and Bzdak, 2015).

The program theory underpinning BTE follows a set of propositions that are fundamental to most STEM enhancement programs, viz., (1) participation will increase STEM exposure and skills, (2) these, in turn, will translate into stronger orientations and help develop technical and soft skill competencies, (3) the results are an alignment with and a commitment to pursue STEM education and careers. Examples of technical skill development are ability to follow a set of basic assembly instructions, conduct a simple statistical analysis, master basic field observation techniques, conduct a simple lab experiment, prepare cell cultures, write a narrative summary of descriptive data, apply the metric system, apply basic knowledge of arithmetic and algebra. Soft skill development includes enhanced oral and written communication effectiveness, increased capacity to work within a team, critical thinking and problem solving, job readiness, goal setting and the ability to deal with frustration in a constructive manner. Mastery of both sets of abilities is deemed necessary in the creation of STEM identities, and essential to the successful pursuit of STEM and healthcare careers.

Although each BTE program takes on the unique character of the local J&J operating company, public school and higher education partners that comprise the stakeholder collaborative, all programs are required to operationalize this theory by following a common template or logic model. As Frechtling (2007) notes, logic models can be thought of as theories of change which guide the program operations that need to be made, the hypotheses that need to be tested and the empirical predictions that are suggested. An example of this program model guide is shown in Figure 1.

The guidance suggests several learning activities that could be expected to yield one or more of the short term and/or end-of-grant outcomes listed. Collaborators are, of course, free to propose additional activities with the stipulation that these activities have a direct impact on the outcomes that operationalize the BTE mission. Examples of activities designed to develop soft skills include dining and business etiquette workshops held at restaurants, companies and other public venues, Toastmaster style speaking events, mentoring by Johnson & Johnson employees that target confidence building and work readiness, coaching on test taking techniques, language arts enrichment classes and yoga/stress release sessions.

A typical BTE program receives funding for four years – the first year allows a period of program planning while the subsequent years facilitate operations. Students are selected in the 9^{th} grade using an assignment method that the BTE collaborative believed would balance the need for a quantitative assessment of impact and that would serve a target group of students who they believed would most benefit from the program. Random assignment was almost never selected; instead, counterfactuals were created by identifying a matched comparison group of students who did not have access to BTE but who attended the same high school at the same grade level. The stakeholders are strongly encouraged to populate their comparison group at baseline with students that match the BTE student group on demographic characteristics such as gender and race, and on academic outcomes as measured by grade point average (GPA).

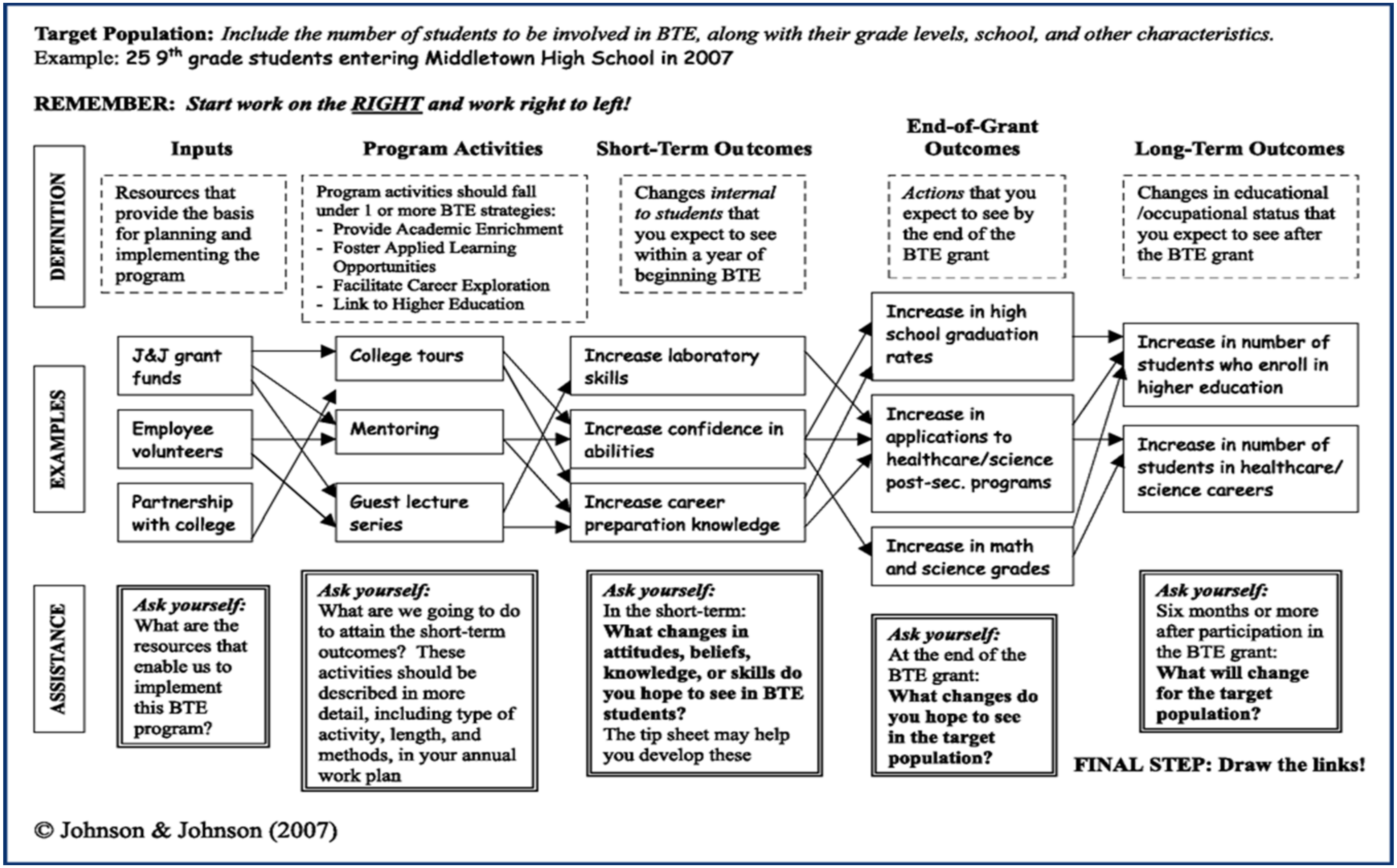

Figure 1. Bridge to Employment Program Model Guide

To date quantitative assessments of BTE outcomes have been limited to the two reports written by FHI-360, an international nonprofit that manages site development for Johnson & Johnson (FHI-360, 2017; Detgen, 2017) and to a series of site-specific assessments, the results of which have been summarized in end-of-year and final reports. Both FHI-360 reports are descriptive of program operations and outcomes and provide no evidence of BTE impact. The relatively small number of BTE students in each program (thru 2015 this number averaged about 30 in U.S. programs) coupled with issues around BTE student selection has limited the value of these individual program reports as sources of overall program impact. Absent any type of impact analysis, assessments of a more general BTE effect have relied on qualitative indicators culled from focus groups, mentor surveys, and anecdotal information. (See for example, Brooks, MacAllum and McMahon, 2005; FHI-360, 2017).

STRUCTURE OF THE EVALUATION

One requirement for the receipt of BTE grant support by a local stakeholder collaborative is the commitment to "use data to continuously improve" program operations (FHI-360, 2017, p.29). Each BTE program site must contract with an outside evaluator (university, consulting firm, etc.), provide the evaluator with a set of specified academic and student opinion data and agree to incorporate evaluation findings into future programing when feasible. For their part, the independent evaluators are required to submit a yearly report to FHI-360 that summarizes these data and assesses how well the program has met the short term, mid-range, and long term objectives outlined in the partners' logic model.

The evaluation design used by most of the independent evaluators is the nonequivalent comparison group approach (Shadish, Cook, and Campbell, 2002). BTE and comparison group students from the same high school are observed at the beginning of each academic year on a set of academic, attitudinal, and behavioral measures (O_{T1}, O_{C1}); these same measures are then repeated at the end of each school year (O_{T2}, O_{C2}). Impact is typically estimated by (O_{T2} - O_{T1}) - (O_{C2} - O_{C1}), i.e., as a simple difference-in-difference. The groups are assumed nonequivalent because of the lack of random assignment.

Between 1999 and 2015, Rutgers University was selected by Johnson & Johnson to evaluate the impact of 17 local BTE programs. Eleven of these site evaluations yielded three full years of impact data, six did not. Two BTE programs operated in Cincinnati, Ohio were structured as two-year programs, and programs in Trenton, New Jersey and Bound Brook, New Jersey were unable to generate three years of data because of failures to deliver their services in one or more years. Programs in Christiana, Delaware and Kennett Square, Pennsylvania, while conducting three years of programming, were unable to maintain their comparison groups over the three year period. One site (Bridgewater, New Jersey) was excluded because the program did not provide services to disadvantaged students. Specific information on these sites is provided in Appendix A. As independent evaluators, the Rutgers University evaluators were not privy to individual student identifiers. The stakeholders at each site, in addition to bearing responsibility for the assignment of students in BTE and comparison groups, obtained parental consent for student participation through their Institutional Review Board (IRB) process.

Our focus in this paper is on changes in soft skills of 286 BTE and 349 Comparison students from across 10 sites where three years of student level data was collected for annual reports. Our measures of soft skills are obtained from a questionnaire designed by FHI-360, with input from individual BTE site evaluators, entitled the BTE Participant Annual Survey. This instrument asks students about their future plans, their BTE experiences, awareness of STEM and healthcare career opportunities and skill levels and their confidence to use specific skills. Comparison group students completed a similar questionnaire that did not contain any BTE items. Both questionnaires were administered at baseline, i.e., the beginning of 10th grade, and at the end of 10th, 11th, and 12th grades.

To analyze these data we employ hierarchical linear models (HLM), also known in the literature as multi-level or latent trajectory models. The HLM is designed to explicitly recognize nested or repeated measures data structures, and permits straightforward examination of both *intra*-unit (within student) change overtime and *inter*-unit (between students) variability in intra-unit change (Curran and Hussong, 2003; Singer and Willett, 2003). Our trajectory analysis has several advantages over site-specific analysis of academic performance. The pooled data, which are the results of structuring a cross-site analysis improves statistical power and reduces the probability of making Type II statistical errors. Also, modelling the performance trajectories provides a stronger test of any treatment-comparison group difference than do post-intervention only or difference-in-difference analyses inasmuch as intervening period data for students' outcomes are incorporated into analysis and are not simply discarded.

In our statistical modeling we control for measured demographic differences between BTE and comparison groups, specifically gender and race, and take into account school-input differences with fixed effects. We recognize however, that this use of covariates does not control for unmeasured characteristics like student achievement, motivation and sociability that may have influenced the selection process used by the stakeholders to populate the BTE and comparison groups.

SAMPLE CHARACTERISTICS AND STUDY VARIABLES

In Table 1, we provide descriptive data on the BTE and Comparison group students from the ten study sites. For each site, we present the BTE program location, years of operation, size of the BTE and Comparison groups, and information on demographic and academic performance at baseline. The demographic and academic data in the Table were obtained from data collection systems maintained by the school district for the purposes of producing student report cards and/or reporting student-level information to state-level departments of education. While significant differences between groups on measured demographics do not appear to pose an overall selection problem, this is not the case for the academic performance measures. BTE-comparison group differences are almost always in favor of students enrolled in the BTE program. It is clear from this Table that any attempt to draw inferences regarding BTE impact on soft skill development must, at minimum, take into consideration through statistical analysis these measured differences at baseline.

Our measures of soft skills are presented in Table 2. All 8 of these measures are extracted from the questionnaire developed by FHI-360 and cover a set of behaviors and personality traits thought to be of high value in the work setting. Three of the behaviors, i.e., teamwork, problem solving, written communication, and one personality trait (grit), are measured by a single item on the questionnaire. Three personality traits, i.e., confidence in job readiness, college readiness and career readiness, and one behavior (goal setting), are measured by multiple items that have been averaged (Brown, J. D., 2001; Waugh, R. F., 2002) for purposes of analysis. The averaging proceeded after analyses using Cronbach alpha revealed internal consistency reliabilities ranging from 0.6 to 0.8.

In Table 3 we show the sample profiles of both the BTE and comparison group students, regardless of site. It is clear from this Table, once again, that the stakeholders fell short in their attempts to achieve a demographic balance when assigning students to BTE and comparison groups. This failure also manifested itself in significant differences between the two groups on two measures of soft skills – problem solving and goal setting. In these instances BTE students reported having engaged in more of these behaviors than their counterparts in the comparison group.

Since we are examining student trajectories over time and are not using simple pre-post or treatment-comparison group difference models, our data are structured as student year observations. If data were available for all demographic and soft skills variables in all study periods, i.e., at baseline, end of years one, two and three, for all BTE students (236) and for all comparison group students (308), we would expect 2,176 student-year observations.

Entries in Table 4 show that there is missing data over the three year period, especially in the case of race, which reduces the actual number of student-year observations available for analysis by about 18 percent. Missing data on some soft skills, especially job readiness, also reduces the number of observations available. The Table also provides a tabulation of the number of student-year observations that each of the 10 sites contribute to the trajectory analysis.

TABLE 1
Sample Characteristics at Baseline by Program Status and BTE Site

	Ambler (2012 - 2015)		Bound Brook (2007 - 2010)		Franklin Township (2010 - 2013)		New Brunswick (1) HSTS (2004 - 2007)		New Brunswick (1) NBHS (2004 - 2007)	
Characteristic	BTE	Comparison	BTE	Comparison	BTE	Comparison	BTE	Comparison	BTE	Comparison
Demographic %	(N = 50)	(N = 32)	(N = 19)	(N = 11)	(N = 21)	(N = 79)	(N = 12)	(N = 11)	(N = 12)	(N = 30)
Female	60.0	61.2	73.7	72.7	62.0*	39.0	54.5	75.0	41.7*	80.0
White	74.5	74.2	10.5*	36.4	0.0	9.1	9.1	10.0	0.0	0.0
Black	19.1	16.1	5.3	9.1	76.5	63.6	27.3	20.0	30.0	14.3
Hispanic	2.1	3.2	63.2	54.5	17.6	18.2	63.6	40.0	70.0	78.6
Other	4.3	6.5	21.1	0.0	5.9	9.1	0.0*	30.0	0.0	7.1
Academic Outcomes Mean (Std.dev.)										
GPA	88.2 (7.6)	88.2 (8.5)	73.1 (8.9)	74.0 (10.2)	79.9 (8.9)*	74.5 (4.6)	84.4 (4.4)	83.0 (6.0)	74.9 (11.4)*	82.1 (9.7)

	New Brunswick (2) HSTS (2010 - 2013)		New Brunswick (2) NBHS (2010 - 2013)		North Plainfield (2011 - 2014)		Trenton (2008 - 2011)		Wilmington (2011 - 2014)	
Characteristic	BTE	Comparison	BTE	Comparison	BTE	Comparison	BTE	Comparison	BTE	Comparison
Demographic %	(N = 23)	(N = 33)	(N = 18)	(N = 19)	(N = 44)	(N = 55)	(N = 26)	(N = 48)	(N = 31)	(N = 30)
Female	73.9	64.5	61.1	42.1	68.2	67.9	88.5*	62.5	61.3*	33.3
White	0.0	0.0	0.0	0.0	9.1	5.7	0.0	0.0	3.2	20.0
Black	30.4	15.2	7.7	10.5	34.1	32.1	69.2	66.7	77.4	70.0
Hispanic	69.6	81.8	92.3	89.5	52.3	56.6	19.2	22.9	19.4	10.0
Other	0.0	3.0	0.0	0.0	4.5	5.7	11.5	10.4	0.0	0.0
Academic Outcomes Mean (Std.dev.)										
GPA	83.9 (5.9)	82.2 (5.8)	86.0 (7.9)*	80.7 (7.3)	84.0 (6.3)*	77.5 (13.8)	80.0 (8.2)	82.4 (15.2)	76.9 (7.7)*	69.5 (6.6)

Notes. For Bound Brook and Wilmington, the data shown here are from Year 1 because baseline data were not available. *Indicates significant group differences at baseline

TABLE 2
Soft Skills Measures

Variable	Question on FHI-360 Questionnaire	Scale
Teamwork	How good are you at working with others?	1 = Very Bad, 2 = Bad, 3 = Good, 4 = Very Good.
Problem Solving	How often do you have the opportunity to use and develop this skill during your studies and activities?	1 = Little/Not at all, 2 = Some, not much, 3 = All the time.
Written communication	How often do you have the opportunity to use and develop this skill during your studies and activities?	1 = Little/Not at all, 2 = Some, not much, 3 = All the time.
Goal Setting	I am confident in my abilities to (a) Use my knowledge / skills to succeed in my educational goals, (b) Identify my goals for the next five years, (c) Determine the steps I need to take to attain my goals. Variable combines (a), (b), and (c).	1 = Strongly disagree, 2 = Disagree, 3 = Agree, 4 = Strongly agree
Job Readiness	I am confident in my abilities to (a) Prepare a Resume (b) Interview for a job. Variable combines items (a) and (b).	1 = Strongly disagree, 2 = Disagree, 3 = Agree, 4 = Strongly agree
College Readiness	I am confident in my abilities to (a) Determine steps I need to get into college, (b) Understand the steps I need to get into higher education, (c) Apply to a higher education institution, (d) Attend higher education. Variable combines items (a), (b), (c), and (d).	1 = Strongly disagree, 2 = Disagree, 3 = Agree, 4 = Strongly agree
Career Readiness	I am confident in my abilities to (a) Find out about different careers, (b) Talk with a person who has a career that I am interested in, (c) Choose a career that fits my interests. Variable combines (a), (b), and (c).	1 = Strongly disagree, 2 = Disagree, 3 = Agree, 4 = Strongly agree
Grit	I am confident in my abilities to reach my goals even if I get frustrated	1 = Strongly disagree, 2 = Disagree, 3 = Agree, 4 = Strongly agree.

TABLE 3
Sample Characteristics at Baseline by Program Status: All Sites Combined

Characteristic	BTE (*n* = 236)	Comparison (*n* = 308)
Demographic (%)		
Female	65.5	58.5
White*	18.6	12.0
Black*	41.4	31.8
Hispanic*	36.4	48.9
Other	3.6	7.3
Academic Outcome [Mean, (Std.dev)]		
GPA*	82.6 (8.8)	80.5 (9.7)
Soft skills [Mean, (Std.dev)]		
Team work	3.27 (0.92)	3.33 (0.85)
Problem solving*	2.81 (0.48)	2.67 (0.56)
Communication	2.67 (0.57)	2.64 (0.59)
College readiness	3.50 (0.47)	3.52 (0.52)
Job readiness	3.31 (0.65)	3.30 (0.67)
Career readiness	3.43 (0.52)	3.42 (0.51)
Goal setting/achievement*	3.35 (0.42)	3.23 (0.48)
Grit	3.15 (0.94)	2.77 (1.18)

Notes. Maximum N shown - it may vary from variable to variable within each group
Measurement of these soft skills is shown in Table 2
* indicates significant group differences at baseline

TABLE 4
Distribution of Study Variables Across Student-year Observations

Variable	*n*	*M*	*SD*	Minimum	Maximum
Female	1,926	0.62	0.49	0	1
Race	1,787				
White		0.18	0.38	0	1
Black		0.35	0.48	0	1
Hispanic		0.41	0.49	0	1
Other		0.06	0.23	0	1
Team work	1,871	3.26	0.85	1	4
Problem solving*	1,856	2.77	0.47	1	3
Communication	1,857	2.70	0.54	1	4
College readiness	1,375	3.48	0.52	1	4
Job readiness	988	3.32	0.65	1	4
Career readiness	1,375	3.41	0.55	1	4
Goal setting/achievement*	1,365	3.37	0.51	1	4
Grit	1,361	3.30	0.83	1	4

Note. % Observations from each site: Ambler 17.6%, Bound Brook 3.2%, Franklin Township 13.9%, New Brunswick (1) HSTS 5%, New Brunswick (1) NBHS 7.5%, New Brunswick (2) HSTS 10.1%, New Brunswick (2) NBHS 6.7%, North Plainfield 16.9%, Trenton 10.1%, and Wilmington 9%.

ANALYTIC APPROACH

We model trajectories of students' soft skills development with multilevel models estimated by the method of maximum likelihood (Stata's xtmixed command in Version 15). These models permit straightforward examination of both *intra*-unit (within student) change in outcomes over time and *inter*-unit (between students) variability in intra-unit change. Further, these overtime changes can be conditioned on one or more predictor variables. Here, we estimate two-level models, where the first level investigates *within* student changes overtime in their soft skills outcomes, i.e., their trajectories, and the second level explores if these individual trajectories are altered by participation or non-participation in the BTE program.

We provide five different specifications, starting with a simple *unconditional means* only model (Model 1), followed by an *unconditional growth* model (Model 2) – these two models provide a useful baseline for comparison with our subsequent models (Models 3-5) that incorporate demographic, treatment group and site-level predictors. The unconditional models decompose the outcome variability into (a) across people irrespective of time and (b) across both individuals *and* time, and help establish whether there is predictable variability in the outcome that warrants an investigation, and if so, whether this variability exists within or between individuals (Singer & Willett, 2003). The unconditional models are systematically augmented with predictors, with Model 3 introducing BTE participation, Model 4 examining the BTE effect while controlling for student gender and race, and finally Model 5 that sharpens the BTE effect while also controlling for site-specific (fixed effect) time invariant differences.

Model 1 is specified as follows, with a Level 1 equation that models the observed outcome as a function of the individual-specific true mean and its deviation at time *t*, while Level 2 examines how this individual-specific mean varies from the grand mean:

$$\text{Level 1: } Y_{it} = \pi_{0i} + \varepsilon_{it} \qquad [1.1]$$

$$\text{Level 2: } \pi_{0i} = \Upsilon_{00} + \zeta_{0i} \qquad [1.2]$$

where

Y_{it} represents a particular soft skills outcome (e.g., team work, problem solving, etc.) for student *i* at time *t*,

π_{0i} is the individual-specific mean outcome,

ε_{it} is the deviation of the observed outcome from the individual-specific mean,

Υ_{00} is the grand mean, and

ζ_{0i} is the deviation of individual-specific mean from the grand mean.

We assume that the Level 1 and Level 2 residuals (ε_{it} and ζ_{0i}) are normally distributed, both with mean 0, and variance σ_ε^2 and σ_0^2 respectively, so that σ_ε^2 provides an estimate of the variability in the outcome of each individual around his/her own mean, and σ_0^2 summarizes the variability of individual-specific means around the grand mean. Since the Level 2 equation cannot be estimated directly because of the structural parameter π_{0i}, we substitute [1.2] into [1.1] to obtain the reduced-form model for the observed responses Y_{it}, with one fixed effect (Υ_{00}) and a composite residual as follows:

$$Y_{it} = \Upsilon_{00} + (\zeta_{0i} + \varepsilon_{it}) \qquad [1.3]$$

In rather poetic terms, Crowder and Hand (1990) refer to the fixed part as the "immutable constant of the universe," to ζ_{0i} as the "lasting characteristic of the individual" and to ε_{it} as the "fleeting aberration of the moment."

Model 2 estimates an unconditional growth model that introduces the predictor 'Time' at Level 1, allowing each student to have a distinct growth rate or trajectory π_{1i}, and enables us to examine whether inter-individual differences emanate from differences in the mean or the growth rate. Level 1, Level 2 and the reduced-form equations are specified as follows:

Level 1: $$Y_{it} = \pi_{0i} + \pi_{1i}\,\text{Time}_{it} + \varepsilon_{it} \qquad [2.1]$$

Level 2: $$\pi_{0i} = \Upsilon_{00} + \zeta_{0i} \qquad [2.2a]$$

$$\pi_{1i} = \Upsilon_{10} + \zeta_{1i} \qquad [2.2b]$$

Reduced-form: $$Y_{it} = (\Upsilon_{00} + \Upsilon_{10}\,\text{Time}_{it}) + (\varepsilon_{it} + \zeta_{0i} + \zeta_{1i}\,\text{Time}_{it}) \qquad [2.3]$$

We now have an additional structural parameter π_{1i} and a corresponding Level 2 equation [2.2b] that estimates inter-individual differences in the rates of change or growth trajectories. The fixed effects Υ_{00} and Υ_{10} now estimate the mean intercept and mean growth rate, respectively; ζ_{0i} and ζ_{1i} are the deviations of each student from the group mean intercept and group mean growth rate; and the Level 1 residuals ε_{it} now tell us the individual deviation from his/her true growth trajectory. We continue to assume that both the Level 1 and Level 2 residuals have a normal distribution, with ζ_{0i} and ζ_{1i} now bivariate normal with mean 0 and variance σ_0^2 and σ_1^2. In addition, the covariance (σ_{01}) between ζ_{0i} and ζ_{1i} is also estimated in this model.

In Model 2, we have made the assumption that the time and individual-specific values of the outcome (Y_{it}) are completely governed by the underlying trajectory process and any deviations of these values from the trajectory are treated as error. We now extend these models to capture situations in which we do not necessarily anticipate that the growth rates in outcomes are completely determined by the underlying trajectory process; rather they are related only partly to the trajectory process but may also be influenced by their participation in the BTE program. We study the BTE effect in Model 3, and examine how the BTE effect changes when additional predictors are added in Models 4 and 5. In light of our quasi-experimental design, we consider Model 5, which controls for both student demographic characteristics and site-specific factors that remain time invariant as our final model.

Level 1, Level 2 and the composite specifications of Model 3 are as follows:

Level 1: $$Y_{it} = \pi_{0i} + \pi_{1i}\,\text{Time}_{it} + \varepsilon_{it} \qquad [3.1]$$

Level 2: $$\pi_{0i} = \Upsilon_{00} + \Upsilon_{01}\,\text{BTE} + \zeta_{0i} \qquad [3.2a]$$

$$\pi_{1i} = \Upsilon_{10} + \Upsilon_{11} \text{BTE} + \zeta_{1i} \quad [3.2b]$$

Reduced-form: $Y_{it} = (\Upsilon_{00} + \Upsilon_{01}\,\text{BTE} + \Upsilon_{10}\,\text{Time}_{it} + \Upsilon_{11}\,\text{BTE*Time}_{it}) + (\varepsilon_{it} + \zeta_{0i} + \zeta_{1i}\,\text{Time}_{it})$ [3.3]

Model 3 now includes BTE participation as a predictor of both the initial or baseline outcome levels as well as the growth (change) in the outcomes. The Model now contains four fixed effects, Υ_{00}, the level of initial outcome of the average comparison group student; Υ_{01}, the difference in the initial outcome level between BTE and comparison students; Υ_{10}, the growth rate of the average comparison student; and finally Υ_{11}, the difference in the growth rate between the BTE and comparison students, which is the coefficient of interest that provides BTE program impact. The random effects parameters are specified as before.

Equations for Models 4 and 5 closely follow the specification used for Model 3, except in Level 2, we add demographic controls in Model 4 and site-specific controls in Model 5. To assess model fit and improvement in model fit across models, we use the likelihood ratio test and the deviance statistic, respectively.

RESULTS

Table 5 presents results of fitting multi-level models for teamwork behavior. Model 1 (Equations [1.1-1.3]) shows that the only fixed effects parameter in the model (Υ_{00}), the average teamwork score across all students over all time periods, is 3.18 on a scale of 1 to 4 points, and is significantly different from zero. The random effects σ_ε^2 and σ_0^2 provide an estimate of the variability in teamwork within and across students, and indicate that there is a significant amount of unexplained variability indicating the need for inclusion of predictors. These variance estimates can also be used to calculate an intra-class correlation coefficient, which provides us with an indication of how much variability in teamwork is due to differences across students (Singer & Willett, 2003). Model 1 indicates that 50 percent of the variability in teamwork is attributable to differences across students.

Model 2 presents the results of the unconditional growth model (Equations [2.1-2.3]) where the two fixed effects Υ_{00} and Υ_{10} tell us that the estimated average starting point in teamwork was 3.15, which is stable over time. The estimated Level 1 residual's standard deviation of 0.60 (σ_ε) shows the amount of average deviation of individual teamwork scores from his/her own linear change trajectory, and when compared to Model 1, indicates that about 5 percent of the within-person variability in teamwork (= (0.63-0.60)/0.63) is systematically related to *Time*, with a significant portion of the variability still unexplained. The Level 2 residuals' standard deviations of 0.7 and 0.16 summarize between-individual differences in the starting point and the rates of change, and their statistical significance suggests that there is still unexplained variability in both the starting point and the growth rate. The Model also estimates that the correlation between the Level 2 residuals (σ_{01}) is -0.48, indicating that the relationship between the true starting point and the rate of change in teamwork is significant and negative, that is, student scores in teamwork that are higher in the beginning decline less rapidly over time.

TABLE 5
Multi-level Regression Model for Teamwork

Fixed Effects		Parameter	Model 1 Coefficient (Robust Std. Error)	Model 2 Coefficient (Robust Std. Error)	Model 3 Coefficient (Robust Std. Error)	Model 4 Coefficient (Robust Std. Error)	Model 5 Coefficient (Robust Std. Error)
Initial Status ($\pi 0i$)	Intercept	Υ_{00}	3.18***	3.15***	3.20***	3.31***	3.50***
			(0.03)	(0.04)	(0.05)	(0.08)	(0.22)
	BTE	Υ_{01}			-0.10	-0.09	-0.12**
					(0.08)	(0.08)	(0.07)
Rate of change ($\pi 1i$)	Intercept	Υ_{10}		0.02	0.003	0.003	-0.03*
				(0.02)	(0.02)	(0.02)	(0.02)
	BTE	Υ_{11}			0.04	0.04**	0.07**
					(0.03)	(0.03)	(0.03)
Demographic controls [a]			No	No	No	Yes	Yes
Site fixed effects [b]			No	No	No	No	Yes
Random Effects			Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)
Level 1	Within person	σ_ε	0.63***	0.60***	0.60***	0.60***	0.60***
			(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Level 2	Initial status	σ_0	0.63***	0.70***	0.70***	0.70***	0.51***
			(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
	Rate of change	σ_1		0.16***	0.15***	0.15***	0.14***
				(0.04)	(0.04)	(0.04)	(0.04)
	Correlation	σ_{01}		-0.48***	-0.47***	-0.48***	-0.57***
				(0.09)	(0.09)	(0.09)	(0.10)
Deviance			3,758.70	3,747.76	3,745.70	3,735.05	3,471.14
P (LR Chisquared Test)			0.00	0.00	0.00	0.00	0.00
n			1,596	1,596	1,596	1,596	1,596

Notes. *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10.
[a] Models 4 and 5 control for race and gender
[b] Model 5 controls for site specific characteristics that are time invariant

In Model 3, we add BTE participation as a substantive predictor in both the initial level of teamwork scores and their growth over time, to assess whether the program served to shift the average trajectory upwards, or if it at least slowed down any decline. The estimated fixed effects for levels of teamwork reported in the top panel of the Table show that the average initial score for the comparison group students was 3.20, while for the BTE students it was 0.10 points lower. The estimated growth parameters indicate that while the average comparison student experienced an increase at a rate of 0.003, the average BTE student showed a higher rate of increase (0.003+0.04 = 0.043). These differences between groups in both the initial scores and their growth rate, however, are not statistically significant.

The estimate of the within-variance component (σ_ε) in Model 3 remains similar to that of Model 2 indicating that the model could benefit from the inclusion of time-varying predictors; however, available data preclude us from pursuing this option. Estimates of the Level 2 between-variance components also remain significant and about the same as the previous model suggesting the inclusion of other predictors for both the level and trajectory in teamwork scores.

Results from Model 4 that includes the students' personal characteristics of gender and race are very similar to that of Model 3. However, in Model 5, when we add site fixed effects, i.e, characteristics specific to each BTE site that remain time-invariant, we see that teamwork scores for the comparison group were declining at an average rate of 0.03 points, while BTE students' scores were *increasing* at a rate of 0.04 (= -0.03+0.07) per year, a statistically significant effect. This effect is all the more important considering the BTE students' lower starting point. Estimates of both the within- and between-variance components continue to indicate the presence of significant unexplained variance at both levels, and the desirability of including additional predictors, a luxury that our dataset does not permit.

All five models show good fit as indicated by the significant likelihood ratio test. Reductions in the deviance statistic in Model 5 relative to the previous model point to the usefulness of adding site-level fixed effects. Model 5 also shows considerable reductions in the between-individual error variance relative to the baseline unconditional models (Models 1 and 2), confirming the conclusions indicated by the deviance statistic with respect to improvements in model fit.

In Tables 6 through 12, we provide the results from our multi-level regressions of the seven additional soft skills. We interpret results in the same fashion as in the case of teamwork focusing on (1) overall mean at initial status, (2) adjustment in that mean for BTE group membership at baseline, (3) overall rate of change over the three year period, (4) the adjustment that BTE group membership has on that trajectory, and (5) indications of unexplained variation. If we limit our comments to Model 5, it is possible to summarize findings as follows:

1. In three soft skill trajectory analyses, i.e., problem solving (Table 6), goal setting behavior (Table 11), and confidence in college readiness (Table 8), BTE participation did not yield a significant difference in the trajectory of skill acquisition than was found in the comparison group. It is worthy of note that in two of the three regressions – problem solving and goal setting – BTE students had higher levels of these skills at baseline.
2. With respect to communication behavior (Table 7), confidence in immediate job readiness (Table 9), and readiness for a career (Table 10), our final models show that BTE participation was responsible for significant changes in the trajectory of skill acquisition. Communication skills among BTE students grew at a faster rate (by 0.03

per year), job readiness increased at a higher rate (0.02 higher per year) relative to their comparison group peers, with the largest annual positive impact occurring in BTE students' career readiness which is 0.06 points higher than in the comparison group.

3. Our analysis of teamwork (Table 5) and career readiness (Table 10) indicates that BTE membership serves to significantly reverse the downward trajectory in skill diminution which is evident in the comparison group.
4. In the regression analyses of grit shown in Table 12, BTE significantly increases the trajectory of skill acquisition observed in the comparison group by 0.05 points annually. It will be recalled that grit is thought to measure perseverance in the achievement of long term goals.
5. Significant unexplained variation remains in both intra-individual trajectories over time and BTE-Comparison differences in these trajectories, even after controlling for available student and site-specific characteristics.

TABLE 6
Multi-level Regression Model for Problem Solving

Fixed Effects		Parameter	Model 1 Coefficient (Robust Std. Error)	Model 2 Coefficient (Robust Std. Error)	Model 3 Coefficient (Robust Std. Error)	Model 4 Coefficient (Robust Std. Error)	Model 5 Coefficient (Robust Std. Error)
Initial Status (π0i)	Intercept	Υ_{00}	2.74***	2.68***	2.66***	2.76***	2.49***
			(0.02)	(0.02)	(0.03)	(0.04)	(0.13)
	BTE	Υ_{01}			0.04	0.04	0.05***
					(0.05)	(0.05)	(0.04)
Rate of change (π1i)	Intercept	Υ_{10}		0.05***	0.06***	0.06***	0.04***
				(0.01)	(0.01)	(0.01)	(0.01)
	BTE	Υ_{11}			-0.02	-0.02	-0.01
					(0.02)	(0.02)	0.02
Demographic controls [a]			No	No	No	Yes	Yes
Site fixed effects [b]			No	No	No	No	Yes
Random Effects			Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)
Level 1	Within person	σ_ε	0.34***	0.32***	0.32***	0.32***	0.31***
			(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Level 2	Initial status	σ_0	0.34***	0.46***	0.46***	0.45***	0.36***
			(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
	Rate of change	σ_1		0.10***	0.10***	0.10***	0.11***
				(0.02)	(0.02)	(0.02)	(0.02)
	Correlation	σ_{01}		-0.87***	-0.87***	-0.87***	-0.86***
				(0.07)	(0.07)	(0.07)	(0.06)
Deviance			1,790.93	1,702.00	1,701.12	1,690.11	1,463.58
P (LR Chisquared Test)			0.00	0.00	0.00	0.00	0.00
n			1,580	1,580	1,580	1,580	1,580

Notes. *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10

[a] Models 4 and 5 control for race and gender

[b] Model 5 controls for site specific characteristics that are time invariant

TABLE 7
Multi-level Regression Model for Communication Skills

Fixed Effects		Parameter	Model 1 Coefficient (Robust Std. Error)	Model 2 Coefficient (Robust Std. Error)	Model 3 Coefficient (Robust Std. Error)	Model 4 Coefficient (Robust Std. Error)	Model 5 Coefficient (Robust Std. Error)
Initial Status ($\pi 0i$)	Intercept	Υ_{00}	2.71***	2.67***	2.66***	2.62***	2.47***
			(0.02)	(0.02)	(0.03)	(0.05)	(0.14)
	BTE	Υ_{01}			0.03	0.02	0.02
					(0.05)	(0.05)	(0.05)
Rate of change ($\pi 1i$)	Intercept	Υ_{10}		0.03***	0.01	0.01	0.01
				(0.01)	(0.02)	(0.02)	(0.02)
	BTE	Υ_{11}			0.04**	0.04**	0.04**
					(0.02)	(0.02)	(0.02)
Demographic controls [a]			No	No	No	Yes	Yes
Site fixed effects [b]			No	No	No	No	Yes
Random Effects			Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)
Level 1	Within person	σ_ε	0.40***	0.36***	0.36***	0.36***	0.36***
			(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Level 2	Initial status	σ_0	0.31***	0.43***	0.43***	0.42***	0.41***
			(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
	Rate of change	σ_1		0.15***	0.14***	0.14***	0.14***
				(0.02)	(0.02)	(0.02)	(0.02)
	Correlation	σ_{01}		-0.66***	-0.66***	-0.68***	-0.69***
				(0.07)	(0.07)	(0.07)	(0.07)
Deviance			2,147.11	2,095.45	2,085.59	2,071.66	2,039.97
P (LR Chisquared Test)			0.00	0.00	0.00	0.00	0.00
n			1,581	1,581	1,581	1,581	1,581

Notes. *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10

[a] Models 4 and 5 control for race and gender

[b] Model 5 controls for site specific characteristics that are time invariant

TABLE 8
Multi-level Regression Model for College Readiness

Fixed Effects		Parameter	Model 1 Coefficient (Robust Std. Error)	Model 2 Coefficient (Robust Std. Error)	Model 3 Coefficient (Robust Std. Error)	Model 4 Coefficient (Robust Std. Error)	Model 5 Coefficient (Robust Std. Error)
Initial Status (π0i)	Intercept	Υ_{00}	3.39***	3.37***	3.35***	3.38***	3.20***
			(0.02)	(0.03)	(0.04)	(0.06)	(0.26)
	BTE	Υ_{01}			0.04	0.02	0.02
					(0.06)	(0.06)	(0.06)
Rate of change (π1i)	Intercept	Υ_{10}		0.01	0.03*	0.02	0.01
				(0.01)	(0.02)	(0.02)	(0.02)
	BTE	Υ_{11}			-0.02	-0.02	-0.01
					(0.03)	(0.03)	(0.03)
Demographic controls [a]			No	No	No	Yes	Yes
Site fixed effects [b]			No	No	No	No	Yes
Random Effects			Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)
Level 1	Within person	σ_ε	0.44***	0.40***	0.40***	0.40***	0.40***
			(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Level 2	Initial status	σ_0	0.33***	0.41***	0.41***	0.40***	0.39***
			(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
	Rate of change	σ_1		0.14***	0.14***	0.14***	0.14***
				(0.02)	(0.02)	(0.02)	(0.02)
	Correlation	σ_{01}		-0.57***	-0.57***	-0.58***	-0.62***
				(0.07)	(0.07)	(0.07)	(0.07)
Deviance			1,681.26	1,658.80	1,658.14	1,646.79	1,616.16
P (LR Chisquared Test)			0.22	0.28	0.62	0.04	0.00
n			1,109	1,109	1,109	1,109	1,109

Notes. *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10

[a] Models 4 and 5 control for race and gender

[b] Model 5 controls for site specific characteristics that are time invariant

TABLE 9
Multi-level Regression Model for Job Readiness

Fixed Effects		Parameter	Model 1 Coefficient (Robust Std. Error)	Model 2 Coefficient (Robust Std. Error)	Model 3 Coefficient (Robust Std. Error)	Model 4 Coefficient (Robust Std. Error)	Model 5 Coefficient (Robust Std. Error)
Initial Status (π0i)	Intercept	Υ_{00}	3.46***	3.41***	3.40***	3.46***	2.84***
			(0.02)	(0.03)	(0.04)	(0.05)	(0.19)
	BTE	Υ_{01}			0.03	0.01	0.01
					(0.06)	(0.06)	(0.05)
Rate of change (π1i)	Intercept	Υ_{10}		0.03**	0.02	0.01	0.01
				(0.01)	(0.02)	(0.02)	(0.02)
	BTE	Υ_{11}			0.02	0.02	0.03*
					(0.02)	(0.02)	(0.02)
Demographic controls [a]			No	No	No	Yes	Yes
Site fixed effects [b]			No	No	No	No	Yes
Random Effects			Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)
Level 1	Within person	σ_ε	0.39***	0.35***	0.35***	0.35***	0.35***
			(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Level 2	Initial status	σ_0	0.32***	0.40***	0.40***	0.39***	0.35***
			(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
	Rate of change	σ_1		0.14***	0.14***	0.14***	0.13***
				(0.02)	(0.02)	(0.02)	(0.02)
	Correlation	σ_{01}		-0.56***	-0.57***	-0.58***	-0.59***
				(0.07)	(0.07)	(0.07)	(0.07)
Deviance			1,461.91	1,423.11	1,420.66	1,400.77	1,348.96
P (LR Chisquared Test)			0.03	0.03	0.04	0.00	0.00
n			1,109	1,109	1,109	1,109	1,109

Notes. *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10

[a] Models 4 and 5 control for race and gender

[b] Model 5 controls for site specific characteristics that are time invariant

TABLE 10
Multi-level Regression Model for Career Readiness

Fixed Effects		Parameter	Model 1 Coefficient (Robust Std. Error)	Model 2 Coefficient (Robust Std. Error)	Model 3 Coefficient (Robust Std. Error)	Model 4 Coefficient (Robust Std. Error)	Model 5 Coefficient (Robust Std. Error)
Initial Status (π0i)	Intercept	Υ_{00}	3.33***	3.31***	3.38***	3.43***	3.15***
			(0.03)	(0.04)	(0.06)	(0.08)	(0.49)
	BTE	Υ_{01}			-0.13*	-0.15**	-0.15**
					(0.08)	(0.08)	(0.08)
Rate of change (π1i)	Intercept	Υ_{10}		0.01	-0.04**	-0.04**	-0.05**
				(0.02)	(0.02)	(0.02)	(0.02)
	BTE	Υ_{11}			0.11***	0.11***	0.11***
					(0.03)	(0.03)	(0.03)
Demographic controls [a]			No	No	No	Yes	Yes
Site fixed effects [b]			No	No	No	No	Yes
Random Effects			Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)
Level 1	Within person	σ_ε	0.53***	0.47***	0.47***	0.47***	0.47***
			(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Level 2	Initial status	σ_0	0.38***	0.54***	0.53***	0.52***	0.51***
			(0.02)	(0.04)	(0.04)	(0.03)	(0.03)
	Rate of change	σ_1		0.18***	0.18***	0.18***	0.17***
				(0.03)	(0.03)	(0.03)	(0.03)
	Correlation	σ_{01}		-0.70***	-0.70***	-0.70***	-0.70***
				(0.05)	(0.06)	(0.06)	(0.06)
Deviance			1,784.31	1,752.49	1,742.08	1,732.06	1,726.62
P (LR Chisquared Test)			0.60	0.52	0.01	0.00	0.00
n			960	960	960	960	960

Notes. *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10
[a] Models 4 and 5 control for race and gender
[b] Model 5 controls for site specific characteristics that are time invariant

TABLE 11
Multi-level Regression Model for Goal Setting/Achievement

Fixed Effects		Parameter	Model 1 Coefficient (Robust Std. Error)	Model 2 Coefficient (Robust Std. Error)	Model 3 Coefficient (Robust Std. Error)	Model 4 Coefficient (Robust Std. Error)	Model 5 Coefficient (Robust Std. Error)
Initial Status ($\pi 0i$)	Intercept	Υ_{00}	3.37***	3.32***	3.28***	3.29***	3.89***
			(0.02)	(0.03)	(0.04)	(0.06)	(0.22)
	BTE	Υ_{01}			0.08*	0.07*	0.08*
					(0.05)	(0.05)	(0.05)
Rate of change ($\pi 1i$)	Intercept	Υ_{10}		0.03***	0.04***	0.04***	0.02
				(0.01)	(0.02)	(0.02)	(0.02)
	BTE	Υ_{11}			-0.01	-0.01	-0.00
					(0.02)	(0.02)	(0.02)
Demographic controls [a]			No	No	No	Yes	Yes
Site fixed effects [b]			No	No	No	No	Yes
Random Effects			Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)
Level 1	Within person	σ_{ε}	0.41***	0.39***	0.39***	0.39***	0.39***
			(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Level 2	Initial status	σ_0	0.29***	0.30***	0.29***	0.29***	0.29***
			(0.02)	(0.04)	(0.04)	(0.04)	(0.04)
	Rate of change	σ_1		0.10***	0.10***	0.10***	0.10***
				(0.03)	(0.03)	(0.03)	(0.03)
	Correlation	σ_{01}		-0.28	-0.28	-0.29	-0.32
				(0.21)	(0.21)	(0.21)	(0.21)
Deviance			1,510.93	1,492.56	1,489.74	1,480.52	1,462.00
P (LR Chisquared Test)			0.00	0.00	0.02	0.00	0.00
n			1,109	1,109	1,109	1,109	1,109

Notes. *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10
[a] Models 4 and 5 control for race and gender

TABLE 12
Multi-level Regression Model for Grit

Fixed Effects		Parameter	Model 1 Coefficient (Robust Std. Error)	Model 2 Coefficient (Robust Std. Error)	Model 3 Coefficient (Robust Std. Error)	Model 4 Coefficient (Robust Std. Error)	Model 5 Coefficient (Robust Std. Error)
Initial Status (π0i)	Intercept	Υ_{00}	3.37***	3.25***	3.29***	3.30***	3.57***
			(0.03)	(0.04)	(0.06)	(0.08)	(0.44)
	BTE	Υ_{01}			-0.09	-0.10	-0.09
					(0.09)	(0.09)	(0.08)
Rate of change (π1i)	Intercept	Υ_{10}		0.07***	0.05**	0.05**	0.01
				(0.02)	(0.03)	(0.03)	(0.03)
	BTE	Υ_{11}			0.05	0.05	0.06*
					(0.04)	(0.04)	(0.04)
Demographic controls [a]			No	No	No	Yes	Yes
Site fixed effects [b]			No	No	No	No	Yes
Random Effects			Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)	Estimate (Std.Error)
Level 1	Within person	σ_ε	0.67***	0.56***	0.56***	0.56***	0.56***
			(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Level 2	Initial status	σ_0	0.27***	0.58***	0.58***	0.58***	0.47***
			(0.04)	(0.05)	(0.05)	(0.05)	(0.05)
	Rate of change	σ_1		0.27***	0.26***	0.26***	0.20***
				(0.03)	(0.03)	(0.03)	(0.03)
	Correlation	σ_{01}		-0.83***	-0.83***	-0.83***	-0.72***
				(0.03)	(0.04)	(0.04)	(0.07)
Deviance			2,383.36	2,322.21	2,320.94	2,319.85	2,250.38
P (LR Chisquared Test)			0.00	0.00	0.00	0.02	0.00
n			1,106	1,106	1,106	1,106	1,106

Notes. *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10

[a] Models 4 and 5 control for race and gender

[b] Model 5 controls for site specific characteristics that are time invariant

[b] Model 5 controls for site specific characteristics that are time invariant

DISCUSSION AND CONCLUSIONS

In this paper we set out to answer two research questions regarding the possible impacts of a corporate sponsored school-to-work program on the soft skills enhancement of disadvantaged high school students. We examined four specific soft skill behaviors and four measures that attempted to determine if soft skill personality traits had been inculcated. Our findings indicate partial support for the inference that Johnson & Johnson's Bridge-to-Employment school-to-career program has a positive influence on the development of these skills in the 10 BTE programs that were examined.

With respect to soft skill behaviors we found that the communication and teamwork skills of BTE students improved over three years of high school at a significantly higher rate than did those in a comparison group. No differences, however, between groups were found for problem solving and goal setting behaviors notwithstanding the fact that BTE students reported significantly higher levels of these behaviors at baseline. Our analyses of personality traits also provided a mixed picture of success. While BTE students reported significantly higher levels of confidence in immediate job readiness, career readiness and grit than did comparison students, there was no difference between groups on confidence in college readiness.

While it is not unusual for studies of soft skills to find differential impacts (see, for example, Ibarraran et al. 2014; Heckman, Stixrud and Urzua, 2006; Galloway et al. 2017; Garcia, 2014), it is important to try to determine why some soft skills are affected by a program and others are not. A simple explanation is that the presentation and/or wording in the FHI-360 designed questionnaire resulted in systematic patterns of measurement error. This explanation, while plausible, seems unlikely inasmuch as neither the question forms nor the question scales appear to distinguish significant from non-significant soft skills findings. More reasonable is a substantive interpretation that BTE is more successful in engendering soft skills, both behaviors and traits, that (a) do not raise immediate awareness of the need for technical skills, and (b) are more closely anchored in contemporaneous interactions with program mentors, tutors and peers. Problem solving, especially in STEM and healthcare enhancement programs like BTE, is a soft skill that is closely linked to the acquisition of tools like math proficiency, word problem comprehension and hypothesis testing (Heckman, Humphries and Kautz, 2014; Caneiro and Heckman, 2003; Coleman, 1990) and our finding of no impact here is likely related to BTE's limited success in improving students' technical skills (Camasso, Jagannathan and Bzdak, 2019). The items measuring "confidence in readiness for college" and "ability to set realistic (educational and) long term goals," given the focus of BTE on college as a pathway to high skill jobs also raises student awareness of the necessity of technical skill competence. These items may additionally capture anxieties around their capacity to acquire these skills.

Soft skills like communication, teamwork, perseverance (grit) and confidence to get a job or have a career signal more generalized and immediate effects arising out of social relationships, i.e., the interactions of impressionable teenagers with accomplished professionals (mentors) pursuing attractive and financially rewarding careers in science and healthcare. Such soft skills can still be acquired, however, with students not fully understanding the amount of hard work and commitment that these careers demand.

Our findings add to the thin but growing literature documenting the positive effect that school-to-work interventions can have on soft skill development (Larsen and Vandergrift, 2000; Baker, 2013; Garcia, 2014; Durlak and Weissberg, 2013; Heckman, Stixrud and Urzua, 2006; Ibarraran et al., 2014). They also point up the utility that a business/industry collaborative stakeholders model can have in addressing the insufficiency of STEM and fundamental employability skills that currently characterize the U.S. labor market. Of course, the Johnson & Johnson BTE approach which places more emphasis on school to college readiness and less on school-to-work is only one of many possible approaches to successfully bridging the gap between education and labor. Here the German two-track vocational model comes to mind.

The study we present has some serious limitations which narrow the generalizability of our findings. While our research design does control for some student characteristics and site level factors it does little to adjust for unmeasured, time-varying factors at either the student or site level. The selection of students by the partners, as we have shown, often has produced BTE and comparison groups with significantly different demographic, academic and soft skills at baseline. It is quite possible that these group differences may signal dissimilarities in resource inputs (in-school, outside school or both) that are correlated with BTE participation and that could also vary overtime. As we attempted to make clear in our presentation of results, a large proportion of the variation in soft skill development remains unexplained. The inclusion of human capital inputs from the school and home background factors/resources measured at the student and school levels would very likely reduce this unexplained variation and make our estimates of BTE effect more precise. Family structure and values information would seem indispensable (Hill, 2017).

Of course, expanded statistical modelling and sensitivity analysis is not the only pathway to more precise BTE estimates. Experimental design with random assignment of students into BTE and control groups would reduce the problem of selection and would decrease the potential influence of covariates (both time invariant and time changing) on any BTE-soft skills acquisition relationship. It is important to note that the trajectory differences reported here are significant but small. More substantial change in trajectories would appear to require longer program exposure which, in turn, points to the necessity of earlier intervention in the student's learning process.

School-to-career programs like BTE illustrate the direct collaboration of business and the public school in an effort to address our nation's growing skills gap. Scaling up these types of partnerships to a level that will impact our nation's labor force will require a dramatic change in how many people in government, the labor movement, and the education community view career education and/or job training for disadvantaged students that is designed and implemented by business/industry.

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APPENDIX A

Cincinnati, Ohio, September 2004 – September 2007

- Partnership of Cincinnati State Technical and Community College, Colerain High School and Ethicon Endo-surgery
- Two year participation period
- 25 BTE 9 Controls
- Excluded - 2 year programs.

Bridgewater-Raritan, Somerset County, NJ, September 1998 – September 2001

- Partnership of the Business and Educational partnership of Somerset and Hunterdon Counties, Bridgewater-Raritan High School and Ortho-McNeil Pharmaceutical
- Three year participation period
- Biology 27 BTE 34 Controls
- Business 11 BTE 22 Business
- Engineering 47 BTE 23 Physics contamination
- Excluded - middle and upper class community

Bound Brook, NJ, September 2000 – September 2003

- Partnership of Bound Brook High School, Somerset Medical School and Ethicon Inc.
- Three year participation period
- 23 BTE 23 Controls
- Excluded – program did not function in years 2, 3 & 4.

Christiana (Wilmington), Delaware, September 2003 – September 2007

- Partnership of Shue Middle School, Delaware Technical and Community College and NORAMCO, Business/Industry Education Alliance
- Three year participation period
- 25 BTE 31 Controls
- Contamination of BTE & Control groups

Cincinnati, Ohio, September 2000 – September 2003

- Same partners as 2007 above
- Two year participation period
- 22 BTE 24 Controls
- Excluded – only a 2 year programs.

Trenton, NJ, September 1999 – September 2003

- Partnership of Mercer Community College, Trenton Central High School and Janssen Pharmaceutical
- Three year participation period
- 20 BTE Control students from 8 to 20
- Excluded - No program in second year.

Kennett Square, PA, September 2002 – September 2007

- Partnership of Kennett High School, West Chester University and Centocor, Inc.
- Four year participation period
- 21 BTE 11 Comparison
- Excluded – All comparison students attrited in second year had to be replaced by a new comparison group.