

Validating an Instrument to Measure School Culture in Project-Based Learning Environments

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Submitted: 12 Nov 2020; Accepted: 12 Dec 2020; Published: 19 Dec 2020

Abstract

Measuring school culture and analyzing student learning experiences is a rapidly growing practice, with a notable uptick following the increased focus on learning experiences spurred by international comparisons of educational environments and resulting student outcomes. The literature documents common constructs that are often included in school culture surveys. However, often all learning environments are organized together and offered the same school culture survey. This is problematic because a common school culture survey construct is “learning environment” and the items that form this construct will be significantly different based on the instructional model. Therefore, providing educators with a one size fits all culture survey does not meet the needs of schools offering problem-based learning (PrBL) and project-based learning (PBL) environments. This research examines the process for revising, designing, and validating a school culture survey aligned to PrBL and PBL environments.

Keywords: Project-Based Learning (PBL), Survey Validation, Confirmatory Factor Analysis, School Culture, Survey

Introduction

The objective of this research was to revise a student culture survey with explicit alignment to project-based learning (PBL) environments using Confirmatory Factor Analysis (CFA) and Exploratory Factor Analysis (EFA) to not only provide a general tool that project-based learning (PBL) schools can utilize, but also contribute a process to the larger community that will inform the measurement of student culture in a variety of specialized learning environments. A common construct on student culture surveys is “learning environment” or “academics” or “classroom experiences” and it is important that this construct be aligned to the pedagogical approaches being implemented [1-3].

This article will enable project-based learning schools to measure culture with a learning environment construct that is aligned to PBL instruction. And, more generally, this research will provide a framework for all schools to align culture surveys with their specific learning environment model, enabling all school models to transform culture in service of better social, emotional, and academic outcomes for all students.

Perspective

There is not a single consensus definition of school culture, but most definitions include descriptions of norms, practices, beliefs, policies, and learning experiences [4]. Differentiating between a

school’s culture and its climate is important to do before collecting data and analyzing the impact for students. While the two elements of experiencing a school are closely linked, the extant literature suggests making the distinction in order to build the capacity of the school as it is suggested culture is more easily altered [5-7]. Van Houtte concludes that “the culture concept is more accurate [compared to climate], since it is clear how culture originates and how culture may influence (the behavior of) individual members of the organization.”

Effecting changes in school culture requires school leaders to accurately measure progress towards their goals. Transforming an unhealthy school culture into a healthy school culture that mitigate risks can be one of the biggest challenges instructional leaders face [8]. As noted in Guiding Principles, approaches to measuring and changing school culture must be uniquely suited to each school [9]. Numerous instruments have been evaluated and made available for school use, however, schools operating unique programs are often required to adapt instruments not aligned with their unique learning environments [10]. For instance, data that suggests a positive PBL learning environment, such as student self-directed movement, could be misinterpreted in a non-PBL as off-task or disruptive. New Tech schools implement project-based learning (PBL) and the nearly 200 public schools in the network have been reflecting on and changing student culture within the

context of project-based learning for over 10 years.

Methods

The New Tech Network Culture Survey series includes four surveys: Student Culture Surveys for grade PreK-2 (video-based), 3-6 and 6-12, as well as an Educator Culture Survey. The Student Culture Surveys measure the hypothesized constructs of School Connectedness, Learning Experiences, Rules and Discipline Processes, Peer Relationships, Adult Relationships, and College and Career Readiness (for grades 9-12). The Educator Culture Survey measures hypothesized constructs of School Connectedness, School Vision and Mission, Staff Interactions and Structures, and Leadership. The item development and resulting constructs were informed by the extant literature and are continuously evaluated against emerging literature.

Factor Analysis. To analyze the hypothesized construct structure confirmatory factor analysis (CFA) and exploratory factor analysis (EFA) were used. Factor analysis is a statistical method designed to understand how variables (survey items) sort based on underlying mechanisms (factors) and form constructs. CFA is a form of factor analysis that tests how well the hypothesized constructs align with actual number of factors and variable loadings [11]. EFA approaches the factor structure without a hypothesis and documents factor structures that emerge.

A total of 3,959 complete survey responses were included in the analysis. Surveys with missing values on any items were excluded from the analysis. All analyses were performed using the statistical software program SAS, version 9.3. A significance level of 0.05 was used for determining statistical significance. The basic assumptions of normality and multivariate normality were assessed and found lacking because of the discrete nature of the data (most item responses were scored on a four- or five-point scale rather than a continuous scale). Most of the results should be relatively robust to this departure from normality, since observed distributions are symmetric, though not normal.

The correlation within each subscale of the instrument and the overall Cronbach's Alpha score (Table 1) were computed to verify past results of instrument validity and reliability.

Table 1: Cronbach's Alpha

	Cronbach's Alpha	
	Raw variables	Standardized variables
School Connectedness	0.824	0.826
Learning	0.880	0.881
Discipline	0.898	0.898
Peer Relationships	0.916	0.917
Adult Relationships	0.829	0.849
College and Career Ready	0.895	0.895
Overall	0.956	0.958

The relatively high correlations computed for this sample data are consistent with values previously calculated. Confirmatory factor

analysis was used to assess whether the observed data supports or contradicts the hypothesized factor structure (Figure 1).

Elements of School Culture	Survey Questions (Included in construction of Total Scores)
School Connectedness	6, 9a, 9b, 9c, 9d, 9e
Learning	10a, 10b, 10c, 10d, 10e, 10f, 11a, 11b, 11c, 11d
Discipline	12a, 12b, 12c, 12d, 13a, 13b, 13c, 13d
Peer Relationships	14a, 14b, 14c, 15a, 15b, 15c, 15d
Adult Relationships	17a, 17b, 17c, 17d, 17e, 18
College and Career Ready	20a, 20b, 20c, 20d, 20e, 20f, 21a, 21b, 21c, 21d

Figure 1: Hypothesized structure

An initial CFA model was fit that included all six of the latent elements of school culture: school connectedness, learning, discipline, peer relationships, adult relationships, and college and career ready. The path diagram for this model is included as Figure 2.

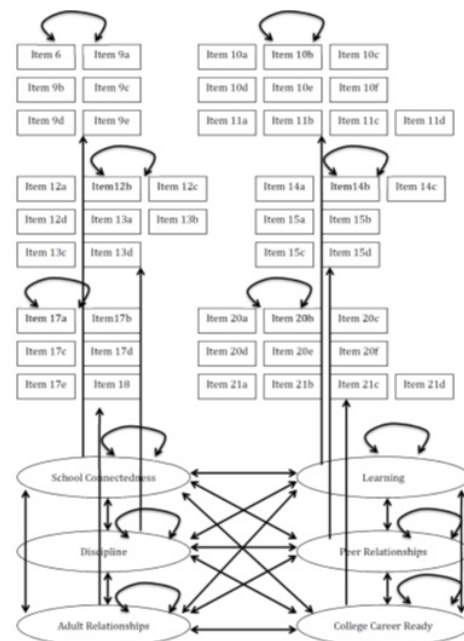


Figure 2: Path Diagram for CFA Model With all Six Elements of School Culture.

The hypothesized model structure assigns one directional relationships between each survey item and the respective element of school culture to which it is associated. These relationships are depicted in the path diagram by one-headed arrows going from elements of school culture to associated survey items. The covariance structure for the elements of school culture is not restricted. Two-headed arrows in the path diagram represent covariances. A second CFA model was also considered that left off the college and career ready portion of the survey.

Data Sources

Data for this analysis was collected via an online survey link to the grades 6-12 Student Culture Survey during the 2015-16 academic year. School leaders in 90 schools shared the link with students during the Spring 2016 survey window. Surveys typically require 15 minutes or less to complete, and many schools choose to administer the survey at a specific time during the day

(English, homeroom, 1st period, etc.). The survey remained open for 5 weeks. Of the 7,454 student responses collected during the 2015-16 academic year, 3,959 completed responses were used in this analysis. The grades 6-12 Student Culture Survey was originally created in 1996 and has undergone numerous revisions based on input from school practitioners and developments in the extant literature on school culture. The Student Culture Survey is designed to be timely, relevant, and valid for U.S. public schools implementing PBL. The Student Culture Survey version used for the analysis in the research included 47 Likert statements and was last revised in 2013. In 2013, reliability was measured by calculating the overall Cronbach's Alpha score and correlation within each subscale of the instrument was calculated to measure validity. An overall high Cronbach's Alpha score ($r = .930$) indicated reliability of the instrument. Moderately high correlations between each sub-construct and the overall construct of school culture indicated validity: School Connectedness ($r=.791$), Learning Experiences ($r=.847$), Rules and Discipline Processes ($r=.718$), Peer Relationships ($r=.833$), Adult Relationships ($r=.868$). Additionally, evidence supporting face validity was documented in 2013 [12].

Results

In both CFA models considered, all the estimated parameters were found to be significantly different from 0 at significance level 0.05 (Table 2 and Table 3). The non-zero factor loadings suggest that there is some merit to the hypothesized survey structure. In particular, all of the survey items that are assigned to each of the elements of school culture do have some notable link demonstrated within this sample data.

Table 2: Parameters for the model with all six elements of school culture

N	Description	Results
15	Covariances between elements of school culture	All differ significantly from 0
47	Factor loadings	All differ significantly from 0
47	Error variances	All differ significantly from 0
109	Total parameters	

Table 3: Parameters for the model with only five elements of school culture - exclude college/career

N	Description	Results
10	Covariances between elements of school culture	All differ significantly from 0
37	Factor loadings	All differ significantly from 0
37	Error variances	All differ significantly from 0
84	Total parameters	

Several metrics are available for assessing the adequacy of the hypothesized model. In the hypothesized model that includes all six elements of school culture, all reported metrics suggest that the hypothesized model structure is not adequate.

- A chi-squared test suggests that there is significant evidence contradicting the hypothesized factor structure ($X^2 = 22952$, $DF = 1019$, $p\text{-value} < .0001$).
- Adjusted goodness of fit index (AGFI) = .7264 shows a poor fit. A good model fit is indicated by values above 0.90 [13].
- Standardized root mean square residual (SRMR) = .1008 shows a poor fit. A good model fit is indicated by values below 0.05 [13].
- Root mean square error approximation (RMSEA) = .0737 shows a poor fit. A good model fit is indicated by values below 0.05 [13].

In the hypothesized model that includes only five elements of school culture (excludes college and career ready), all commonly used metrics except SRMR suggest that the hypothesized model structure is not adequate. These mixed results suggest that the hypothesized factor structure is slightly lacking, but that it may be corrected with only slight modification.

- The chi-squared test suggests that there is significant evidence contradicting the hypothesized factor structure ($X^2 = 11963$, $DF = 619$, $p\text{-value} < .0001$).
- Adjusted goodness of fit index (AGFI) = .8115 shows a poor fit. A good model fit is indicated by values above 0.90.
- SRMR = .050 shows a good (borderline) fit. A good model fit is indicated by values below 0.05.
- RMSEA = .0680 shows a poor fit. A good model fit is indicated by values below 0.05.

Following pre-data screening tests, exploratory factor analysis (EFA) with principle component extraction was used to clarify areas of correction required [11]. The rotated component matrix was used to evaluate which items loaded best with each factor/component. The results suggest that five items across factors 1, 3, 4, 5, and 6 were weak and 9 out of the 12 items on factor 2 were weak. The analysis organized the items into factors and within factors sorted items by strength of alignment. Table 4 documents how the items sorted and highlights the weak and flawed items. Flawed items had scores in other factors that could suggest it was originally intended to measure something else and "straddles" two factors or it was overall weak and didn't align to any factor strongly. The revised structure reorganizes factor 2 (school connectedness) and factor 6 (college and career ready) items and includes revised items to clarify confusing language in the weak items (Table 5 outlines the revised factor structure).

Table 4: Items organized into factors and sorted by strength

Item	Status
Factor 1: Relationship with peers (hypothesized items 14a-c, 15a-d) (actual items 14a-c, 15a-d, 11d, 13a)z	
• Item 15b: How much do you agree or disagree with the following statements about the social interactions of...-Students at my school respect each other.	Aligned
• Item 14b: How much do you agree or disagree with the following statements about your experiences with other...-My peers treat me with respect.	Aligned
• Item 15c: How much do you agree or disagree with the following statements about the social interactions of...-Most students at my school get along.	Aligned
• Item 15d: How much do you agree or disagree with the following statements about the social interactions of...-Nearly everyone is accepted at my school.	Aligned
• Item 15a: How much do you agree or disagree with the following statements about the social interactions of...-Students at my school feel physically safe.	Aligned
• Item 14c: How much do you agree or disagree with the following statements about your experiences with other...-I feel accepted for who I am at school.	Aligned
• Item 14a: How much do you agree or disagree with the following statements about your experiences with other...-I feel physically safe on campus.	Aligned
• Item 11d: How much do you agree or disagree with the following statements about working with other students?-Students in groups communicate respectfully. Could be factor 5 as well	Flawed
• Item 13a: How much do you agree or disagree with the following statements about students following or break...-Most students follow the rules. Could be factor 3 as well	Flawed

Factor 2: school connectedness (hypothesized items 6, 9a-e) (actual items 6, 9a-e, 17a-e, 18)	
• Item 9c: How much do you agree or disagree with the following statements?-I take on leadership roles in my school.	Aligned
• Item 9a: How much do you agree or disagree with the following statements?-I contribute positively to my school.	Aligned
• Item 9b: How much do you agree or disagree with the following statements?-I have been recognized for something positive at my school.	Aligned
• Item 17b: How much do you agree or disagree with the following statements?-Most teachers care about my success.	Weak
• Item 17c: How much do you agree or disagree with the following statements?-Most teachers treat me with respect.	Weak
• Item 9e: How much do you agree or disagree with the following statements?-I am encouraged to be a strong learner at school.	Weak
• Item 17a: How much do you agree or disagree with the following statements?-Most teachers know me well.	Weak
• Item 17e: How much do you agree or disagree with the following statements?-If I was in trouble, there is at least one school staff member I could go to for help.	Weak
• Item 17d: How much do you agree or disagree with the following statements?-Most teachers recognize my effort.	Weak
• Item 9d: How much do you agree or disagree with the following statements?-I receive a high quality education at this school. Could be factor 5 as well	Flawed
• Item 6: Which of the following statements best describe how proud you are of your school? Check only one. Could be factor 3 or 5 as well	Flawed
• Item 18: Which of the following statements best reflect how you might handle a situation where one of your... weak overall	Flawed

Factor 3: Rules and Discipline (hypothesized 12a-d, 13 a-d) (actual 12a-d, 13b-d)

<ul style="list-style-type: none"> Item 12a: How much do you agree or disagree with the following statements about rules at your school?-School staff and students make the rules together. 	Aligned
<ul style="list-style-type: none"> Item 12d: How much do you agree or disagree with the following statements about rules at your school?-Rules are enforced fairly for all students. 	Aligned
<ul style="list-style-type: none"> Item 12c: How much do you agree or disagree with the following statements about rules at your school?-There is a process for students to change the rules. 	Aligned
<ul style="list-style-type: none"> Item 12b: How much do you agree or disagree with the following statements about rules at your school?-The rules make sense. 	Aligned
<ul style="list-style-type: none"> Item 13b: How much do you agree or disagree with the following statements about students following or break...-Consequences for breaking the rules apply equally to everyone. 	Aligned
<ul style="list-style-type: none"> Item 13c: How much do you agree or disagree with the following statements about students following or break...-Students who break the rules can earn back trust from teachers and peers. 	Weak
<ul style="list-style-type: none"> Item 13d: How much do you agree or disagree with the following statements about students following or break...-Students who break the rules talk with school staff to understand what they did wrong. 	Weak

Factor 4: College and Career Ready/life after high school (hypothesized 20a-f, 21 a-d) (actual 20a-f)

<ul style="list-style-type: none"> Item 20b: How ready do you feel for each of the following?-Applying for college 	Aligned
<ul style="list-style-type: none"> Item 20e: How ready do you feel for each of the following?-Enrolling in a 4-year college 	Aligned
<ul style="list-style-type: none"> Item 20c: How ready do you feel for each of the following?-Obtaining financial aid for college 	Aligned
<ul style="list-style-type: none"> Item 20f: How ready do you feel for each of the following?-Success in college 	Aligned
<ul style="list-style-type: none"> Item 20d: How ready do you feel for each of the following?-Taking classes at a community college 	Aligned
<ul style="list-style-type: none"> Item 20a: How ready do you feel for each of the following?-Getting a job 	Aligned

Factor 5: Learning (hypothesized 10a-f, 11a-d)(actual 10a-f, 11a, 11b, 11c)

<ul style="list-style-type: none"> Item 10e: How often do the projects in your classes provide you with the opportunity to?-Talk with experts and community members about my ideas to solve problems. 	Aligned
<ul style="list-style-type: none"> Item 10d: How often do the projects in your classes provide you with the opportunity to?-Present to an audience other than students and teachers. 	Aligned
<ul style="list-style-type: none"> Item 10b: How often do the projects in your classes provide you with the opportunity to?-Help my community or others. 	Aligned
<ul style="list-style-type: none"> Item 10c: How often do the projects in your classes provide you with the opportunity to?-Allow me to be creative and innovative. 	Aligned
<ul style="list-style-type: none"> Item 10f: How often do the projects in your classes provide you with the opportunity to?-Learn the skills to successfully complete projects. 	Aligned
<ul style="list-style-type: none"> Item 11b: How much do you agree or disagree with the following statements about working with other students?-I have learned how to work well with other students. 	Aligned
<ul style="list-style-type: none"> Item 11c: How much do you agree or disagree with the following statements about working with other students?-Students in groups share responsibility for the work. 	Aligned
<ul style="list-style-type: none"> Item 10a: How often do the projects in your classes provide you with the opportunity to?-Feel excited about the work. 	Aligned
<ul style="list-style-type: none"> Item 11a: How much do you agree or disagree with the following statements about working with other students?-I usually work in groups in my classes. Could also be factor 2 and weak overall 	Flawed

Factor 6: Adult relationships (hypothesized 17a-e, 18)(actual 21a-d)

<ul style="list-style-type: none"> Item 21d: How much do you agree or disagree with the following statements about how well your school prepar...-School staff provide information about what is required to be accepted at the college of my choice. 	Aligned
<ul style="list-style-type: none"> Item 21c: How much do you agree or disagree with the following statements about how well your school prepar...-School staff help with college applications. 	Aligned
<ul style="list-style-type: none"> Item 21a: How much do you agree or disagree with the following statements about how well your school prepar...-School staff talk with students about options after high school. 	Aligned
<ul style="list-style-type: none"> Item 21b: How much do you agree or disagree with the following statements about how well your school prepar...-School staff teach job hunting skills. 	Aligned

Table 5: Suggested Valid Structure

Factor	Strong Items	Weak/ flawed items	Changes from hypothesized structure	Items should be removed from the suggested structure
1: relationships with peers	14a-c, 15a-d	11d, 13a	+11d, 13a	11d, 13a
2: school connectedness	9a-c	6, 9d, 9e, 17a-e, 18	+17a-e, 18	6, 9d, 18
3. discipline	12a-d, 13b	13c, 13d	-13a	
4. CCR	20a-f		-21a-d	
5. Learning	10a-f, 11b, 11c	11a	-11d	11a
6. Adult relationships	21a-d		+21a-d, -17a-e	

Within school connectedness a new construct emerged, school pride. The relationship between school connectedness and positive social, emotional, and academic outcomes for students is well-documented in the literature [14-18]. Disentangling pride from connectedness is critical in developing an accurate measure of overall school culture. Additionally, many of the college and career items actually aligned with adult relationships. This suggests a refocus on measuring college and career efforts at the school level that don't rely on single contributions from adults. An examination of practices, policies, and attitudes surrounding college and career would improve the survey and yield results indicative of a college and career ready culture as opposed to identifying isolated adult practices, such as a single teacher helping a student with college applications. To correct this, items related to college and career ready were reworded to capture practices instead of adult supports. In the hypothesized structure, each of the college and career items began with the statement "School staff provide. . .". In the revised structure this wording was revised to "I have access to. . .". This shift captures the structures at the school from the student perspective as opposed to adult top-down services.

Significance

Implications of this analysis not only impact school-based decision-making, but also contribute an actionable instrument to the extant literature on school culture. Experiences of school culture can differ significantly by student race therefore it is critical to use a valid instrument to measure school culture in the support of creating equitable and effective learning environments for all students [19]. Nearly 200 public schools in the U.S. implement PBL using the New Tech model and this tool can inform their work directly. Use of the revised Student Culture Survey provides school leaders with a tool to support school culture transformation in the service of better and equitable learning experiences for all students. Given the recent increase in attention on measuring school culture, it is important to contribute an instrument that has undergone testing to ensure it measures what it intends to measure.

Further research examining the validity of the Student Culture

Survey in schools with different student compositions will be critical in ensuring the instrument can be used as a lever for equitable schools. Socio-cultural factors can be a driver for equity when the interaction between cultures of schools and the influence they have on incorporation of specific groups of students can be accurately and reliably examined [20]. Carter summarizes previous research that has suggested that school racial composition can impact cultural alienation, school connectedness, social adjustment, racial discrimination, and interpersonal relationships for students of color [20].

Creating equitable schools requires an accurate examination of school culture using a tool designed for unique school programming. The validation of the NTN Student Culture Survey will move the field forward by providing one such measure for schools using PBL and PrBL environments [21,22].

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