

Collaborative Learning Expansion Set Psychometric Portfolio

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The psychometric portfolio of the Collaborative Learning Expansion Set (CLES) is a collection of evidence developed by a NSSE research analyst and myself to support the use and interpretation of CLES results. The CLES was an experimental item set administered during the 2020 National Survey of Student Engagement (NSSE) administration. The components of the portfolio address different aspects of the CLES, as well as how researchers should interpret instrument results and use the instrument for future studies. The psychometric portfolio starts off with a discussion of the respondents who completed the CLES and is then organized into five sections, as described by AERA, APA, and NCME's 2014 Standards for Educational and Psychological Testing: Survey Content Evidence, Response Process, Internal Structure, Relations to Other Variables, and Consequential Validity Evidence.

Respondents

In the 2020 NSSE administration, the CLES was completed by 12,863 respondents from 30 4-year institutions. NSSE administrations are only given to first-year and senior students and this sample consisted of 60% seniors. Majority of the respondents identified as women (63%) followed by men (34%), respondents who preferred not to respond (14%), and identified with another gender identity (13%). For racial/ethnic identity, a little over half of respondents identified as White (54%) followed by Hispanic or Latino (12%), Multiracial (11%), Asian (11%), Black or African American (7%), and respondents who prefer not to respond (2%), with American Indian or Alaskan Native, Middle Eastern or North African, Native Hawaiian or Other Pacific Islander, and respondents who identified with another race/ethnic identity all having

respondents that represented less than 1% of the sample. About 95% of respondents identified as domestic students and 29% reported being in a STEM major.

Survey Content Evidence

The survey content evidence examines how well survey items represent its constructs as it is understood in relevant literature (NSSE Psychometric Portfolio, n.d.b). The survey content evidence for the CLES instrument includes discussion about the motivations to create the CLES and how the creation of the CLES is connected specifically to literature that highlights Black undergraduate college student experiences.

Collaborative learning is described as an instructional method that emphasizes small group interactions with peers to achieve an objective, solve problems, and deepening material understanding (Barkley et al., 2014; Cabrera et al., 2002; NSSE Engagement Indicators, n.d.a, Prince, 2004). In the 1980s through 1990s, the stagnation of college student enrollment at U.S. colleges and universities pushed higher education stakeholders to find more effective ways to keep students engaged in their college experiences (Berry, 1991; Bruffee, 1984; Goodsell, 1992; Kerr, 1900; Prince, 2004) and this led to an increase of collaborative learning implementation. Much of the collaborative learning literature takes place during the late 1980s to the early 2000s (Cabrera et al., 2002), which historically documented its increased importance in higher education classrooms.

In today's higher education context, collaborative learning is increasingly becoming a crucial practice for college student engagement. The American Association of Colleges and Universities (AAC&U) considers collaborative assignments and projects a high-impact practice (Kuh, 2008). Specifically in Science, Technology, Engineering, and Mathematics (STEM) fields, academic programs are required to have collaborative student outcomes as part of the criteria to

be accredited by the Accreditation Board for Engineering and Technology and is emphasized by the National Science Technology Council Committee on STEM Education (ABET, 2017; National Science & Technology Council, 2018). With a continued increased interest in collaborative learning as a valuable practice for college students from national organizations, it is beneficial to examine various components of collaborative learning.

The inspiration for the CLES initially comes from the Collaborative Learning Engagement Indicator on the core portion of the National Survey of Student Engagement (NSSE Engagement Indicators, n.d.a). The Collaborative Learning Engagement Indicator includes four items that asks students about the frequency of participating in collaborative learning acts, such as how often students ask peers for help with coursework, explaining course material to peers, preparing for exams with peers, and working with peers on course projects or assignments (Table 1). Using the Collaborative Learning Engagement Indicator, I conducted a project assessing Black STEM students' collaborative learning experiences and how they related to their perceptions of supportive institutional environments, effective teaching practices, and satisfaction with their institutions (Priddie, 2018). However, through conducting the study, I discovered that the interpretation of the findings had to remain vague because the wording of the four items was not specific enough, as the items do not articulate any motivations for participating in collaborative learning experiences. More specifically, I was not able to infer whether students were the initiators in collaborative learning experiences or if faculty members required a specific level of collaborative activity as part of their curriculum. Reflecting on the vague interpretation of study findings, I concluded that the creation of the CLES would become beneficial to more deeply understand the collaborative learning experiences of college students.

Table 1

NSSE's Collaborative Learning Engagement Indicator

During the current school year, about how often have you done the following?	
<i>Response options: Very often, Often, Sometimes, Never</i>	
CLaskhelp	Asked another student to help you understand course material
CLexplain	Explained course material to one or more students
CLstudy	Prepared for exams by discussing or working through course material with other students
CLproject	Worked with other students on course projects or assignments

The CLES includes six questions and they were designed with two major considerations. First, the CLES questions were created based on previous literature that detailed specific perceptions and/or experiences that college students experience through collaborative learning activities. The collaborative learning literature covers various aspects of collaborative activities, such as motivations, interdependence among group members, leadership, roles and responsibilities, and faculty involvement (Brewer & Klein, 2006; Delucchi, 2006; Domingue, 2015; Freeman et al., 2008; Järvelä & Järvenoja, 2011; Jeong & Chi, 2007; Umbach & Wawrzynski, 2005; Yacizi, 2005). The second consideration connects to subset theories of Critical Race Theory, which include BlackCrit and QuantCrit. BlackCrit has three framing concepts addressing how anti-blackness reinforces educational inequities through understanding that anti-blackness is central to understanding our society, blackness exists in tension with neoliberal-multicultural imagination, and with the hope of creating space for Black liberatory fantasy (Dumas & ross, 2016). Similarly, QuantCrit focused on how quantitative methods can be beneficial in the development of critical studying race in educational research (Gillborn et al., 2018). Through both BlackCrit and QuantCrit, the CLES items were created while centering the college-going experiences of Black undergraduate students, as opposed to only considering a

“typical college student”. Therefore, BlackCrit and QuantCrit inspired this method of survey creation as I am guided by a new way of thinking about who is considered in survey item creation while considering how race/ethnicity is an important component of survey responses.

Table 2 demonstrates connections between CLES items and what Black college students are experiencing in higher education. Broadly, Black people often report that they hold worldview orientations that lean toward Africentricism (Bakari, 1997; Baldwin & Hopkins, 1990), collectivism (Carson, 2009), and communalism (Moemeka, 1998), meaning they place more value in the collective and the community as opposed to only looking out for oneself. Understanding the worldview orientation that Black people generally tend to hold, the assumption can be made that Black students attending higher education institutions hold similar beliefs. From this understanding, it may be one of the reasons researchers found that Black students tend to have close relationships with same-race peers and may seek support through groups rather than alone (Domingue, 2015; Lancaster & Xu, 2017; Palmer & Gasman, 2008; Palmer & Young, 2009; Patton, 2006; Thelamour et al., 2019). More specifically, a good chunk of researchers’ examinations of Black college student experiences focus on academic achievement from various perspectives (Carson, 2009; Harper & Kuykendall, 2013; Hope et al., 2013; Morris & Monroe, 2009), their experiences with stereotypes and microaggressions (Chavous et al., 2004; Domingue, 2015; Fries-Britt & Griffin, 2007; Harper, 2015; McGee, 2015), and their interactions with instructors, both formally and informally (Patton, 2006). Some researchers take explorations a step further by examining specific stereotypes that are heard and experienced from both their Black peers and non-Black peers and two important concepts are ‘acting white’ (Durkee et al., 2019; Fordham & Ogbu, 1986) and Black women tropes, such as Angry Black Woman (Childs, 2005; Corbin et al., 2018; Domingue, 2015). Given the vastness of

previous studies conducted on Black college students experiences, I used this information to craft the CLES item set as a way to intentionally set up items that would specifically speak to the ‘Black experience’, as opposed to a ‘typical college student’ experience. However, it is important to note that even though the CLES item set was created with intentions to speak to Black college student experiences, it was written so that any college student could answer the questions in the item set.

Table 2

CLES Items and Black Student Experience Concepts

Item(s)	Concepts
1, 6d,6e	Africentric Worldview Orientation
2, 5	Black students seeking support
6a, 6n	Black student friendships with same race peers
6h, 6i, 6r	Black stereotypes and microaggressions
6j	‘Acting white’
6m	Black women tropes (Angry Black Woman, Black Mama)
3	Instructor Expectations
6f, 6g, 6l	Black student achievement
6c, 6o, 6p	Black student communication styles

Response Process

The response process evidence is used to demonstrate the fit between measured constructs and responses given by participants. Typically, response process evidence is captured through focus groups and cognitive interviews to be able to assess the thoughts respondents had as they answered each survey item. However, given the timeline of the item set creation, expert reviews and item descriptive information are used as current evidence.

The validity of the CLES items was checked through an expert review process with colleagues at the National Survey of Student Engagement. Expert review is beneficial due to

experts' abilities to assess if the survey items are able to meet the needs of the study (Groves et al., 2011). The expert reviewers were higher education scholars who have extensive experience creating and reviewing survey items for quality. The first round of expert review feedback was given after they received a first draft of the CLES items and their feedback consisted of suggestions for survey length, word and phrase emphasis, and the order of items. Once edits were made to the CLES items, a second draft of the item set was sent to expert reviewers and a meeting took place between myself, the research analyst who assisted with the CLES item creation, and members of the NSSE leadership team. During the meeting, the collective discussed each CLES item, its meaning, how it might be interpreted by future respondents, and suggested edits. From this meeting, I made the suggested edits to the CLES and finalized the item set for programming.

Table 3 represents the individual item descriptives for the CLES. All CLES items had Likert-scale response options, ranging from 1 to 5 (Strongly disagree to Strongly agree), 1 to 7 (Poor to Excellent), or 1 to 4 (with anchors representing frequency and importance). Given the standard deviation of all CLES items, it is shown that there is variation among respondents for each item, with some items reporting responses a little closer to the mean. Respondents were more likely to agree with the statements in the first question that emphasized community over individualism, which makes sense given that a little less than half of respondents identified as people of color and communities of color, such as Black and Latinx populations, tend to have more collectivist orientations (McGee & Bentley, 2017). Respondents reported that their instructors emphasized how collaborative learning can help them develop stronger relationships with peers quite a bit, which is shown to be an important collaborative learning benefit (Cabrera, 2002). For question six, respondents reported effective communication, helping others complete

tasks, making sure own tasks are completed, providing feedback on peers' work, and working with peers who share similar cultural backgrounds as them as important to their collaborative learning experiences. These results tend to be fairly common, as the collaborative learning literature discusses the important of group dynamics in collaborative experiences (Järvelä & Järvenoja, 2011; Joseph & Payne, 2003; Stump et al, 2011).

On the other end, respondents were less likely to agree with the first question statement "My success depends on others", which slightly conflicts with the higher agreeance about valuing community but also may mean that valuing community may not necessarily suggest that they are unable to succeed on their own. In question five, respondents reported that they voluntarily formed a group to work on course material only sometimes, which might suggest that they are becoming engaged in collaborative experiences primarily through faculty requirements or expectations (Delucchi, 2006; Stump et al., 2011). In question six, respondents reported receiving a higher grade than peers in group work, being respected by others in group, being recognized for their contributions, being assigned the most important role, and working with peers from different cultural backgrounds as them as the least important to their collaborative experiences. Individuals in groups can be actively working to compete against one another in order to achieve a goal and this may be due to differences in working styles (Järvelä & Järvenoja, 2011; Laal & Ghodsi, 2012) However, for these respondents, competition does not seem to be something as important to them in their collaborative experiences.

Table 3***CLES Item Descriptives***

Item	Mean	Std. Dev.	Variance	Min	Max	Skewness	Kurtosis
CLE2001a	4.05	0.841	0.706	1	5	-0.733	0.478
CLE2001b	3.84	0.910	0.828	1	5	-0.606	0.131
CLE2001c	3.60	0.925	0.855	1	5	-0.227	-0.266
CLE2001d	3.86	0.872	0.761	1	5	-0.581	0.226
CLE2001e	3.82	0.935	0.874	1	5	-0.495	-0.233
CLE2001f	2.90	1.125	1.265	1	5	0.135	-0.760
CLE2001g	3.25	1.098	1.205	1	5	-0.305	-0.554
CLE2002	5.08	1.362	1.854	1	7	-0.635	0.413
CLE2003a	2.80	0.913	0.833	1	4	-0.285	-0.775
CLE2003b	2.66	1.012	1.024	1	4	-0.196	-1.061
CLE2003c	3.05	0.949	0.901	1	4	-0.695	-0.510
CLE2003d	2.83	0.965	0.930	1	4	-0.360	-0.872
CLE2004a	2.95	0.901	0.811	1	4	-0.359	-0.842
CLE2004b	2.94	0.885	0.783	1	4	-0.391	-0.699
CLE2004c	2.57	0.986	0.972	1	4	-0.021	-1.032
CLE2005a	2.35	1.036	1.074	1	4	0.200	-1.120
CLE2005b	2.55	1.036	1.073	1	4	-0.035	-1.161
CLE2005c	2.53	0.966	0.933	1	4	0.003	-0.970
CLE2005d	2.80	0.931	0.866	1	4	-0.278	-0.845
CLE2006a	2.75	0.960	0.922	1	4	-0.254	-0.911
CLE2006b	2.87	0.914	0.836	1	4	-0.369	-0.730
CLE2006c	3.50	0.654	0.428	1	4	-1.172	1.173
CLE2006d	3.02	0.780	0.609	1	4	-0.371	-0.450
CLE2006e	3.64	0.581	0.337	1	4	-1.534	2.223
CLE2006f	2.08	1.042	1.087	1	4	0.493	-1.004
CLE2006g	2.94	0.827	0.684	1	4	-0.408	-0.428
CLE2006h	3.44	0.700	0.489	1	4	-1.127	0.946
CLE2006i	1.69	0.975	0.951	1	4	1.164	0.086
CLE2006j	2.82	0.922	0.850	1	4	-0.336	-0.749
CLE2006k	2.20	0.999	0.998	1	4	0.325	-0.995
CLE2006l	2.29	1.012	1.023	1	4	0.225	-1.064
CLE2006m	2.44	1.037	1.075	1	4	-0.007	-1.175
CLE2006n	2.00	1.011	1.022	1	4	0.581	-0.867
CLE2006o	3.33	0.750	0.562	1	4	-0.925	0.346
CLE2006p	3.08	0.776	0.602	1	4	-0.513	-0.203

Internal Structure

To assess the construct validity of the CLES, the CLES factor structures were examined through exploratory and confirmatory factor analysis (EFA/CFA). Factor analysis provides additional evidence to support statements that the CLES measures what it intends to measure (NSSE Psychometric Portfolio, n.d.b). Prior to conducting the EFA and CFA, all CLES respondents were randomly divided into two groups, where one group was used for the EFA (n = 5,854) and the other group was used for the CFA (n = 5,844).

Method: Exploratory Factor Analysis

An exploratory factor analysis was conducted to explore what factor structure may emerge from the CLES data. Polychoric correlations were used due to the ordinal nature of the data, as they better account for these types of variables than Pearson correlations (Drasgow, 2006). The EFA included all of the CLES items given to participants and the EFA model used principal axis factoring with a direct oblimin (oblique) rotation in order to allow the factors to correlate. Factors were identified with eigenvalues of 1.0 or greater and with factor loadings of 0.3 or greater (Tabachnick & Fidell, 2001).

Results: Exploratory Factor Analysis

All 35 CLES items were included in the initial round of the EFA and evidence suggested there was a 9-factor solution. An examination of the 9-factor solution yielded three factors with two or less items loading on each factor. Therefore, a simple structure was not achieved through a 9-factor solution and after further examination, the sample suggested a 6-factor structure for 24 items with one cross-loading (Table 4 & 5). There were 11 items that were removed from the EFA due to low factor loadings, but it is evident why some of these items did not make the final structure. For example, CLES items 1b, 1e, and 1f did not load very highly on any of the six

factors, particularly the orientation/value factor because these items had more of a focus on individualism. The case may be that lower scores on the Communal Orientation and Values might give insight into a more individualistic viewpoint and those items were not necessary to capture that experience. Furthermore, not all of the sub-items for CLES item 6 made the final factor structure but through understanding the collaborative learning areas the 6 factors cover, removed items did not appear to fit with the current factors. The EFA only explained 57% of the variance in the variables but the Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 92%, indicating “marvelous” factorability of the items (Kaiser, 1974).

Table 4***CLES Scales and Factor Items***

Scale	Variable	Item
Instructors Valuing Peer Networks (PN)	CLE2003a	Supporting your peers
	CLE2003b	Working with peers who have different backgrounds than you
	CLE2003c	Respecting other students' backgrounds
	CLE2003d	Developing stronger relationships with peers
Importance of Recognition and Leadership (RL)	CLE2006f	Receiving a higher individual grade than other group members
	CLE2006i	Being viewed by group members as the smartest
	CLE2006j	Being recognized for you contributions
	CLE2006k	Being assigned an important role in the group
Student Initiative (SI)	CLE2006l	Taking leadership of the group
	CLE2005a	Voluntarily formed a group to work on course material
	CLE2005b	Developed a close relationship with another student as a result of collaborative work
	CLE2005c	Chosen to work with a diverse group peers
Maintenance of Individual Contribution and Respect (CR)	CLE2005d	Felt uncomfortable asking another student for help with course material
	CLE2006c	Communicating effectively with group members
	CLE2006e	Making sure your own tasks are completed
	CLE2006h	Being respected by others in the group
Communal Orientation and Values (CO)	CLE2006o	Minimizing conflict among group members
	CLE2001a	My cultural background values community
	CLE2001c	I value the success of my community more than any one person
Instructor Expectations (IE)	CLE2001d	When my community wins, I win
	CLE2004a	Complete group assignments
	CLE2004b	Discuss your understanding of course material with other students
	CLE2004c	Prepare for exams by discussing or working through the course material with other students

Table 5***Exploratory Factor Analysis Pattern Matrix for CLES***

	Factors						Uniqueness
	1	2	3	4	5	6	
CLE2003a	.757						.65
CLE2003b	.890						.76
CLE2003c	.828						.65
CLE2003d	.730						.67
CLE2006f		.621					.37
CLE2006i		.795					.64
CLE2006j		.532		.307			.39
CLE2006k		.814					.69
CLE2006l		.701					.55
CLE2005a			.797				.66
CLE2005b			.864				.74
CLE2005c			.675				.59
CLE2005d			.705				.58
CLE2006c				.741			.60
CLE2006e				.864			.56
CLE2006h				.627			.46
CLE2006o				.509			.35
CLE2001a					.387		.24
CLE2001c					.763		.59
CLE2001d					.825		.68
CLE2004a						.489	.41
CLE2004b						.825	.68
CLE2004c						.502	.57

Extraction Method: Principal Factor Analysis.
Rotation Method: Oblimin.

Method: Confirmatory Factor Analysis

Using the second group of randomly selected respondents, I conducted a CFA using the six factors: Instructors Valuing Peer Networks, Importance of Recognition and Leadership, Student Initiative, Maintenance of Individual Contribution and Respect, Communal Orientation and Values, and Instructor Expectations. Four different fit indices were used to assess model fit: TLI (Tucker-Lewis index), CFI (comparative fit index), RMSEA (root mean square error

approximation, and SRMR (standardized root mean square residual). The rule of thumb to discover a good fitting model is approximately: CFI > .95, TLI >.95, RMSEA <= .05, and SRMR < .10 (Kline, 2015).

Table 6

Standardized Regression Weights

Scale	Variable	Estimate
Instructors Valuing Peer Networks (PN)	CLE2003a	.869
	CLE2003b	.909
	CLE2003c	.848
	CLE2003d	.886
Importance of Recognition and Leadership (RL)	CLE2006f	.659
	CLE2006i	.829
	CLE2006j	.663
	CLE2006k	.891
	CLE2006l	.834
Student Initiative (SI)	CLE2005a	.849
	CLE2005b	.757
	CLE2005c	.775
	CLE2005d	.738
Maintenance of Individual Contribution and Respect (CR)	CLE2006c	.821
	CLE2006e	.872
	CLE2006h	.851
	CLE2006o	.807
Communal Orientation and Values (CO)	CLE2001a	.645
	CLE2001c	.785
	CLE2001d	.818
Instructor Expectations (IE)	CLE2004a	.706
	CLE2004b	.793
	CLE2004c	.846

Based on these criteria, Table 7 suggests moderate to good fit across the different scales. The TLI, CFI, and SRMR indices indicated a good fitting model while the RMSEA indicated a reasonable approximation for the model. Table 6 represents the standardized regression weights for the confirmatory factor analysis, which indicate the strength of factor loadings. All

standardized regression weights were statistically significant, ranging from .645 to .909, showing that the factor loadings had good strength for all scales (Kline, 2002). Overall, it was concluded that the 6 scales were good subscales for the CLES.

Table 7

Summary of Fit Indices for Confirmatory Factor Analysis

	TLI	CFI	RMSEA	SRMR
CLES Scales	.981	.984	.061	.062

Internal Consistency Reliability

I estimated the reliability of the CLES scales by calculating the Cronbach's alphas. Internal consistency, more specifically, is used to assess how a group of items measure the same construct (Paulsen & BrckaLorenz, 2017). Higher internal consistency enables researchers to create a composite score as a measure of the construct (Paulsen & BrkcaLorenz, 2017). Cronbach's alpha ranges from zero to one, where a lower score indicates a lower internal consistency where a higher score indicates a higher internal consistency, and any alpha below .70 should be used with caution (McMillan & Schumacher, 2001). Internal consistency for the CLES scales were measured using Cronbach's alpha of each measure, inter-item correlations, Cronbach's alpha if item was deleted, and corrected item-scale correlations. I used the criteria summarized from Paulsen and BrckaLorenz (2017) in Table 8.

Table 8***Internal Consistency Criteria***

Reliability Statistics	Criteria for a Good Scale
Cronbach's Alpha	Greater than or equal to .70
Range of inter-item correlations	Between .15 and .85
Average inter-item correlation	Between .15 and .50
Range of Cronbach's alpha if item deleted	Deleting any item would decrease the alpha
Range of corrected item-scale correlations	Greater than or equal to .50

Table 9 consists of internal consistency results. The Cronbach's alpha suggests a high internal consistency for all CLES scales except for Communal Orientation and Values, which indicated a relatively low internal consistency at .568. The Cronbach's alpha for the other five scales ranged from .769 to .896. The range of inter-item correlations met the criteria, ranging from .309 to .720. The average inter-item correlations for Importance of Recognition and Leadership, Maintenance of Individual Contribution and Respect, and Communal Orientation and Values met the criteria while the other three scales did not which means that the items on these scales were more highly correlated than other scales. For Instructors Valuing Peer Networks, Student Initiative, and Instructor Expectations, the average inter-item correlation might be higher than the criteria given the specific concept we desired to capture through the creation of those items but they are not far off of the criteria requirements. All items with the exception of one (CLE2006j) met the criteria for Cronbach's alphas if the item was deleted. However, results suggested CLE2006j would only increase .001, which indicates there would not be much of a change to reliability if that item was deleted. In terms of Corrected Item Scale Correlations, only a few items (CLE2006j, CLE2001a, CLE2001b, CLE2001c) did not meet the criteria, with all of the items in the Communal Orientation and Values scale being among the lowest corrected item-scale correlations.

Table 9***Internal Consistency for CLES Scales***

Scale	Items	Cronbach's α	Inter-Item Correlation	Average Inter-Item Correlation	Cronbach's α if Item Deleted	Corrected Item-Scale Correlation
Instructors Valuing Peer Networks	CLE2003a	.896	.628-.720	.684	.868	.767
	CLE2003b		.692-.720		.853	.806
	CLE2003c		.628-.715		.875	.745
	CLE2003d		.653-.696		.868	.764
Importance of Recognition and Leadership	CLE2006f	.830	.309-.588	.493	.817	.556
	CLE2006i		.401-.624		.775	.701
	CLE2006j		.309-.499		.831	.491
	CLE2006k		.464-.685		.761	.743
Student Initiative	CLE2006l	.872	.397-.685	.631	.788	.655
	CLE2005a		.581-.692		.839	.724
	CLE2005b		.643-.692		.816	.777
	CLE2005c		.604-.657		.841	.716
Maintenance of Individual Contribution and Respect	CLE2005d	.775	.581-.643	.473	.850	.695
	CLE2006c		.437-.606		.689	.640
	CLE2006e		.389-.606		.712	.608
	CLE2006h		.434-.497		.720	.580
Communal Orientation and Values	CLE2006o	.568	.389-.437	.307	.764	.510
	CLE2001a		.309-.353		.410	.418
	CLE2001c		.258-.309		.521	.343
Instructor Expectations	CLE2001d	.769	.258-.353	.528	.471	.375
	CLE2004a		.468-.526		.739	.556
	CLE2004b		.526-.589		.636	.652
	CLE2004c		.468-.589		.689	.605

Overall, the six scales of the CLES item set show varied levels of internal consistency.

Results indicated that Instructors Valuing Peer Networks, Importance of Recognition and Leadership, Student Initiative, Maintenance of Individual Contribution and Respect, and Instructor Expectations had a relatively good internal consistency, with three of the scales being slightly more intercorrelated than others. However, the Communal Orientation and Values scale had the worst results of internal consistency, with a low Cronbach's alpha and low corrected

item-scale correlations. This result suggests that the Communal Orientation and Values scale is not a reliable scale and would need further reconfiguration for future analysis regarding collaborative learning experiences of undergraduate students. For this reason, the next two sections of the psychometric portfolio do not include the Communal Orientation and Values scale.

Relationship to Other Variables

An important component of assessing validity is examining how the constructs of interests are related to other constructs. For this psychometric portfolio, the CLES scales were assessed relative to other constructs already established on the core NSSE survey, as well as measured through different sample demographic information.

Correlations

Two correlational analyses were conducted to assess relationships between the CLES and NSSE constructs. The first correlational analysis assessed correlations between the five CLES scales established in the previous section and the core NSSE collaborative learning items (Table 10). As stated previously, the CLES was established as an extension of four collaborative learning items that are administered to everyone who completes the NSSE. Results showed that all correlations were significant at an alpha level of .05 but some correlations were stronger than others. The CLES scales that had the strongest correlations with the four collaborative learning items were Student Initiative and Instructor Expectations, which makes sense given the reasoning for the item's conception. For Student Initiative, both the collaborative learning items and the scale examine the frequency of students participating in specific types of collaborative learning experiences with the main difference being the Student Initiative items asking more pointed questions on the frequency of students seeking out these experiences. The Instructor

Expectations items were worded very similar to the core collaborative learning items with the main difference being that students were asked to report the frequency in which their instructors required them to engage in collaborative experiences. On the other end, the Instructors Valuing Peer Networks, Importance of Recognition and Leadership, and Maintenance of Individual Contribution and Respect were not as strongly correlated with the core collaborative learning items and this could be attributed to the concepts covered by the scales. These three scales were intentionally created to assess student perceptions of what they consider important to their collaborative learning experiences, as well as the frequency to which instructors placed value in collaborative learning experiences whereas the core collaborative learning items only captured the frequency to which students participated in collaborative learning.

Table 10

Correlations Between CLES Scales and NSSE's Core Collaborative Learning Items

	Core Collaborative Learning Items			
	CLaskhelp	CLexplain	CLstudy	CLproject
PN	.19*	.18*	.25*	.24*
RL	.15*	.20*	.21*	.17*
SI	.49*	.48*	.59*	.51*
CR	.14*	.21*	.16*	.21*
IE	.31*	.31*	.39*	.45*

The second correlational analysis assessed correlations between the five CLES scales and the ten NSSE Engagement Indicators plus the Perceived Gains and Sense of Belonging scales. The NSSE Engagement Indicators measure constructs that are intended to capture distinct aspects of students' college experiences (National Survey of Student Engagement, n.d.a). Similarly, the Perceived Gains and Sense of Belonging scales are measuring specific concepts of

the college experience. Results also showed that all correlations were significant at an alpha level of .05 with varying degrees of correlation strength (Table 11). Majority of the NSSE Engagement Indicators, Perceived Gains, and Sense of Belonging scale relationships to the five CLES scales were weak to moderate, which could be attributed to how collaborative learning experiences are a very specific form of engagement and within this engagement, there may not be many opportunities to experience and reflect on how some of the other Engagement Indicators take place within collaborative experiences. Additionally, only three of the Engagement Indicators (Collaborative Learning (CL), Discussions with Diverse Others (DD), and Supportive Environments (SE)) directly ask students to think about their college engagement in relation to other people while the rest of the scales are more geared toward students' individual experience with specific concepts. The Importance of Recognition and Leadership scale had the lowest correlations with the NSSE scale and as noted above, this could potentially be attributed to how the Importance of Recognition and Leadership items were created to measure how important recognition is for students in their collaborative learning experiences, which is a concept not really captured in any of the NSSE scales. There were only two correlations above .5 and they were the relationship between Student Initiative and the Collaborative Learning scale and between Instructors Valuing Peer Networks and Perceived Gains. The relationship between Student Initiative and the Collaborative Learning scale make sense given our first correlational analysis and how the Student Initiative items intentionally ask students to report on more nuanced information that is captured in the Collaborative Learning scale. The relationship between Instructors Valuing Peer Networks and Perceived Gains scales also could conceptually be understood, as both scales measures various concepts and experiences that students could gain from participating in various college experiences.

Table 11***Correlations Between CLES Scales and NSSE's Engagement Indicators***

	NSSE's Engagement Indicators											
	HO	RI	QR	LS	CL	DD	SF	ET	QI	SE	pg	sb
PN	.35*	.35*	.28*	.32*	.26*	.24*	.31*	.38*	.31*	.45*	.54*	.39*
RL	.15*	.15*	.23*	.16*	.22*	.09*	.28*	.08*	.03*	.15*	.24*	.10*
SI	.29*	.33*	.34*	.28*	.64*	.32*	.45*	.21*	.20*	.30*	.41*	.27*
CR	.29*	.33*	.15*	.26*	.22*	.26*	.15*	.25*	.20*	.25*	.29*	.22*
IE	.32*	.34*	.32*	.29*	.45*	.25*	.35*	.28*	.21*	.32*	.44*	.26*

Known Group Differences

In many assessments regarding student engagement, there is a series of demographic information that is frequently used to assess how different groups respond to the same constructs. For the CLES scales, five demographic items that were administered on the core NSSE were used to examine how groups differed in responses to the CLES scales. STEM major identification, international status, class year, gender identity and race/ethnic identity were used as the demographics in mean comparison analyses, such as t-tests and ANOVAs.

STEM Major Identification. T-tests were conducted to analyze how STEM and non-STEM majors differed in their scores on the CLES scales (Table 12). Overall, students in STEM and non-STEM majors significantly differed on their scores on the Instructors Valuing Peer Networks, Importance of Recognition and Leadership, and Student Initiative scales. Non-STEM majors were more likely to perceive their instructors communicate the importance of peer networks and place importance in recognition and leadership opportunities in collaborative

groups than STEM majors. Moreover, students in STEM majors were more likely to initiative collaborative learning experiences than non-STEM majors. These findings could be attributed to the larger concern that STEM faculty are not incorporating active learning experiences, such as collaborative learning, into their teaching practices (Freeman et al., 2014).

Table 12

T-Test Results for CLES Scales by STEM Major

	Non-STEM		STEM		t-test
	M	SD	M	SD	
PN	2.89	.82	2.72	.86	9.85**
RL	2.23	.77	2.19	.75	3.07**
SI	2.52	.85	2.66	.83	-8.62**
CR	3.48	.52	3.47	.52	.62
IE	2.82	.76	2.81	.77	1.04

* $p < .05$, ** $p < .01$

International Status. T-tests were conducted to analyze how students' identification with having domestic or international status differed in their scores on the CLES scales (Table 13). Scores on the Instructors Valuing Peer Networks, Importance of Recognition and Leadership, Maintenance of Individual Contribution and Respect, and Instructor Expectations significantly differed by students' international status. International students were more likely to perceive their instructors valuing peer networks and requiring them to engage in collaboration and find it important for them to keep up their contributions to group work while being recognized for their collaborative contributions. The understanding of these findings is quite broad, given that various cultures are captured in which students identify as international. However, particularly with the Instructors Valuing Peer Networks and Maintenance of Individual Contribution and Respect scales, this may be connected to how institutions encourage social support systems for international students while international students discover a sense of

belonging in American higher education institutions for themselves (Garcia et al., 2019; Taliaferro et al., 2020).

Table 13

T-Test Results for CLES Scales by International Status

	Domestic Students		International Students		t-test
	M	SD	M	SD	
PN	2.83	.84	2.98	.75	-4.67**
RL	2.20	.76	2.45	.77	-7.54**
SI	2.56	.85	2.59	.79	-1.08
CR	3.48	.52	3.39	.56	3.73**
IE	2.81	.77	2.93	.73	-3.82**

* $p < .05$, ** $p < .01$

Class Year. T-tests were conducted to analyze how students' class year differed in their scores on the CLES scales (Table 14). Scores on all CLES scales significantly differed for first year and senior students. First-year students were more likely to report that their instructors value peer networks and that they see it important that they are recognized for their contributions in collaborative learning than seniors. Conversely, seniors were more likely to report they initiated collaborative learning, wanted to ensure they contributed fairly to the collaborative group, and that their instructors required them to participate in collaborative experiences. These findings could be attributed to the different socialization processes first-year students and senior students go through in college. For first-year students, their socialization may be focused around social engagement with peers both in and out of the classroom (Cole et al., 2020), while for seniors, they are likely to have more collaborative experiences and have determined what it takes to be successful in collaborative learning activities.

Table 14***T-Test Results for CLES Scales by Class Year***

	First-years		Seniors		t-test
	M	SD	M	SD	
PN	2.88	.79	2.81	.86	4.92**
RL	2.24	.76	2.20	.77	2.90**
SI	2.51	.83	2.59	.85	-5.92**
CR	3.45	.53	3.49	.52	-3.55**
IE	.276	.75	2.85	.77	-5.99**

* $p < .05$, ** $p < .01$

Gender Identity. A series of one-way analysis of variance was conducted to examine how students with different gender identities responded to each CLES scale (Table 15). The CLES scale descriptives for each gender identity are represented in Table 16. The Student Initiative and Instructor Expectations scales did not violate the homogeneity of variance assumption and therefore the classic F test and Tukey's post hoc tests were used for these scales. For the other three CLES scales, the Welch's F test and Games-Howell post hoc tests were used to account for the violations in homogeneity of variance. Overall, results showed that students with different gender identities significantly differed in their responses to all five CLES scales.

For the Instructors Valuing Peer Networks scale, women ($M = 2.87$, $SD = .84$) had the highest mean and this significantly differed from students identifying as men ($M = 2.79$, $SD = .83$) and students who preferred not to respond ($M = 2.53$, $SD = .92$). Men also significantly differed in their response to the Instructors Valuing Peer Networks scale than students who preferred not to respond.

For the Importance of Recognition and Leadership scale, students identifying as men ($M = 2.23$, $SD = .77$) reported significantly different needs in terms of recognition and leadership in collaborative learning than students identifying with another gender identity ($M = 1.98$, $SD =$

.73), and students who preferred not to respond ($M = 1.99, SD = .72$). Similarly, students identifying as women ($M = 2.22, SD = .76$) reported significantly different needs in terms of recognition and leadership in collaborative learning than students identifying with another gender identity and students who preferred not to respond.

For the Student Initiative scale, students who preferred not to respond with a gender identity ($M = 2.38, SD = .86$) were significantly less likely to initiate collaborative learning experiences with their peers than students identifying as women ($M = 2.57, SD = .85$) and students identifying with another gender identity ($M = 2.61, SD = .83$).

For the Maintenance of Individual Contribution and Respect scale, students identifying as men ($M = 3.39, SD = .55$) were significantly less likely to want to demonstrate their contributions and want respect from collaborative learning groups than students identifying as women ($M = 3.53, SD = .49$). Students who preferred not to respond scored significantly lower on this scale than students identifying as women and another gender identity.

For the Instructor Expectations scale, students who preferred not to respond ($M = 2.54, SD = .80$) were significantly less likely to have instructors require collaborative experiences than students identifying as men ($M = 2.78, SD = .76$), women ($M = 2.84, SD = .77$), and another gender identity ($M = 2.84, SD = .81$). Additionally, students identifying as women scored significantly higher on this scale than men.

Table 15***Analysis of Variance Results for CLES Scales by Gender Identity***

		Sums of Squares	Df	Mean Square	F
SI	Between Groups	8.88	3	2.96	4.161**
	Within Groups	8992.03	12629	0.71	
IE	Between Groups	24.06	3	8.02	13.753**
	Within Groups	7394.01	12676	0.58	
					Welch's F
PN	Between Groups	36.06	3	12.02	15.59**
	Within Groups	8892.79	12685	0.70	
RL	Between Groups	19.55	3	6.51	12.25**
	Within Groups	7353.76	12581	0.58	
CR	Between Groups	64.54	3	21.51	71.64**
	Within Groups	3377.64	12591	0.26	

* $p < .05$, ** $p < .01$ **Table 16*****CLES Scale Descriptives by Gender Identity***

	CLES Scale Means									
	PN		RL		SI		CR		IE	
	M	SD	M	SD	M	SD	M	SD	M	SD
Man	2.79	.83	2.23	.77	2.54	.83	3.39	.55	2.78	.76
Woman	2.87	.84	2.22	.76	2.57	.85	3.53	.49	2.84	.77
Another gender identity	2.72	.93	1.98	.73	2.61	.83	3.50	.60	2.84	.81
Prefer not to respond	2.53	.92	1.99	.72	2.38	.86	3.25	.72	2.54	.80

Consequences of Survey Use

The CLES was created to develop a deeper understanding of collaborative learning experiences while extending the knowledge gathered about collaborative learning on the core NSSE administrations. Furthermore, the CLES item set was created to support Christen Priddie's dissertation research to explore how Black STEM students experience collaborative learning to contribute to current literature that examines college-level collaborative learning experiences. This psychometric portfolio will primarily be used to support Christen's dissertation research, helping determine what the most appropriate use of the CLES should be. However, it could also be used to examine other groups' experiences with collaborative learning and how a nuanced understanding of collaborative learning is beneficial to creating more tailored and meaningful collaborative experiences in college classrooms.

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