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Development and Validity Evidence for the Liberal Arts Core Competencies Assessment Scales

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Abstract: In a series of studies in four phases, responses from over 27,000 undergraduate students were collected to evaluate reliability and validity evidence for the Core Competencies Assessment Scales (CCAS) designed to measure development of 10 core competencies indicating career readiness in undergraduate liberal arts students. The competencies were identified through a thorough review of extant literature and with feedback from key stakeholders. Each assessment scale consists of 10-16 items asking students to indicate how often they engage in behaviors indicative of the intended competency. Results of the studies provide evidence of score reliability and measurement invariance across academic level, sex, and race/ethnicity, as well as content, convergent, and predictive validity. In aggregate, we demonstrate that the CCAS are well suited to measure students' core competencies in a convenient and scalable way, allowing students to track their career readiness development and informing college faculty on curricula and course design.

Keywords: *career readiness assessment, core competencies, liberal arts education*

Introduction

It is generally accepted that college education, and particularly liberal arts education, helps students develop their career and world readiness and provides a solid foundation for post graduate life (Boyer 2030 Commission, 2022). World and career readiness broadly refer to the knowledge, skills, and abilities an individual develops and demonstrates during the academic and co-curricular experiences (Akkermans et al., 2013; Koerner, 2018). Higher levels of world and career readiness have been predictive of a variety of positive individual and organizational career outcomes (Jo et al., 2024) including greater perceived employability (Blokke et al., 2019) and participation in employability activities (Presti et al., 2022), greater subjective and objective career success (Blokke et al., 2019; Presti et al., 2022), and greater added value to one's organization (Fleisher et al., 2014).

Defining Readiness as Core Competencies

Studying the effect of liberal arts education on students' world and career readiness has been difficult largely due to a lack of consensus about how to define readiness. There are essentially two somewhat incompatible views that dominate the discussion (Conley et al., 2017; Guest, 1991). In one view, readiness is the acquisition of specific technical or cognitive skills and knowledge needed to adequately fulfill specific job duties in a given career field, such as computer coding, command of a particular software, or ability to play an instrument. In this view, career readiness is like vocational training in that readiness is specialized and limited to a particular occupation or career field. The alternative view is that readiness is the acquisition of broadly applicable competencies that apply to many, if not all, career fields, such as analytical thinking, problem solving, and managing people. The latter view is more general and a better fit when thinking about the readiness of liberal arts students (Aoun, 2017). Although there is agreement among proponents of the latter view that competencies are more general, there is no broadly accepted list of which competencies are required for career readiness.

In one attempt to provide a comprehensive set of career competencies, Akkermans and colleagues (2013) integrated four perspectives on career competencies (boundaryless, protean, self-management, and human capital) to develop the 21-item Career Competencies Questionnaire (CCQ) measure of six career competencies: reflection on motivation, reflection on qualities, networking, self-profiling, work exploration, and career control. These competencies were intended to be broadly applicable to the workforce. Subsequently, other researchers (e.g., Chan & Fong, 2018; Sweetman et al., 2014) argued that the broad, generic competencies lack utility given the relative importance of competencies varies by career field; therefore, students' motivation to develop particular competencies may also vary by their intended career path. In a balance between broad domain-agnostic and domain-specific sets of competencies, a career readiness initiative at a large, Midwest university began in 2015 a process of defining career competencies students could expect to develop through a liberal arts education. With students as the primary audience, a second goal of the initiative was to develop assessments measuring students' performance in these competencies to inform a) students of their career readiness and b) support faculty in the design of courses and curricula. Because the definitions of the competencies were new, there were no existing assessments of the competencies and new assessments had to be developed as well.

Defining liberal arts career competencies started with an extensive literature review of both scholarly and popular media sources (e.g., magazine articles, op-ed pieces), as well as existing competency frameworks. To gain an understanding of how competencies associated with the liberal arts are perceived, a wide net was cast to include a variety of competency frameworks in this review. These frameworks included the National Association of Colleges and Employers Career Readiness Competencies (NACE, 2015), the Association of American Medical Colleges fifteen core competencies for entering medical students (AAMC, 2016), the Measuring College Learning Essential Competencies from the Social Science Research Council (Arum et al., 2016), and the VALUE rubrics from the American Association of Colleges and Universities (2009). Additionally, the research team interviewed liberal arts faculty and employers who recruited and employed liberal arts students to determine qualities indicative of a successful liberal arts education and future employability. The research team identified conceptual alignment across the literature, existing frameworks, and interviews to articulate a final set

of 10 competencies (Table 1) with operationalized definitions that reflected experiences and behaviors students could undertake. Finally, the research team developed an instrument to reliably assess the 10 competencies to expand the utility of the competency framework, which is the focus of this paper.

Table 1

Definitions and Example Behaviors for the Liberal Arts Core Competencies

Competency	Definition	Example Behaviors
Active Citizenship & Community Engagement	A consciousness about one's potential contributions and roles in the many communities one inhabits, in person and online, and acts accordingly.	• Actively engage with the communities in which they are involved. • Evolve their awareness of culture and power in community dynamics.
Analytical & Critical Thinking	Comprehensively explores issues, ideas, knowledge, evidence, and values before accepting or formulating an opinion or conclusion.	• Recognize there may be more than one valid point of view. • Identify when information is missing or if there is a problem, prior to coming to conclusions and making decisions.
Applied Problem Solving	The process of designing, evaluating, and implementing a workable strategy to achieve a goal.	• Recognize constraints • Generate and evaluate alternatives using a set of criteria • Monitor the actual outcomes of selected solution.
Career Management	The active engagement in the process of exploring possible careers, gaining meaningful experience, and building skills that help one excel after college and lead to employment or other successful post-graduation outcomes.	• Understand their values, interests, identity, personality, skills, and strengths • Are able to articulate how those characteristics, combined with and shaped by a liberal arts education, lead to career success.
Digital Literacy	Leverages knowledge of information and communications technology and media literacies, and utilizes the interpersonal skills necessary to succeed in a digital space.	• Assess sources of information. • Adapt tools to new purposes. • Keep up with responsible use of evolving technology landscape.
Engaging Diversity	Cultivates awareness of one's own identity and cultural background and that of others through an exploration of domains of diversity. This requires an understanding of historical and	• Understand how culture affects perceptions, attitudes, values, and behaviors. • Are able to navigate an increasingly complex and diverse world by

	social contexts and a willingness to confront perspectives of dominant cultural narratives and ideologies, locally, nationally, or globally.	appreciating and adopting multiple cultural perspectives or worldviews.
Ethical Reasoning & Decision Making	Recognizes ethical issues arising in a variety of settings or social contexts, reflects on the ethical concerns that pertain to the issue, and chooses a course of action based on these reflections.	• Assess their own personal and moral values and perspectives as well as those of other stakeholders. • Consider intentions and the short- and long-term consequences of actions and the ethical principles that apply before making decisions.
Innovation & Creativity	Generates new, varied, and unique ideas, and makes connections between previously unrelated ideas.	• Challenge existing paradigms and propose alternatives without being constrained by established approaches or anticipated responses of others. • Employ their knowledge, skills, abilities, and sense of originality.
Oral & Written Communication	Intentionally engages with an audience to inform, persuade, or entertain.	• Consider relationships with the audience and the social and political context in which one communicates, as well as the needs, goals, and motivations of all involved. • Ensure that communication is functional and clear.
Teamwork & Leadership	Builds and maintains collaborative relationships based on the needs, abilities, and goals of each member of a group.	• Understand their own roles and responsibilities within a group, and how they may change in differing situations. • Leverage the strengths of the group to achieve a shared vision or objective. • Effectively acknowledge and manage conflict toward solutions.

Note: Full descriptions are available at: <https://cla.umn.edu/undergraduate-students/cla-core-competencies>

Research Objectives and Design Overview

The subsequent sections document the studies investigating validity evidence for interpreting undergraduate liberal arts students' self-reports on the 10 Core Competency Assessment Scales (CCAS) as their perceived level in each competency. CCAS scores are intended to be used as benchmarks for students to monitor their growth during their undergraduate journey and preparedness for embarking on their post-baccalaureate career path. To provide flexibility given the varied interests and goals of students and liberal arts programs, the CCAS were developed such that each of the 10 scales could be

administered, interpreted, and used independently (i.e., standalone measures of each competency) rather than requiring administration and scoring as an entire set. Validity evidence for the 10 CCAS was collected through four phases of scale development. Phase 1 consisted of item development, content reviews, and exploration of dimensionality with an initial pilot study. In Phase 2, items and response options were refined based on results from additional pilot studies. In Phase 3, we examined convergent validity evidence through associations of the CCAS with other, established measures for some of the competencies. Lastly, Phase 4 evaluated the factor structure of each competency scale, measurement invariance across sex, race/ethnicity, and academic level, and predictive validity of post-graduation measures. All research activities across the four phases were approved by the Institutional Review Board at the primary author's institution.

Phase 1. Content Validity Evidence and Initial Pilot Study

Development of the CCAS measuring the 10 liberal arts core competencies began with the research team in collaboration with faculty content experts recruited from the home institution of the first author conceptualizing each competency and operationalizing levels of proficiency within each competency. Specifically, behavioral descriptors were written representing a trajectory of student growth from novice (Level 1) to intermediate (Level 2) to advanced (Level 3). Using these advanced level descriptors as guides, initial items were written as behavioral statements with a 5-point Likert-type response format of Strongly Disagree (1) to Strongly Agree (5). Thus, greater agreement would indicate greater mastery of the competency. Between 22 and 36 items were written for each competency. To establish validity evidence based on assessment content (e.g., Sirici & Faulkner-Bond, 2014), external stakeholders were then invited to review the items for clarity, potential bias, relevancy to the intended competency, and to evaluate whether the item pool adequately represented the entirety of the competency. The stakeholders included career services staff, academic advisors, liberal arts faculty from multiple colleges and universities, community members from education organizations and K-12 schools – with the latter helping distinguish between readiness at the high school and collegiate levels. This expertise seemed particularly relevant because college readiness is of great concern to K-12 education and while the competencies are similar conceptually, the expected level of student performance is not. Thus, the research team was concerned not only with identifying the competencies that characterize liberal arts education, but also the level at which they are performed. The research team also conducted focus groups with undergraduate liberal arts students which included multilingual students. Items were revised based on qualitative feedback followed by an initial pilot study to explore the dimensionality of the assessment for each competency.

Method

In Spring 2017, 2,197 undergraduate students were recruited for the CCAS pilot study and incentivized through entry into a drawing to win one of three iPad Minis. Participants were asked to complete the assessment items for three randomly assigned competencies via Qualtrics resulting in an average of 640 responses to each competency item (range = 570-663). Participants' mean age was 20 years old (range = 18-27) with 19% being freshman, 23% sophomores, 26% juniors, 30% seniors, and 2% non-degree seeking or graduate students. Most participants identified as female (66%) with 32% as male, 2% as gender queer and 4% not reporting.

To reduce the complexity and length of the CCAS, principal component analysis (PCA) with oblimin rotation was performed on the responses to each competency in SPSS. Items with low component weight ($\alpha < .50$) were removed as these provided insufficient information about the competency. Likewise, items with component weights of $\alpha > .20$ on two or more components were also removed to clarify the interpretation of each component. Items were removed iteratively with PCA re-run after each item was removed. Missing data was addressed through listwise deletion (3% of sample removed). Internal consistency reliability, measured by Cronbach's α , was estimated on the revised item set for each competency.

Results

The initial set of 272 items across the 10 CCAS was reduced to 123 items overall, ranging from 10 items for Teamwork & Leadership to 20 items for Engaging Diversity, with six of the scales consisting of 11 items. Four principal components were extracted for Career Management and Digital Literacy, and three principal components were extracted for the remaining eight competencies. On average, the components accounted for 64% of the variance in responses for each competency. Internal consistency reliability ranged from $\alpha = .75$ for Oral & Written Communication to $\alpha = .84$ for Career Management.

Phase 2. Item and Response Option Refinement

The procedures from the Phase 1 pilot study were then replicated twice to further refine the item pool. This was followed by think-aloud sessions with undergraduate students to evaluate whether the item stems and response options appropriately captured how students thought about their standing on the competencies (Wolcott & Lobczowski, 2021).

Method

As in the pilot study, 1,057 and 2,827 undergraduate students were recruited in Fall 2017 and Spring 2018, respectively, and completed the assessment scales for three randomly assigned competencies via Qualtrics. Thus, an average of 106 students (Fall 2017, range = 70-131) and 383 students (Spring 2018, range = 221-829) completed each competency scale in the two replications, respectively. After revising the items based on the results from these studies, think-aloud sessions were conducted in Spring 2019 with 28 undergraduate students who each completed 2-3 competency assessment scales. In the think-aloud sessions, students were asked to read the items aloud and verbalize their thoughts leading to their responses. The research team conducted a thematic analysis of students' verbalizations to identify problems in responding to the assessment items and possible resolutions. The subsequently revised CCAS were then administered to 11,909 undergraduate students during the 2019-2020 academic year. Unlike the initial pilot and replication studies, students self-selected or were told by their instructors which competency assessments to complete, which resulted in sample sizes ranging from 430 for Active Citizenship & Community Engagement to 3,219 for Analytical and Critical Thinking. Following additional revisions, 8,115 students completed the CCAS in Spring 2021.

Results

The Fall 2017 replication study yielded similar results to the initial pilot study with the PCA extracting four components for Digital Literacy and Career Management and three components for the remaining competencies. Items with a low component weight ($\alpha < .50$) were inspected and ultimately edited for clarity rather than removed. Internal consistency reliability ranged from $\alpha = .74$ for Teamwork & Leadership to $\alpha = .96$ for Engaging Diversity. With the edited items used in the Spring 2018 sample, internal consistency reliability ranged from $\alpha = .82$ for Digital Literacy to $\alpha = .95$ for Engaging Diversity.

The think-aloud sessions with 28 undergraduate students informed minor revisions to item stems to improve readability, and most critically, suggested that the response options were misaligned with how students thought about assessing their competency behaviors. Specifically, students felt the agreement scale was ambiguous and a frequency scale would be easier to consistently respond to and produce a larger distribution of responses that more naturally captured how they characterized competency mastery. A subsequent investigation of the responses from the three prior CCAS administrations (Spring 2017, Fall 2017, Spring 2018) revealed that 75% of the responses were either Agree or Strongly Agree despite the diverse and representative samples, particularly with respect to academic level. These results suggested that the assessments had a ceiling effect and likely were not capturing the full variability in competency levels. Consequently, the initial prompt was changed from “To what extent do you agree or disagree...” to “How often do you...” with new response options on a 1 to 7 scale with anchors of 1 = Never, 4 = Half of the time, and 7 = Always.

The frequency oriented CCAS completed by 11,909 undergraduate students during the 2019-2020 academic year had a reduced, albeit still present, ceiling effect with the two highest response options (6 and 7) accounting for 70% of responses. Consequently, the response options were revised a final time and reduced to a 5-point scale with a label for each point in alignment with best practices: Rarely, Sometimes, Often, Very Often, and Always (Dillman et al., 2014). In the Fall 2021 sample, a ceiling effect remained for some competencies (e.g., 77% of responses were Very Often or Always for Active Citizenship & Community Engagement); however, most competencies showed greater variation in responding across the options (see Supplemental Table 1). Additionally, internal consistency reliability was high, ranging from $\alpha = .86$ for Oral & Written Communication to $\alpha = .95$ for Engaging Diversity.

Phase 3. Convergent Validity Evidence

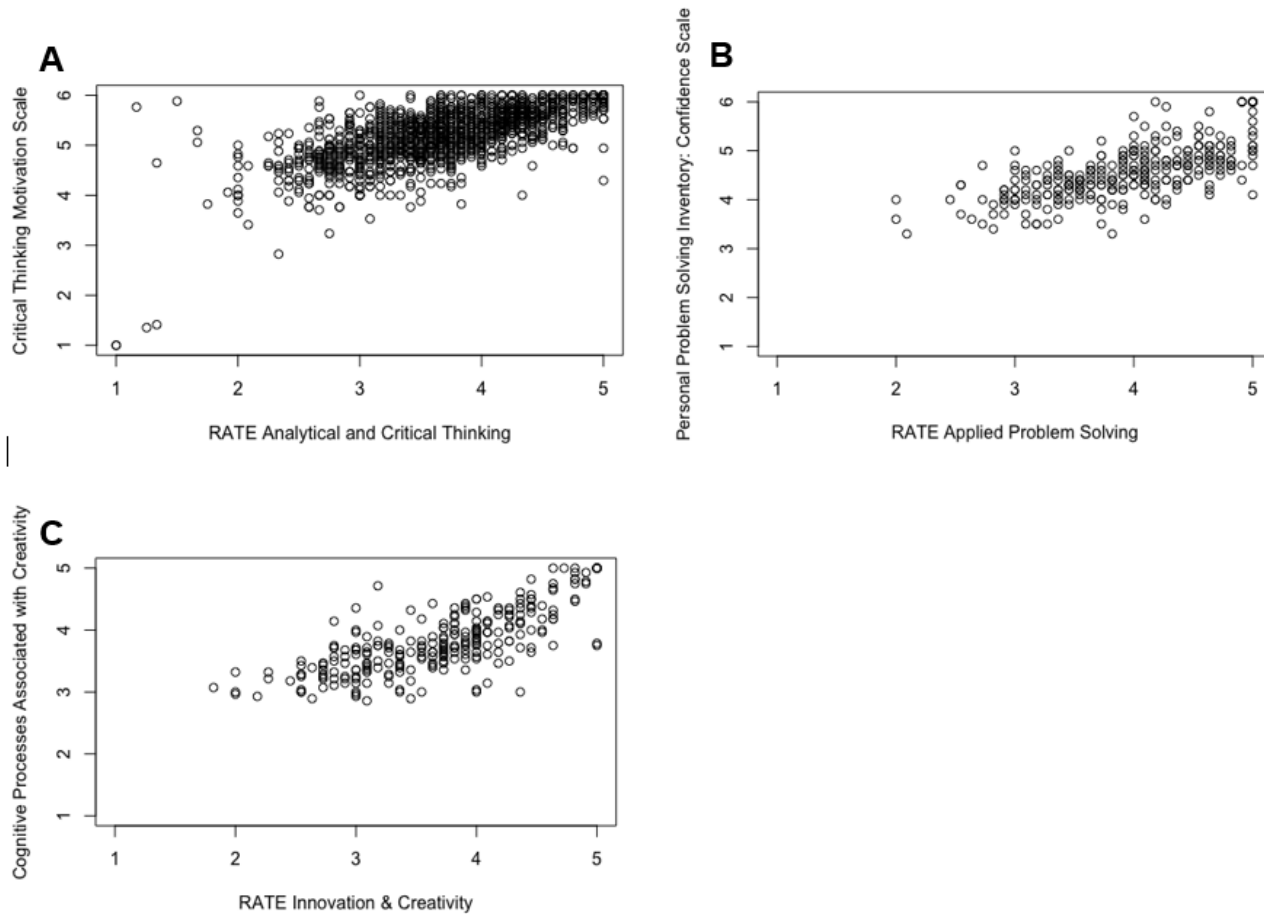
Convergent validity refers to the correlation between CCAS scores and scores on other measures of similar constructs (American Educational Research Association [AERA] et al., 2014). An extensive literature search was undertaken to identify suitable criterion measures based on whether the instrument measured a construct similar to one of the competencies, was published, and had acceptable evidence of reliability and validity. Criterion measures were only found for three of the 10 competencies. The Critical Thinking Motivation Scale (Valenzuela et al., 2011), the Personal Problem Solving Inventory: Confidence Scale (Heppner & Peterson, 1982), and Cognitive Processes Associated with Creativity (Miller, 2014) paired with the Analytical & Critical Thinking, Applied Problem Solving, and Innovation & Creativity competencies, respectively.

Method

In Spring 2021, following the switch to the frequency-based response options, undergraduate students who had self-selected or were required as part of a college course to complete one or more of the three competencies listed above were randomly selected and invited to participate in the convergent validity study and were asked to complete the corresponding criterion measure after they completed the corresponding CCAS. The correlation between the competency score and criterion measure score were then estimated.

Results

Figure 1 displays the scatterplots of the scores from: a) the Critical Thinking Motivation Scale (19 items) and Analytical & Critical Thinking (12 items) competency ($n = 292$) with $r = .69$; b) the Personal Problem Solving Inventory: Confidence Scale (11 items) and Applied Problem Solving (11 items) competency ($n = 101$) with $r = .65$; and c) Cognitive Processes Associated with Creativity (28 items) and Innovation & Creativity (11 items) competency ($n = 90$) with $r = .69$. These results provide convergent validity evidence for the interpretation and use of the Analytical & Critical Thinking, Applied Problem Solving, and Innovation & Creativity scales.

Figure 1*Scatterplots of Competency Scores with Criterion Measure Scores*

Phase 4. Factor Structure, Measurement Invariance, and Predictive Validity Evidence

Factor structure refers to the number of latent factors measured by the items of an instrument and the pattern of item-factor associations for each competency (AERA et al., 2014). The convergent validity study assumed that each CCAS score could be interpreted as a single factor measure of each of the 10 competencies; however, this assumption had not been operationally tested, particularly after switching to the frequency-based response options. Furthermore, the research team investigated measurement invariance, which is the extent to which the factor structure and associated item parameters are equal across different participant groups (e.g., sex; Svetina et al., 2020). Finally, the research team sought predictive validity evidence by investigating whether CCAS scores were predictive of post-graduate outcomes.

Method

Factor Structure and Measurement Invariance. Between June 2021 and February 2024, 13,203 liberal arts undergraduate students completed a total of 24,937 CCAS. Some students completed a CCAS multiple times for the same competency, in which case only the first assessment was used in the analysis. This reduced the analytic sample to 21,310 CCAS. Most students completed a CCAS for a single competency ($n = 7965$, 60.3%) with 3,254 (24.6%) students completing CCAS for two competencies, 1,321 (10.0%) for three competencies, and 663 (5.0%) students for four or more competencies.

Given the intent that each of the 10 CCAS could be used on their own, rather than be required as part of a large assessment battery, we investigated the possible factor structures separately for each competency. To do so, we employed a k-fold cross-validation approach using the kfa package (Nickodem & Halpin, 2022) in R (R Core Team, 2023). The k-fold cross-validation approach identifies the best fitting factor structure that is also replicable over multiple samples (i.e., avoids identifying a model that overfits the data from a single sample; Browne, 2000; Preacher et al., 2013). In this approach, data were randomly split into $k = 3$ folds where each fold consisted of a training sample and a validation sample. An exploratory factor analysis (EFA) was performed on the training sample and the resulting factor structures tested with a confirmatory factor analysis (CFA) on the validation sample. Results from the CFAs were then pooled across folds and the possible factor structures compared using model fit indices and criterion of $CFI > .95$, $RMSEA < .08$, and $SRMR < .06$. The optimal model was then fit to the full sample. All factor analytic models were estimated with Weighted Least Squares Means and Variance adjusted (WLSMV) on the polychoric correlations to account for the ordinal nature of the items. There were no missing data in the item responses.

Using the optimal factor structure for each competency, measurement invariance testing was conducted using multigroup CFA by gender, race/ethnicity, and academic level using procedures outlined by Svetina and colleagues (2020) and utilizing Wu and Estabrook's (2016) constraints for model identification with ordinal items. This meant fitting a configural model where model parameters were estimated separately for each group, followed by a model constraining item thresholds to be equal, then a model constraining item thresholds and factor loadings to be equal. The models were compared using the traditional chi-square difference test and change fit indices; however, these criteria are known to be oversensitive to trivial misfit and lacking sensitivity to true misfit, respectively. Thus, we primarily relied on $RMSEA_D$, which has shown less bias in model selection than the other methods (Beribisky & Hancock, 2023; Savalei et al., 2023). Specifically, when the upper bound of the 90% confidence interval of $RMSEA_D$ was $< .10$, we concluded that measurement invariance held.

Predictive Validity Evidence. The Post-Graduation Survey (PGS) is used to collect data on students' post graduate career trajectory and is made available to every student upon completion of their baccalaureate degree at the research team's institution. A total of 671 students completed the PGS between Summer 2021 to Summer 2022 who had also previously completed a CCAS for at least one

competency with the final frequency-based response options. To gather predictive validity evidence, CCAS scores were correlated with 17 PGS variables, which were grouped into three areas: primary status, competency level, and career development. Primary status comprised two dichotomous variables (1/0) indicating whether students were employed or whether they had continuing education plans following graduation. Graduates were also asked, “To what extent has your undergraduate education helped you develop competence in...” with the 10 competencies listed along with Communicating in a Foreign Language. Graduates responded to each item on a scale from Not at All (1) to To A Very Large Extent (5). Lastly, graduates responded on a Strongly Disagree (1) to Strongly Agree (5) scale to four career development items: “I have had conversations with faculty in the [college] about how I am developing my Core Competencies.”; “The [college] has supported me in my career development.”; “My experience as a student in the liberal arts has prepared me to succeed after graduation.”; and “I can explain how my undergraduate academic and co-curricular experiences prepared me for my career.” Given the dichotomous or ordinal nature of the PGS items, polychoric correlations were estimated using the lavaan package (Rosseel, 2012) in R (R Core Team, 2023). The sample sizes for each correlation varied from 16 to 214 depending on the competency and the PGS variable and are presented in Supplemental Table 5.

Results

Factor Structure and Measurement Invariance. In the k-fold cross-validation, a unidimensional structure (i.e., all items loading onto a single factor) was the only stable factor structure across all three folds in eight of the 10 competencies. Full sample fit statistics are presented in Table 2. A 2-factor structure was also stable for Applied Problem Solving, however, the second factor only consisted of three items and did not provide unique information in the predictive validity study. Consequently, we conclude that the CCAS for Applied Problem Solving should be treated as a unidimensional measure. Conversely, model fit and the predictive validity study indicated a 2-factor model as optimal for Digital Literacy with seven items measuring students’ ability to discern the quality of information and four items measuring their comfort using technology.

Table 2

Full Sample Confirmatory Factor Analysis Model Fit for each Competency

Competency	<i>n</i>	χ^2	<i>df</i>	<i>CFI</i>	<i>RMSEA</i>	<i>90% CI</i>	<i>SRMR</i>
ACCE	613	207.59	44	.98	.08	[.07, .09]	.04
ANCT*	5020	2318.69	53	.95	.09	[.09, .10]	.04
APPS – 1-factor	1296	792.81	44	.94	.11	[.11, .12]	.05
APPS – 2-factor	1296	274.73	43	.98	.06	[.06, .07]	.03
CRMG	1403	1431.96	104	.95	.10	[.09, .10]	.05
DGLI – 1-factor	773	945.76	44	.89	.16	[.15, .17]	.10
DGLI – 2-factor	773	241.67	43	.98	.08	[.07, .09]	.05
ENDV	2089	3581.48	170	.94	.10	[.10, .10]	.05

ERDM*	747	330.24	43	.96	.09	[.09, .10]	.05
INCR	1240	254.84	43	.98	.06	[.06, .07]	.03
OWCM	5630	1551.74	44	.96	.08	[.07, .08]	.04
TKLP	2499	1018.30	35	.95	.11	[.10, .11]	.05

Table Note. ACCE = Active Citizenship & Community Engagement, ANCT = Analytic & Critical Thinking, APPS = Applied Problem Solving, CRMG = Career Management, DGLI = Digital Literacy, ENDV = Engaging Diversity, ERDM = Ethical Reasoning & Decision Making, INCR = Innovation & Creativity, OWCM = Oral & Written Communication, TKLP = Teamwork & Leadership. *One residual correlation was added between two items to improve model fit. The chi-square statistic was significant at $p < .01$ for all models.

The measurement invariance model comparison results for the CCAS by academic level, sex, and race/ethnicity are presented in Supplemental Tables 2-4. Despite being oversensitive to trivial misfit, the chi-square statistics were non-significant for almost all competencies when adding the item threshold and loading constraints across groups. The upper bound of the 90% confidence interval of $RMSEA_D$ was $< .10$ for all model comparisons. These indices provide evidence that measurement invariance held across academic level, sex, and race/ethnicity for each of the 10 competencies, thereby indicating that student's self-assessment of their level on the competencies was not affected by these demographic variables.

Predictive Validity Evidence. The polychoric correlation between students' self-assessed level on a competency and post-graduate outcomes are presented in Table 3. Higher CCAS scores in most competencies were positively correlated with reporting on the PGS that growth in the competencies could be attributed to their undergraduate education. For instance, higher Career Management scores were predictive of attributing growth not only in Career Management ($r = .43$), but also the other nine competencies ($r = .29 - .45$). Regarding primary status, immediate post graduate employment was positively associated with Active Citizenship & Community Engagement and Ethical Reasoning & Decision Making. Higher scores on Active Citizenship & Community Engagement, Career Management, and the Information Quality factor of the Digital Literacy competency were predictive of graduate education plans whereas graduates who reported high Innovation & Creativity were less likely to have graduate education plans. Regarding the career development items, higher Teamwork & Leadership scores was positively predictive of all four items and higher Innovation & Creativity was positively predictive of three of the four items.

Table 3*Polychoric Correlation of Unidimensional CCAS scores with Post-Graduate Survey (PGS) Outcome Items*

Outcome	ACCE	ANCT	APPS	CRMG	DGLI-IQ	DGLI-TU	ENDV	ERDM	INCR	OWCM	TKLP
Employed	.66	.20	.07	.03	.07	-.14	.15	.42	.00	-.20	.20
Continuing Education	.25	-.06	.14	.43	.21	.09	.12	.15	-.47	.17	.13
PGS ACCE	.25	.21	.21	.29	.14	.21	.25	.01	.26	.21	.27
PGS ANCT	.39	.11	.38	.39	.13	.27	.18	.18	.21	.36	.40
PGS APPS	.35	.29	.21	.45	.14	.28	.30	.08	.25	.27	.33
PGS CMFL	.03	.21	-.08	.07	.02	.05	.07	.02	.22	.08	.14
PGS CRMG	.56	.38	.18	.43	-.08	-.02	.25	.22	.17	.27	.36
PGS DGLI	.39	.30	.26	.35	.06	.15	.38	.28	.34	.27	.25
PGS ENDV	.15	.24	.29	.35	.15	.17	.21	.17	.36	.29	.29
PGS ERDM	.31	.31	.38	.41	.00	.16	.25	.02	.23	.40	.32
PGS INCR	.40	.21	.12	.34	.00	.12	.41	.07	.40	.28	.28
PGS OWCM	.55	.28	.17	.34	.15	.24	.31	.15	.31	.38	.45
PGS TKLP	.53	.30	.14	.31	.31	.32	.39	.10	.32	.29	.20
Career Conversations	-.32	.16	.32	.34	.05	.34	-.04	.31	.38	.29	.37
Career Support	.02	.07	.05	.19	-.12	-.12	-.19	-.15	.52	.06	.26
Post Grad Success	.05	.16	.16	.19	.08	.12	.05	.21	.48	.12	.34
Explain Preparation	.04	.20	.14	.26	.12	.22	.09	.18	.18	.29	.42

Table Note. ACCE = Active Citizenship & Community Engagement, ANCT = Analytic & Critical Thinking, APPS = Applied Problem Solving, CMFL = Communicating in a Foreign Language, CRMG = Career Management, DGLI = Digital Literacy, IQ = Information Quality, TU = Technology Use, ENDV = Engaging Diversity, ERDM = Ethical Reasoning & Decision Making, INCR = Innovation & Creativity, OWCM = Oral & Written Communication, TKLP = Teamwork & Leadership. Bold indicates correlation > |.2|.

Discussion

This series of studies provide compelling evidence that 10 core career competencies in the liberal arts can be reliably and validly measured using the CCAS. An extensive review of existing literature and interviews of stakeholders such as alumni, employers, and career services professionals identified 10 core career competencies resulting from a comprehensive liberal arts education. These competencies were defined, then operationalized by the CCAS in a way that produces reliable scores unaffected by students' demographic characteristics such as sex, race/ethnicity, or year of study. In cases where there were alternative measures for the competencies available, our research demonstrated that the CCAS had convergent validity with the same or fewer items. Thus, assessing the core competencies using the CCAS is equal to or more efficient and convenient as existing measurements. We also demonstrated that the most recent version of the CCAS has response choices that maximize interpretability for students and create sufficient variance in responses to be useful in correlational analysis and monitor growth. Finally, results of our research also showed that scores on CCAS were predictive of students' post-graduation success, indicating that the assessment of career readiness is not only of theoretical interest, but has practical, real-world applications for students who can use CCAS scores to monitor, evaluate, and plan their career readiness development during college.

Implications

The ability to reliably and validly assess students' career readiness has several important implications not only for students and their families but for colleges and universities as well. It has long been a cultural truism that a comprehensive liberal arts education is a solid foundation for students' professional success. Recently, however, this truism has been challenged in public discourse and enrollment in liberal arts majors and public support for liberal arts colleges has declined (Watkins, 2024). This series of studies demonstrates that core career competencies students develop in liberal arts education can be defined and operationalized in a way that provides valuable information to students and educational institutions. For students, CCAS scores are indicators of their individual development of the competencies and guides for which educational opportunities to seek out to further their development. For institutions, measuring students' development of core career competencies as a result of particular curricular or co-curricular experiences allows them to: 1) direct resources to those experiences that are valuable to students, and 2) to inform faculty about which curricula are particularly helpful to students, especially students that for historical and socio-economic reasons may experience barriers to their career success. Finally, it gives colleges and universities reliable and valid empirical evidence for the value of their liberal arts education.

Limitations

The research presented here has certain limitations. Most significantly is that the number, scope, and definitions of the 10 core career competencies are necessarily restrictive and cannot completely account for the entirety of the undergraduate experience in the liberal arts. Any measure that uses self-reports and is administered to large populations of very diverse educational and socio-economic

backgrounds will invariably have to present its constructs in overly simple and unambiguous terms that may not fully capture the richness and nuances of the actual educational experiences of the students. To us that is an unfortunate but necessary trade-off that we are willing to accept. The advantage of being able to assess and compare the competency development of students of various ages and experiences across a wide range of academic disciplines and majors, in our minds, outweighs the loss of precision and nuance that it brings with it. Another limitation is that the competencies were conceptualized and operationalized at a relatively high level of abstraction and they apply generically to many careers rather than being diagnostic of specific skills associated with more narrowly defined professional skills, such as being able to write computer code or play a specific instrument.

Consequently, CCAS scores might be of less value for those students whose career success to a large degree depends on specific technical or cognitive skills. The careers of liberal arts students are often less tied to their majors than students in professional fields, such as engineering or business school, so we again accept the limitation that CCAS scores might be less meaningful for some students entering specialized fields.

Conclusion and Future Directions

This series of studies provide initial empirical evidence for measuring the career readiness of undergraduate liberal arts students through a rigorous assessment of 10 core career competencies producing scores that are reliable and predictive of career outcomes for students. Validation, of course, is an ongoing process and there are avenues for building additional evidence for the interpretation and use of scores. For instance, investigating longitudinal measurement invariance to support the use of scores in modeling students' growth over time. Researchers should next examine whether there are other, equally important core career competencies in addition to the 10 identified and operationalized here. Furthermore, researchers should systematically investigate which curricular and co-curricular experiences are particularly helpful for students as they develop their career readiness in college, which informs how programs can best support their students.

In the meantime, however, the use of the CCAS has already aided almost 100,000 undergraduate students to become more aware of the competencies they acquire in their liberal arts education, be more intentional in their engagement with and development of the competencies, and better articulate their competencies to their families, potential employers, and most importantly, to themselves. Similarly, the systematic use of CCAS has aided faculty to be more intentional in how they teach the competencies to their students and how they can design courses that are more attentive to the career readiness of their students.

References

- Akkermans, J., Brenninkmeijer, V., Huibers, M. & Blonk, R.W. B. (2013). Competencies for the contemporary career: Development and preliminary validation of the career competencies questionnaire. *Journal of Career Development*, 40(3), 245-267.
<https://doi.org/10.1177/0894845312467501>.
- American Association of Medical Colleges. (April, 2016). *The premed competencies for entering medical students*. Students & Residents. <https://students-residents.aamc.org/real-stories-demonstrating-premed-competencies/premed-competencies-entering-medical-students>
- American Educational Research Association, American Psychological Association, & National Council on Measurement in Education (2014). *Standards for educational and psychological testing*. American Educational Research Association.
- Aoun, J. E. (2017). *Robot-proof: higher education in the age of artificial intelligence*. MIT press.
- Arum, R., Roksa, J., & Cook, A. (Eds.). (2016). *Improving quality in American higher education: Learning outcomes and assessments for the 21st century*. John Wiley & Sons.
- Association of American Colleges and Universities. (2009). *Inquiry and analysis VALUE rubric*.
<https://www.aacu.org/initiatives/value-initiative/value-rubrics/value-rubrics-inquiry-and-analysis>
- Beribisky, N., & Hancock, G. R. (2023). Comparing RMSEA-based indices for assessing measurement invariance in confirmatory factor models. *Educational and Psychological Measurement*.
<https://doi.org/10.1177/00131644231202949>
- Blokker, R., Akkermans, J., Tims, M., Jansen, P. & Khapova, S. (2019). Building a sustainable start: The role of career competencies, career success, and career shocks in young professionals' employability. *Journal of Vocational Behavior*, 112, 172-184. <https://doi.org/10.1016/j.jvb.2019.02.013>.
- Boyer 2030 Commission (2022). *The equity-excellence imperative. A 2030 blueprint for undergraduate education at U.S. research universities*. The Association for Undergraduate Education at Research Universities. <https://doi.org/10.37514/CUS-B.2022.1503>
- Browne, M. W. (2000). Cross-validation methods. *Journal of Mathematical Psychology*, 44(1), 108-132.
- Chan, C. K. Y., & Fong, E. T. Y. (2018). Disciplinary differences and implications for the development of generic skills: a study of engineering and business students' perceptions of generic skills. *European Journal of Engineering Education*, 43(6), 927-949.
<https://doi.org/10.1080/03043797.2018.1462766>
- Conley, S. N., Foley, R. W., Gorman, M. E., Denham, J., & Coleman, K. (2017). Acquisition of T-shaped expertise: An exploratory study. *Social Epistemology*, 31(2), 165-183.
<https://doi.org/10.1080/02691728.2016.1249435>
- Guest, D. (1991). *The hunt is on for the renaissance man of computing*. London: The Independent.
- Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method* (4th ed). Wiley.
- Heppner, P. P., & Petersen, C. H. (1982). The development and implications of a personal problem-solving inventory. *Journal of Counseling Psychology*, 29(1), 66-75.
<https://doi.org/10.1037/0022-0167.29.1.66>

- Jo, H., Park, M., & Song, J. H. (2024). Career competencies: An integrated review of the literature. *European Journal of Training and Development*, 48(7/8), 805-832. <https://doi.org/10.1108/EJTD-04-2023-0052>
- Koerner, A. (2018). Career readiness is integral to the liberal arts. *NACE Journal*, 79(2), 36-44.
- Miller, A. L. (2014). A self-report measure of cognitive processes associated with creativity. *Creativity Research Journal*, 26(2), 203-218. <https://doi.org/10.1080/10400419.2014.901088>
- National Association of Colleges and Employers. (2015). Career Readiness for the New College Graduate: A Definition and Competencies. <https://naceweb.org/career-readiness/competencies/career-readiness-defined>
- Preacher, K. J., Zhang, G., Kim, C., & Mels, G. (2013). Choosing the optimal number of factors in exploratory factor analysis: A model selection perspective. *Multivariate Behavioral Research*, 48(1), 28-56. <https://doi.org/10.1080/00273171.2012.710386>
- Presti, A. L., Capone, V., Aversano, A. & Akkermans, J. (2022). Career competencies and career success: On the roles of employability activities and academic satisfaction during the school-to-work transition. *Journal of Career Development*, 49(1), 107-125. <https://doi.org/10.1177/0894845321992536>.
- R Core Team (2023). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>.
- Savalei, V., Brace, J. C., & Fouladi, R. T. (2023). We need to change how we compute RMSEA for nested model comparisons in structural equation modeling. *Psychological Methods*. <https://doi.org/10.1037/met0000537>
- Svetina, D., Rutkowski, L., & Rutkowski, D. (2020). Multiple-group invariance with categorical outcomes using updated guidelines: An illustration using M plus and the lavaan/semtools packages. *Structural Equation Modeling: A Multidisciplinary Journal*, 27(1), 111-130. <https://doi.org/10.1080/10705511.2019.1602776>
- Sweetman, R., Hovdhaugen, E., & Karlsen, H. (2014). Learning outcomes across disciplinary divides and contrasting national higher education traditions. *Tertiary Education and Management*, 20(3), 179–192. <https://doi.org/10.1080/13583883.2014.902096>
- Valenzuela, J., Nieto, A., & Saiz, C. (2011). Critical thinking motivational scale: A contribution to the study of relationship between critical thinking and motivation. *Electronic Journal of Research in Educational Psychology*, 9(2), 823-848.
- Watkins, S. (2024). *Protecting the Liberal Arts and Humanities in American Higher Education*. <https://media4.manhattan-institute.org/wp-content/uploads/protecting-the-liberal-arts-and-humanities-in-american-higher-education.pdf>
- Wolcott, M. D. & Lobczowski, N. G (2021). Using cognitive interviews and think-aloud protocols to understand thought processes. *Currents in Pharmacy Teaching and Learning*, 13, 181-188. <https://doi.org/10.1016/j.cptl.2020.09.005>
- Wu, H., & Estabrook, R. (2016). Identification of confirmatory factor analysis models of different levels of invariance for ordered categorical outcomes. *Psychometrika*, 81, 1014–1045. <https://doi.org/10.1007/s11336-016-9506-0>

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