



THE BRIEF COURSE BELONGING SCALE: DEVELOPING A MEASURE OF POSTSECONDARY STUDENTS' COURSE-LEVEL SENSE OF BELONGING ACROSS ONLINE AND FACE-TO-FACE MODALITIES

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Abstract: Sense of belonging is an important topic in higher education. However, few studies have examined this important construct at the course level and in the online learning context; even fewer are quantitative by design. The aim of our study was to develop and evaluate a measure of sense of belonging that could be used across different postsecondary learning contexts. A psychometric investigation was conducted at a large, US southeastern university on data using the newly developed Brief Course Belonging Scale (BCBS). Results provide evidence for the unidimensional treatment of BCBS data across delivery context, convergent validity for BCBS scores as they relate positively to belonging at the university level, connectedness, and academic motivation, and discriminant validity for BCBS scores as they related minimally with loneliness. Differential item functioning was detected on one item, but this did not jeopardize score validity and reliability. Specific psychometric implications regarding the domainspecificity of the course delivery context as well as the administration of the novel instrument to a more broad, and diverse student population are recommended.

Keywords: Sense of belonging, postsecondary students, online, differential item functioning, higher education

Introduction

A growing trend in higher education is to offer more courses, as well as degree programs, in fully online contexts as an alternative to or extension of face-to-face instruction, despite unresolved issues of student persistence, retention, and graduation (AACSU, 2019). Furthermore, sociocultural events—specifically, the global pandemic beginning in 2020—shifted considerations of online learning from a temporary alternative to a permanent solution. One of the pathways to ensure postsecondary students' success across learning contexts is to address their sense of belonging. Both conceptual and empirical work shows that a sense of belonging positively influences outcomes that colleges and universities prioritize, such as mental health and graduation rates (e.g., Gopalan & Brady, 2020; Hurtado & Carter, 1997; Tinto, 2017).

However, few studies have been conducted to investigate postsecondary students' sense of belonging at the course level and in the online learning context; even fewer are quantitative by design (see Decker & Beltran, 2016; Hewson,

2018). Instruments have been developed to quantify postsecondary students' sense of belonging (e.g., Slaten et al., 2018), but existing instruments were not developed with the intention of measuring the sense



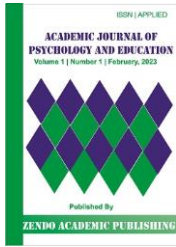
of belonging to other students in an online course. Moreover, instruments have not been field-tested with postsecondary students completing their degree in fully online learning programs while living at a distance from the physical campus environment. Current instruments lack psychometric evidence to produce data that allow for the comparative investigation of differences in students' sense of belonging to other students across learning contexts (i.e., fully online vs. fully face-to-face). Based on these concerns and in response to evolving instructional opportunities, an instrument to measure postsecondary students' sense of belonging to other students across learning contexts is an in-demand extension to fill this gap in the literature.

Postsecondary Students' Sense of Belonging

A sense of belonging among postsecondary students has been associated with persistence, retention, and graduation (Tinto, 2017)—key metrics of student success closely tracked by higher education administrators. Despite two decades of research on postsecondary students' sense of belonging, this construct remains conceptually elusive and difficult to measure due to constant advancements in higher education (Slaten et al., 2018). Maslow (1943) proposed the foundational concept that belonging influences positive peer and self-esteem, and is essential for self-actualization. The “belongingness hypothesis” (Baumeister & Leary, 1995, p. 500), expanded the conceptualization of belonging as maintained and frequent conflict-free interaction with others, as well as committed, stable, and genuine bonds. Within education, students' sense of belonging is described as “the extent to which students feel personally...supported by others in the school social environment” (Goodenow, 1993, p. 80). Scholars similarly recognize the relational nature of the construct. However, conceptual discrepancies persist, and proposed definitions vary widely (Walton & Brady, 2017). Also, this construct has been evidenced at postsecondary institutions to influence indicators of student well-being and achievement, such as academic motivation and social connectedness (e.g., Arslan et al., 2022; Cheung & Datu, 2021; Francis et al., 2019; Kosovich et al., 2015; Waters & Charles Higgins, 2021; Waters & Johnstone, 2022). In contrast, loneliness, depression, and disengagement, as well as feelings of invisibility, shyness, and devaluation, have been associated with feeling like one does not belong in these spaces (e.g., Gunn et al., 2012; Yıldırım et al., 2022). This suggests that the learning context—including virtual or online settings—may influence how students experience a sense of belonging. Even though students may share similarities across modalities, there may be unexpected group characteristics that could lead to differences in belonging.

Sense of Belonging in Online Learning Contexts

Investigating postsecondary online students' sense of belonging is concerningly limited, given the rapid expansion into online learning contexts. Researchers have identified that students who are enrolled in fully online programs desire to feel a sense of belonging in the online learning contexts before attending to academic duties (Peacock & Cowan, 2018). Also, fully online students deliberately seek opportunities to interact with others beyond basic engagement to compensate for a lack of physical presence (e.g., Delahunty et al., 2014). Hewson (2018) identified unintended negative psychological effects of the online learning experience, which include anxiety, stress, guilt, and hyper-competitiveness. O'Shea et al. (2015) reported that “online learners identify themselves as ‘second-class citizens’ or ‘just an online student’” (p.



55). Unexpectedly, rather than making higher education more accessible, online learning may isolate and stifle the social and academic experience of vulnerable students (Hewson; O'Shea et al.). To be sure, face-to-face contexts elicit similar psychological reactions, but the variability between the two learning contexts might be more nuanced than currently understood.

Differences in experiences of belonging, specifically in higher education, remain an issue with increasing complexity (Hurtado & Carter, 1997; Strayhorn, 2012). The variety of learning contexts (i.e., face-to-face, online, and hybrid courses; Allen & Seaman, 2013; Green, 2022), increases the potential of further marginalizing students that are from vulnerable groups (Hussain & Jones, 2021). Since distance education programs receive less support and resources, students who are fully online are particularly susceptible to being disadvantaged (e.g., O'Shea et al., 2015; Peacock & Cowan, 2018). Addressing these important issues of equity related to the sense of belonging due to the educational environment, specifically the online learning context, at higher education institutions may better improve enrollment, achievement, and retention efforts. Online learning contexts present opportunities for instructors to attend to these issues resulting from the online learning context, including students' sense of belonging (e.g., Bautista & Escofet, 2015; Thomas et al., 2014). Understanding postsecondary students' sense of belonging—and its measurement—in both online and face-to-face learning contexts subsequently improves the academic experiences of all students.

Measuring Postsecondary Students' Sense of Belonging

The use of existing instruments to measure students' sense of belonging has recently gained momentum as higher education institutions deliberately focus on the sense of belonging to address student retention issues (e.g., Angelino et al., 2007; Slaten et al., 2018). Despite efforts to improve students' sense of belonging in postsecondary settings, there is a gap in the available instruments for this construct. Existing instruments (i.e., Hoffman et al., 2002; Slaten et al.) are widely used but have been presented with limited validity evidence. Studies have recognized the importance of measuring belonging (e.g., Hurtado & Carter, 2007; NCES, 2012), but the most used—Goodenow's (1993) Psychological Sense of School Membership (PSSM)—focuses on adolescent students. Though the PSSM is a popular choice for a sense of belonging research, concerns have been expressed about the psychometrics of the PSSM (You et al., 2011) and its age appropriateness given that it is not developed for use with postsecondary students.

Single items on national surveys (e.g., NCES, 2012) present psychometric limits and alternative instruments with improved psychometric qualities for sampled data have been developed (e.g., Slaten et al., 2018; Whiting et al., 2018). For instance, the Simple School Belonging Scale (SSBS) scale by Whiting was developed in response to multidimensionality issues demonstrated by the PSSM but specifically designed for adolescents, not postsecondary students. However, a brief instrument that has been developed for and field-tested with postsecondary students taking courses and studying in an online environment is not available. Few studies address this distinct issue (e.g., Decker & Beltran, 2016; Hewson, 2018). More pressing, the existing instruments were not developed with the intention of measuring the sense of belonging in an online course or for use with postsecondary students completing their degree in a fully online program while living at a distance from the physical campus. Ultimately, the development of a



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robust instrument to measure postsecondary students' sense of belonging can only help higher education institutions address contemporary issues, including the growing demand for online education.

Theoretical Framework

This investigation is situated in two concurrent frameworks: Bandura's social cognitive theory (SCT, 1986) and Tinto's model of retention (2017). The personal factors of students' beliefs (i.e., sense of belonging), environmental factors of the academic context (i.e., course context), and behavioral factors of student achievement (i.e., retention) are appropriately situated within SCT. Tinto's model of student motivation and persistence (in compliment to SCT) allows for these relationships to be examined more concretely. Like SCT, Tinto highlighted bidirectional relationships of students' sense of belonging and other personal motivation and environmental factors, which include online and face-to-face learning contexts. According to Tinto, a sense of belonging maintains and enhances motivation, thus supporting student persistence. So, students' sense of belonging, and its relationship with self-efficacy and perceptions of the curriculum, comprises a student's motivation to persist towards achievement goals. Together, these two theoretical frameworks capture the dynamic relationships between individual and institutional factors to best frame how a sense of belonging can be conceptualized for postsecondary students and its influence on behaviors associated with student success.

Purpose

The purpose of our study was to extend the research on students' sense of belonging by developing a new Brief Course Belonging Scale (BCBS) that measures postsecondary students' sense of belonging to other students within the same course in both online (i.e., students enrolled in online courses and learning from a distance from the university) and face-to-face (i.e., students who attended classes on the physical campus of the university) course delivery contexts. The BCBS was developed to assist course instructors so that they can become more aware of the level of sense of belonging occurring within their course(s) and to use this information to strengthen belonging among students in their course(s). Specifically, we wanted to assess the internal structure (i.e., dimensionality and differential item functioning [DIF] across course delivery contexts) of data on the BCBS. So that appropriate and defensible claims about students' sense of belonging to other students within the same course can be made, a fair and reliable instrument should be relieved of potential issues of validity based on group differences (e.g., course delivery context). Bandalos (2018) stated that "If unintended consequences are found, researchers should determine, to the degree possible, whether these are due to sources of test invalidity such as test irrelevance or construct underrepresentation" (p. 296). By developing and evaluating sense of belonging instruments that are contexts-specific, like the BCBS, researchers and practitioners alike can ensure fair measurement and better understand how to measure belonging in online and face-to-face contexts. Additionally, convergent and discriminant validity evidence was assessed by examining how BCBS scores correlated with related and different constructs.

First, we hypothesized that data from the BCBS is unidimensional. Second, we wanted to know if items on the BCBS behave differently across online and face-to-face course delivery contexts. If items do behave differently by course contexts, we wanted to know if these differences are large enough to meaningfully



impact the measurement scoring. Third, after removing any item(s) from the BCBS which behave differently across contexts, is there a difference in mean BCBS scores across contexts? Specifically, we hypothesized that scores in the online context will be slightly lower than scores in the face-to-face context given that face-to-face courses tend to lend themselves to more interactions. Fourth, we expected scores on the BCBS to have the strongest positive relationship with scores from instruments measuring the sense of belonging at the university level and social connectedness (Slaten et al., 2018; Whiting et al., 2018). Fifth, we expected medium to strong positive correlations between BCBS and academic motivation scores. Finally, scores on the BCBS were predicted to have the weakest negative relationship with loneliness scores (Slaten et al., 2018).

Method

Participants

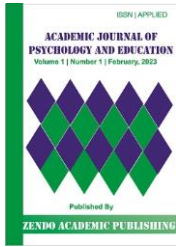
Based on the sampling design, 127 online and 123 face-to-face courses were included. The resulting sample was asked to participate in a survey about their experiences on campus for internal reporting to SAL and TLAI. During the last three weeks of the semester, partners in IR invited a sample of randomly selected students ($N = 2,643$) from randomly selected courses ($J = 250$) that met the inclusion criteria to participate in this university-wide survey. Participants came from 146 courses (response rate = 58.4%). Participants in the sample ($n = 305$; response rate = 11.5%) who were interested and provided their explicit consent, as required by the protocol approved by the IRB. The sample consisted of primarily female (70.5%) students, taking online courses (56.7%), seeking a graduate degree (71.8%, Undergraduate = 10.2%, Professional = 18%), and identified as White or Caucasian (70.8%, Asian = 4.6%, Black or African American = 6.9%, Hispanic or Latino = 4.9%, Multiracial = 3.6%, Decline or Unknown = 8.5%) with an average age was 31.9 years ($SD = 10.5$).

Measures

Brief Course Belonging Scale

The current study examined postsecondary students' sense of belonging to other students in their course. Initially, a pool of 20 items was written by the authors based on themes regarding postsecondary students' qualitative descriptions of sense of belonging in online and face-to-face modalities (Author et al., 2021), considering the current sense of belonging instruments (Goodenow, 1993; Slaten et al., 2018; Whiting et al., 2018), and according to guidelines for best practices in educational and psychological measurement (AERA et al., 2014; Bandalos, 2018). A set of 20 items were iteratively refined based on expert reviews and cognitive interviewing until the final set of items was determined.

First, content and field experts ($n = 5$) in education and psychology who conduct research on the sense of belonging, higher education, and post-secondary students, and/or applied psychometric techniques were purposefully selected to complete a process-based review (Rubio et al., 2003) for (a) phrasing clarity; (b) item retention or removal; and (c) importance to the measurement of belonging. Of the original 20 items, 6 items were deleted based on content and field experts' recommendation that these items were poorly worded, redundant, and/or irrelevant to the construct. Next, cognitive interviews (Peterson et al., 2017) were conducted with a sample of students ($N = 6$) specifically recruited for their experience with both



online and face-to-face courses. An open-response protocol was established to describe the clarity of the item, as well as any phrasing revisions, and to provide feedback on construct relevance. Cognitive interviews were conducted to saturation and common responses across the interview sessions were reflected in the refinement of items until the intended meaning was clearly communicated by students during each interview. After cognitive interviewing, 11 items were proposed. The second round of higher education professionals and field experts ($n = 8$) provided another qualitative review which confirmed the 11 items refined at the end of the cognitive interviews. The integration of the qualitative data and iterative item writing process informed an intentional and thoughtful approach to measure postsecondary students' sense of belonging to other students in online and face-to-face contexts. The 11-item BCBS ($\alpha = .96$) uses a 4-point Likert-type scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*).

University Belonging Questionnaire

The 24-item University Belonging Questionnaire (UBQ; Slaten et al., 2018) was developed specifically for use with students to measure overall university belonging ($\alpha = .94$) and is consists of three subscales—university affiliation ($\alpha = .93$), support ($\alpha = .91$), and relationships ($\alpha = .92$). Each item on the UBQ is rated on a 4-point Likert-type scale ranging from 1 (strongly disagree) to 4 (strongly agree). A higher score on the UBQ represents a stronger sense of belonging at the university.

Expectancy-Value-Cost Scale

The 10-item Expectancy-Value-Cost Scale (EVC; Kosovich et al., 2015) measures students' overall academic motivation ($\alpha = .83$) on three theoretically separate and important motivational constructs – E ($\alpha = .87$), V ($\alpha = .93$) and C ($\alpha = .78$). The EVC uses a 6-point Likert-type response format ranging from 1 (strongly disagree) to 6 (strongly agree). A higher score on the EVC represents greater overall academic motivation.

Social Connectedness Scale

The 8-item Social Connectedness Scale (SCS; Lee & Robbins, 1995) measures the emotional distance from others

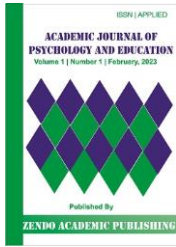
($\alpha = .94$). Each item is rated on a 6-point Likert-type scale ranging from 1 (strongly agree) to 6 (strongly disagree). A higher score on the SCS represents a closer emotional connection to others.

UCLA Loneliness Scale

The 20-item UCLA Loneliness Scale (UCLALS; Russell et al., 1980) assesses global loneliness ($\alpha = .91$). The UCLALS uses a 4-point Likert-type scale ranging from 1 (never) to 4 (always). A higher score on the UCLA Loneliness Scale represents greater feelings of global loneliness.

Procedure

Students were invited to participate in this study based on specific inclusion criteria. First, eligible courses were selected (excluding hybrid courses). To include only fully online and only fully face-to-face students, only courses active at the time of data collection were sampled and certain types of courses were excluded (e.g., experiential learning [internships, co-ops], study abroad, dissertation writing, and compressed video). Only sections that had more than five students were included. Courses from both modalities were then matched by course characteristics, based on the course (e.g., MATH 109 face-to-face and MATH 109



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online), level (e.g., 100- and 200-level courses), department, and college. Next, eligible students were selected. Online students were classified as those who were seeking a degree from a fully online program, learning from a distance. Face-to-face students were classified as those who were seeking a degree from a traditional program and attending classes on the physical campus of the university. If a student met the inclusion criteria and appeared in the participant pool more than once, then we randomly selected a single occurrence.

Our study was conducted at a predominantly White institution that offers a robust selection of courses and program degrees as fully online opportunities. Data were collected in partnership with Institutional Research (IR), Student and Academic Life (SAL), and Teaching, Learning and Academic Innovation (TLAI) units. Campus partners were interested in learning more about the experience of enrolled students (i.e., their perceived sense of belonging to other students in their courses). Based on consultation with IR, an intricate sampling design and inclusion criteria were established to reflect the typical participation rates at the university and student characteristics of both online and face-to-face student populations.

The survey was configured for randomization at both instrument and item levels to address any potential issues associated with participant fatigue or local item dependency. Also, a three-form design (Pokropek, 2011) was used to reduce the cognitive load on participants. In this design, three forms of the survey were developed so that all participants responded to the instruments measuring the primary constructs of interest (i.e., BCBS, EVC). Participants were randomly assigned one of the instruments measuring the related constructs (i.e., SCS, UCLALS), as well as one of the subscales of the UBQ. The BCBS and EVC were paired together as a block within the survey and presented first to mitigate any possible measurement error due to the priming of other constructs. Data were anonymized prior to any data analyses.

Data Analysis

Preliminary Analysis

Due to several items having low response frequency (< 5) in the two lowest agreement categories we chose to collapse the four categories into three (i.e., Strongly disagree or Disagree = Disagree; Agree = Agree; Strongly agree = Strongly agree). Combining response categories was employed to produce more reliable thresholds (Reise et al., 2021) and reliably distinguish sense of belonging scores without reducing the data so much that reliability was diminished, or quality of model fit inflated (Rutkowski et al., 2019). Also, intraclass correlation coefficients (ICCs) and design effect (DEFF) values were computed for each item based on an intercept-only multilevel ordinal logistic regression. Furthermore, the expected unidimensional nature of the BCBS was investigated by computing eigenvalues and using parallel analysis to provide evidence concerning the dimensionality of the data (Horn, 1965).

Confirmatory Factor Analysis

Considering the nested structure of data (i.e., students within courses), a within-cluster construct with a saturated level-2 was anticipated to allow for cluster-level variability with a saturated model of the covariances among the clusters (Stapleton et al., 2016). Although this model is a realistic approximation of the construct of students' sense of belonging to others within a course, issues of model convergence occurred when a multilevel approach was used with item-level indicators. Thus, a multilevel confirmatory



factor analysis (CFA) was not feasible with the current data, but it was possible to conduct single-level CFAs using the TYPE = COMPLEX option in Mplus 8.6 (Muthén & Muthén, 2021) to provide standard errors which account for clustering of persons in courses.

Unidimensional CFAs were estimated separately for the online sample and the face-to-face sample with the weighted least squares with mean and variance correction (WLSMV) estimator. Exact fit was concluded if the χ^2 was not significant ($p > .05$). Otherwise, the approximate fit was concluded if standardized root mean square residual (SRMR) was $\leq .08$ and large absolute residual correlations were not observed (Asparouhov & Muthén, 2018). Small absolute residual correlations were defined as those less than or equal to .10 (Kline, 2016). Convergent validity evidence for the BCBS was provided by computing the average variance extracted (AVE) and composite reliability (i.e., coefficient omega). Acceptable level evidence of convergent validity is established when AVE is at least 0.50 (Fornell & Larcker, 1981) and composite reliability is at least 0.80 (Nunnally and Bernstein, 1994).

Hierarchical Ordinal Logistic Regression

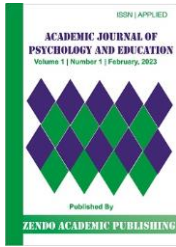
Hierarchical ordinal logistic regression (HOLR) was used to assess DIF based on course delivery context, accounting for both the polytomous item response options used to collect data on the BCBS and the nested nature of the data. The HOLR procedure uses likelihood ratio testing (LRT) among three models for each item to determine the significance of uniform and non-uniform DIF. Model 1 employs the total score as a predictor of the item score. Model 2 adds the grouping variable (online vs. face-to-face) as a predictor. If Model 2 fits the data significantly better than Model 1, uniform DIF is indicated. Model 3 adds the interaction between total score and grouping variable as a predictor. If Model 3 fits the data significantly better than Models 1 or 2, nonuniform DIF is indicated. To adjust for multiple comparisons being conducted, α was adjusted using the Bonferroni technique. Since there are 11 items in the BCBS, we used an α of $.05/11 = .0045$ as our indicator of statistical significance for the presence of nonuniform DIF (Crane et al., 2004). To determine the importance of DIF in each item, the expected score standardized difference (ESSD) effect size (Meade, 2010) was computed for each item and values > 0.2 were considered for removal.

Multilevel Analysis

Differences in BCBS mean scores between the online and face-to-face groups were assessed using a multilevel modeling approach. The significance of the grouping variable (online vs. face-to-face) as a predictor of BCBS mean scores were tested using LRT between an intercept-only model and a model where the grouping variable was included as a predictor at the between (class) level. The effect size of this mean difference was computed as a partially standardized regression coefficient with only the outcome standardized (Lorah, 2018).

Correlational Analysis

Correlational evidence of validity for BCBS scores was obtained by estimating the relationship between the scores of the BCBS and those of the UBQ, ECV, SCS, and UCLALS by computing the Pearson correlation coefficient in Mplus using the TYPE = COMPLEX option. Specifically, convergent evidence was established when a specifically hypothesized high positive correlation existed between scores on the



BCBS and UBQ and SCS scores, whereas discriminant evidence was established when a specifically hypothesized low negative correlation existed between scores on the BCBS and UCLALS.

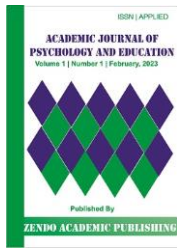
Results

Preliminary Analysis

Item-level ICCs and DEFF values ranged from .000-.349 and 1.000-1.291, respectively, for the online sample, whereas ICCs and DEFF values ranged from .000-.092 and 1.000-1.134, respectively, for the face-to-face sample. Total scores show similar levels of dependence on course, ICC = .198 and DEFF = 1.165 for the online group and ICC = .006 and design effect = 1.008 for the face-to-face group. These values indicate that clustering cannot be ignored. Additionally, the first eigenvalues were 9.10 in the online group and 8.65 in the face-to-face group; the second eigenvalue was less than 1. Parallel analysis suggests extracting a single dimension for both online and face-to-face groups.

Table 1. Factor loading for unidimensional confirmatory factor analysis models

Item	Statement	Standardized factor loadings	
		All items model (Online/Face-to-face)	Item 3 removed (Online/Face-to-face)
BCBS1	I feel like my contributions during class activities matter to other students in this course.	0.80 / .76	0.80 / .76
BCBS2	I feel appreciated by other students in this course.	0.96 / .90	0.96 / .89
BCBS3	I want to keep in touch with other students after this course is over.	0.75 / .82	
BCBS4	I feel like other students in this course encourage me to do well.	0.96 / .89	0.96 / .89
BCBS5	I feel respected by other students in this course.	0.98 / .92	0.98 / .92
BCBS6	I feel like other students in this course accept me for who I really am.	0.93 / .95	0.93 / .95
BCBS7	I can be myself with other students in this course.	0.90 / .90	0.90 / .90
BCBS8	I feel like other students in this course understand my ideas when I share what I am thinking.	0.97 / .84	0.97 / .84
BCBS9	I feel supported by other students in this course.	0.96 / .96	0.96 / .96
BCBS10	If I face academic challenges in this course, I feel comfortable asking other students for help.	0.81 / .83	0.81 / .83



BCBS11 I feel included by other students in this course.	0.92 / .94	0.92 / .94
Average Variance Extracted (AVE)	.82 / .78	.85 / .79
Composite Reliability (omega)	.95 / .96	.95 / .96

Confirmatory Factor Analysis

CFAs indicate exact fit was not met for the online group, $\chi^2(44) = 98.992, p < .001$, and face-to-face group, $\chi^2(44)$

$= 98.992, p < .001$. However, both online (SRMR = .035, CFI = .995, RMSEA = .097, RMSEA 90% CI [.072, .123]) and face-to-face (SRMR = .041, CFI = .991, RMSEA = .110, RMSEA 90% CI [.089, .131]) groups exhibited approximate fit, as SRMR was $< .08$ and r_{residual} tended to be low. In both face-to-face and online groups, 4 out of 55 r_{residual} had absolute value $> .100$ (largest = .159 and .110, respectively). As shown in Table 1, standardized factor loadings were large ($> .70$) in both groups. Average variance extracted ($\text{AVE}_{\text{face-to-face}} = .78, \text{AVE}_{\text{online}} = .82$) and composite reliability ($\omega_{\text{face-to-face}} = .95, \omega_{\text{online}} = .96$) were high.

Hierarchical Ordinal Logistic Regression

Results of the HOLR DIF analyses are summarized in Table 2. Only BCBS3 yielded a significant test of uniform DIF; no items displayed non-uniform DIF. The ESSD effect size for BCBS3 was -0.404, indicating that BCBS scores in the online group can be expected to be 0.404 standard deviations lower than in the face-to-face group as a result of DIF. The size of this effect is concerning, and BCBS3 was removed from the instrument for all further analyses. Previous analyses (i.e., CFAs) were performed based on the revised 10-item set, with largely unchanged results; reliability estimates, specifically, were unchanged when rounded to two decimal places.

Multilevel Analysis

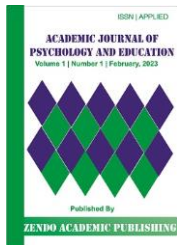
The model with the course delivery context grouping variable as a predictor of BCBS mean score fit better than the intercept-only model, $\chi^2(1) = 5.000, p = .025$. The outcome-standardized regression coefficient (i.e., effect size) was -1.326, indicating that BCBS scores are 1.3 standard deviations lower for the online group than the face-to-face group.

Correlational Analysis

As expected, BCBS scores correlated significantly with UBQ, SCS, EVC, and UCLALS scores, in order of decreasing magnitude of correlation (Table 3). Relative to UBQ scores, BCBS scores correlated more strongly with EVC but less strongly with SCS and ULCALS scores.

Table 2. Hierarchical ordinal logistic regression testing for differential item function (DIF)

Item	LL Model 1	LL Model 2	LL Model 3	Overall DIF p	Uniform DIF p	Nonuniform DIF p	ESSD
BCBS1	-201.423	-199.382	-199.219	.110	.043	.568	0.260
BCBS2	-104.890	-104.679	-104.028	.422	.516	.254	-0.071
BCBS3	-202.300	-197.257	-197.133	.006	.001*	.618	-0.404
BCBS4	-124.540	-123.794	-123.776	.466	.222	.850	-0.125



BCBS5	-83.214	-82.785	-82.540	.510	.354	.484	0.036
BCBS6	-98.820	-97.709	-97.706	.328	.136	.938	0.084
BCBS7	-125.690	-125.497	-125.495	.823	.534	.950	0.031
BCBS8	-123.782	-122.582	-121.792	.137	.121	.209	0.100
BCBS9	-101.625	-100.292	-100.284	.262	.103	.899	0.091
BCBS10	-173.131	-172.678	-172.411	.487	.341	.465	-0.118
BCBS11	-98.744	-98.729	-98.589	.856	.862	.597	-0.038

Note LL = log-likelihood; Model 1: total score as a predictor of the item score; Model 2: total score and grouping variable as predictors of the item score; Model3: total score, grouping variable, and their interaction as predictors of the item score; Overall DIF p = test of significance for Model 3 vs. Model 1; Uniform DIF p = test of significance for Model 2 vs. Model 1; Nonuniform DIF p = test of significance for Model 3 vs. Model 2; ESSD = expected score standardized difference. $*p < .05/11$.

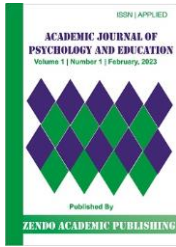
Table 3. Observed correlations of postsecondary students' sense of belonging to others within the course and scores on related measures

Measure	1	2	3	4	5
1. Course-level belonging ^a	.95				
2. University-level belonging ^b	.47*	.96			
3. Academic motivation ^c	.40*	.30*	.89		
4. Social connectedness ^d	.39*	.47*	.20*	.95	
5. Loneliness ^e	-.35*	-.42*	-.13*	-.80*	.93
Mean	3.21	3.14	4.89	4.67	1.98
Standard Deviation	0.57	0.53	0.73	1.28	0.51
Skew	-0.09	-0.27	-0.67	-0.87	0.43
Excess Kurtosis	-0.72	-0.25	0.50	-0.01	-0.37
Internal Consistency (α)	.96		.83	.94	.91

Note. Descriptive statistics are based on item averages. Observed correlations are below the diagonal; omega (ω) reliability values are provided on the diagonal. Constructs were measured by: ^a10-item Brief Course Belonging Scale; ^bUniversity Belonging Questionnaire (UBQ; Slaten et al., 2018); ^cExpectancy-Value-Cost Scale (EVC; Kosovich et al., 2015); ^dSocial Connectedness Scale (SCS; Lee & Robbins, 1995); ^eUCLA Loneliness Scale (UCLALS; Russell et al., 1980). $*p < .05$.

Discussion

This study extends inquiries into postsecondary students' sense of belonging (Hurtado & Carter, 2007; Slaten et al., 2018) by providing empirical evidence—across online and face-to-face course delivery contexts—to support the use and interpretation of scores from a new instrument developed to measure students' sense of belonging with other students in the same course. The data from this new instrument provided support for the definition of this construct as students' perceptions of affirming interpersonal



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relationships among students informed by interactions in a common academic experience. Findings support our first hypothesis of a unidimensional treatment of BCBS data for both delivery contexts, which is aligned with findings by Whiting et al. (2018), but different from the UBQ (Slaten et al., 2018). The BCBS extends beyond prior work by providing insights into the factor structure within online and face-to-face samples.

The results also addressed our question about whether BCBS items behave differently across delivery contexts. Although uniform DIF was detected for one item (BCBS 3), removing BCBS3 had negligible effects on factor structure and reliability, but it was still removed to arrive at the final 10-item BCBS. The detection of this difference provides insight into the existing literature about online course delivery contexts as having unique aspects, at times different from traditional, face-to-face course delivery contexts (e.g., Hewson, 2018; Thomas et al., 2014). Furthermore, a content inspection of BCBS3 reveals uniform differences in perception regarding keeping in touch with students after the course is over. This suggests that the differences in perceptions across course delivery contexts regarding keeping in touch with classmates is constant across the continuum of report students' sense of belonging. This type of item-level difference should be considered but, as evidenced by the psychometric investigation conducted herein, the removal of the problematic item did not influence the results. These conclusions inform practitioners and researchers about specific issues, such as classroom culture and interpersonal relationships, as they develop strategies and interventions to boost belonging in their courses.

Results also supported our hypothesis about mean differences by showing that students enrolled in online courses have a lower level of belonging than students enrolled in face-to-face courses. This finding is important because it squarely indicates the importance of placing urgency among faculty teaching students in fully online courses to nurture opportunities for positive interactions and to develop healthy relationships, despite remote or virtual constraints. In addition to understanding the internal structure of BCBS scores and mean differences across course delivery contexts, data collected on social connectedness and loneliness demonstrated that for both fully online and fully face-to-face students, social connectedness increased, whereas loneliness decreased, a sense of belonging to other students within the same course increased. Other proposed belonging instruments showed similar strong positive correlations with UBQ scores and connectedness, medium to strong positive correlations with academic motivation, and weak negative correlations with loneliness.

Implications

After a post-pandemic world (where the online course delivery context became a norm), data should be collected during a time when instruction is delivered without interruption. With the rapid push into online learning, the current study can serve as more of a pilot to inform a wider data collection process for future semesters. Once the BCBS is further purified as a brief instrument to measure postsecondary students' sense of belonging to other students within the same course, scores from the BCBS can be analyzed along with student success metrics, as well as other student beliefs (i.e., self-efficacy and perceptions about the curriculum) to test the model recommended by Tinto (2017) and comparisons across course delivery contexts and student demographics could be made. This would fully actualize the potential of an

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instrument like this to help inform policies and practices that are influenced by these students' sense of belonging. However, before Tinto's model of student persistence can be tested in both online and face-to-face modalities, psychometrically sound instruments need to be developed for the different types of course delivery contexts as well as diverse student populations. Domain-specific measurement of social cognitive constructs has been recommended over general measurement by Bandura (2006).

Limitations

The BCBS was designed in close collaboration with content and field experts, soliciting feedback from the target population, and developed in accordance with best practice (e.g., Bandalos, 2018). Despite careful intention, our study has certain limitations. First, issues with the sample prevents the generalizability. The results are sample-dependent, and limited in both size, diversity, and convenience, reducing the ability to conduct the multilevel CFA that was intended and capture the variety of experiences. Second, students who appeared in multiple courses based on the inclusion criteria should have been retained and techniques for cross-classified data structure should have been employed, rather than excluding these students, which would have increased the generalizability of the findings. Third, the decision to collapse data collected from four to three response categories. Although this is an acceptable practice (e.g., Rutkowski et al., 2019), important information was lost and statistical analyses were constrained; thus, making findings sample dependent and replication necessary. Fourth, the data collection coincided with the host institution decisions to move to completely remote instruction in response to the global pandemic beginning in Spring 2020, the semester scheduled for data collection. Although students were on Spring Break at the point of data collection and had not adjusted to the change in course delivery context, it is uncertain whether there was an influence on how students—specifically, face-to-face students—responded to the BCBS. Thus, the self-reports from students about how their sense of belonging to others in their course was perceived before the university response to move all instruction to an online context was likely tainted by the global pandemic. However, this sociocultural event is known to affect all respondents the same way.

Future Research

Future research should focus on the expansion of the BCBS to a larger sample to allow further psychometric testing. The psychometric evaluation for this new instrument was limited. With the BCBS as a unique instrument that measures postsecondary students' sense of belonging at a course level, the same inclusion criteria can be followed as the one used in this study, but with the expansion of the cluster sizes to allow for the multilevel analyses that was originally intended and to allow for students to represent multiple courses and therefore use cross-classified multilevel models. Second, the specific context of the course level should be investigated since ongoing work on a sense of belonging at the institution level is being actively pursued (e.g., Slaten et al., 2018; Tinto, 2017). Third, the sample should be expanded to understand the experience of diverse student populations with a given course (e.g., Hurtado & Carter, 1997; Hussain & Jones, 2019; Strayhorn, 2012; Vaccaro & Newman, 2016). Fourth, as online courses and programs expand to include more undergraduate students, the BCBS should be collected from both graduate and undergraduate students, since this sample was majority of graduate students due to the



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established inclusion criteria. Fifth, perhaps additional cognitive interviewing opportunities should be offered to further refine the BCBS, prior to expanded data collection. Research conducted by Lewis et al. (2019) on the sense of belonging and microaggressions experienced at historically White institutions demonstrates the profound need for further research on this construct, should practitioners and researchers alike truly hope to improve retention and graduation for historically marginalized students.

Conclusion

Our study pursued a line of inquiry on postsecondary students' sense of belonging to other students within the same course building on limited, although seminal, research regarding the measurement of this complex and elusive construct. Goodenow and Grady (1993) situated their research on students' sense of belonging at the classroom level but focused on students in middle grades—a drastic developmental difference from postsecondary students.

Slaten et al. (2018) conducted research on postsecondary students' sense of belonging, but at the university or institution level, not at the course level. Although Slaten's instrument is comprehensive, consisting of 24 items that make up three subscales, there are currently no brief instruments for use with postsecondary students, despite researchers (i.e., Öğülmüş & Vuran, 2021; Whiting et al., 2018) demonstrating that brief scales can be psychometrically robust and can serve as an adequate alternative instrument to longer, extended versions (Arslan, 2021). In response to the rapidly changing higher education landscape that is venturing into online education, this line of research was pursued across two distinct course delivery contexts—online and face-to-face.

Decades of work address a sense of belonging in a variety of contexts, however, this study uniquely addresses a timely and relevant issue that has been exacerbated by current events: online learning as the future of higher education. Also, the psychometric issues that occurred as part of this instrument development study set a path for even further conversations about belonging within the evolving context of online learning. From this study, findings support the domain-specificity of the course delivery context—online or face-to-face—as an important consideration to ensure reliable measurement that can provide validity evidence for appropriate interpretations.

Compliance with Ethical Standards

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Competing interests

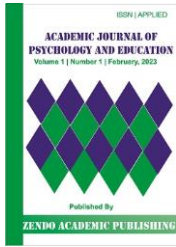
The authors acknowledge no conflict of interest.

Ethical standards

All procedures conducted in this study were in accordance with the institutional research board (IRB).

Informed consent

All study participants provided informed consent prior to study enrollment, in accordance with the study protocol approved by the IRB.



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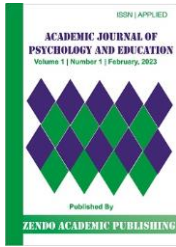
This research received no specific grant funding in the public, commercial, or not-for-profit sectors. This manuscript has not been submitted elsewhere and it has not been submitted simultaneously for publication elsewhere.

Data availability statement

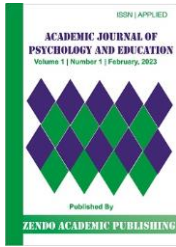
The data that support the findings of this study are available on reasonable request from the corresponding author.

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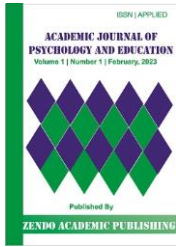
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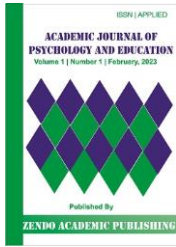
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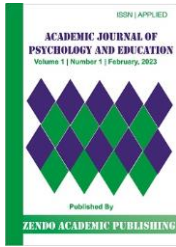
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