Journal of Learning Development in Higher Education ISSN: 1759-667X
Issue 31 September 2024

Basic psychological needs to online engagement and achievement among first-year undergraduates

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Abstract

Empirical research has largely focused on either identifying online learner characteristics or best practices to support online learning in higher education settings. Yet gaps remain in our empirical understanding of which and to what extent certain factors influence online learning. This exploratory study sought to corroborate the influence of three student-level variables in Basic Psychological Needs (BPNs) of autonomy, competence, and relatedness among students as they participate in online higher education coursework. This study conducted multiple regression modelling on 159 cases of first-year undergraduate students to determine the extent to which the three variables relate to engagement and achievement in online coursework. Results present preliminary empirical evidence that the basic psychological need for autonomy relates to achievement in online coursework. However, the other basic psychological needs of competence and relatedness did not clearly relate with either engagement or achievement. Results in part affirm the claim that efforts to drive student achievement in online higher education coursework ought to embed elements that support student autonomy. And results support a position of nuance where BPNs influence specific dimensions rather than all dimensions of online higher education learning as a catch-all construct.

Keywords: basic psychological needs; online instruction; student engagement; student achievement; higher education.

Introduction

Empirical research on online learning has largely focused on either identifying online learner characteristics or best practices which support online learning (Roddy et al. 2017; Martin et al., 2020). Student-level factors like time management skills, self-regulation, prior academic history, and technological fluency have been reported to link with greater levels of engagement and achievement in online coursework (Shroff et al., 2008; Artino and Stephens, 2009; Bradford and Wyatt, 2010; Dray et al., 2011; Broadbent, 2017). Structural factors like teacher presence, clear communication, and classroom community have been reported to link with greater levels of engagement and achievement in online coursework as well (Li and Beverly, 2008; Glazer and Murphy, 2015; Jiang, 2017). However, as noted by Martin et al. (2020) and Roddy et al. (2017), gaps remain in our empirical understanding of which, where, and to what extent certain factors influence effective online learning.

Basic psychological needs and link to learning

One factor that has yet to be fully considered is the Basic Psychological Needs (BPNs) of students as they participate in online higher education coursework. BPNs comprise one major premise of Ryan and Deci's (2017) Self-Determination Theory (SDT), which refers to an umbrella of sub-theories that account for why people start and maintain behaviours. BPNs refer to universal innate needs of autonomy, competence, and relatedness whose fulfilment belie the most complete expressions of any given human activity. *Autonomy* refers to the extent to which an individual perceives they have the choice to make decisions without coercion (Deci and Ryan, 1987; Ryan and Deci, 2017). Autonomy does not entail total disregard for any external pressure, nor does it speak to isolating oneself from any social relationship; instead, it speaks to the extent that a person perceives their behaviours as self-governed given such external pressure or social relationships. *Competence* refers to the extent to which an individual perceives they have the knowledge/skills to act upon their choices with efficacy (Ryan and Deci, 2017; Ryan and Moller, 2017). It speaks to an innate impulse to shape one's environments and to do so in a way that corresponds with one's intentions. It parallels the construct of *self-efficacy* as exemplified in the work of Bandura (1997), which refers to an individual's belief in their capacity to organise and implement action to produce desired achievement and results. *Relatedness* refers to the extent an individual perceives themselves as having meaningful

relationships and interactions with other people (Baumeister and Leary, 1995; Ryan and Deci, 2017). It conveys a fundamental desire to belong and mean something significant to other human beings.

A major claim behind SDT is that as much as humans need prerequisite physical nutrients like water and vitamins to function, humans also need prerequisite psychological nutrients in BPNs to flourish. This claim has been affirmed by ample empirical research which has reported that satisfaction of BPNs corresponds with optimal and enduring expression across myriad human activities – including work, recreation, and learning (Niemiec et al., 2009; Jang et al., 2016; Ryan and Deci, 2017; Carmona-Halty et al., 2019). Students' sense of having more rather than less autonomy, competence (self-efficacy), and instructor/peer relationship quality in coursework has been consistently reported to predict greater engagement and greater achievement across different subject domains, education levels, and cultural contexts (Black and Deci, 2000; Furrer and Skinner, 2003; Sheldon and Filak, 2008; Roorda et al., 2011; Jang et al., 2012; Wang and Eccles, 2013; Chen et al., 2015; Jeno et al., 2018; Wang, Y. et al., 2019; Zhou et al., 2021; Buzzai, et al., 2022; Conesa et al., 2022).

The underlying mechanism that drives this relationship is that greater general satisfaction of BPNs fosters the likelihood of autonomously-regulated motivations like intrinsic motivation (interest/enjoyment) over controlled motivations like external regulation (physical reward/punishment) for human activities like the learning process (Ryan and Deci, 2017; 2020). In turn, autonomously-regulated motivations have been extensively corroborated as a central factor to students who start and stay with instruction – despite challenges and setbacks – towards fluency and mastery (Ryan and Deci, 2017; 2020). This underlying mechanism affirms conceptual intuition because we cannot expect students to engage the learning process towards fluency or mastery when they approach it from a pervasive sense of compulsion (lack of choice), inefficacy (lack of knowledge/skills), or isolation (lack of social stakes).

Empirical gap between basic psychological needs and online learning

Yet despite substantial evidence, relatively few empirical studies have explicitly considered each discrete BPN as defined through SDT in the context of online learning in higher education. Notably, Chen and Jang (2010) conducted a pioneering study, 'Motivation in

online learning: testing a model of Self-Determination Theory', which considered the extent to which BPNs relate with online coursework engagement and achievement. They examined 267 students enrolled in an online teaching certificate programme spread over 7 semesters to determine the extent that satisfaction of BPNs predicted coursework engagement, which was measured by module access counts and self-report to number of hours studied, and coursework achievement, which was measured by perceived learning, expected final grade, and actual final grade. They reported that satisfaction of BPNs positively related with coursework engagement. In contrast, they reported that satisfaction of BPNs only positively related with expected final grade.

Hsu et al. (2019) sought to verify such findings by conducting a study that examined undergraduate students who were enrolled across different online courses. As with the Chen and Jang (2010) study, Hsu et al. (2019) sought to examine the extent that BPNs related to online coursework engagement, as measured by self-report of more autonomously-regulated motivations for learning, and online coursework achievement, as measured by self-report of expected knowledge transfer, self-report of learning gains, and end-of-term grades. They reported that all BPNs positively related to online coursework engagement and achievement across all three measures with varying degrees of influence. Around the same time, Wang, C. et al. (2019) conducted concurrent studies that sought to determine the extent that satisfaction with one BPN related to satisfaction in other BPNs among university students who were enrolled in just online coursework; and to determine if BPN satisfaction at all related to achievement which was measured by perceived knowledge transfer and final grades among university students enrolled in both online and face-to-face coursework. Among other findings, they reported that each discrete BPN related to each other in the first study and found that BPN satisfaction related with perceived knowledge transfer but did not relate with final grades.

However, the above studies reported several methodological issues that confounded estimates and impeded inferences to generalisability. First, the studies used contestable constructs. All three studies collected self-reports at the end of an academic semester to measure online coursework behaviours and achievement. In highlight, Chen and Jang (2010) adopted student self-reports to time spent on the course as a proxy for engagement which intuitively heightened the risk of inflated estimates. The study examined the number of times a student accessed any part of the online course (i.e. 'hits') as a measure for engagement. This presented the implication that opening any part of the online course –

including checking for one's grades – corresponded to an involved level of cognitive engagement as valued by higher education instructors. Additionally, all three studies used a single combined score to examine relationships. In highlight, Hsu et al. (2019) and Wang, C. et al. (2019) used the single combined score of BPN satisfaction (the sum of satisfaction in autonomy, competence, and relatedness) to predict learning outcomes instead of examining how separate scores to each form of BPN satisfaction may uniquely relate to learning outcomes. The issue with single combined scores is that they distort or mask the unique influence of each form. It may be the case that any significant estimates corresponded to the outsized influence of satisfaction of just a single BPN (e.g. autonomy) or satisfaction to some pair of BPNs (e.g. autonomy and competence) rather than satisfaction of all three BPNs.

Second, the studies neither addressed nor controlled for confounding factors to their target samples (e.g. student demographics and learning contexts) which may influence relationships to online behaviours and achievement. In highlight, Wang, C. et al. (2019) noted that their student sample participated in an online programme which takes several consecutive semesters to finish and that their student sample were enrolled in different courses taught by different instructors. On top of suggesting then that online instructional experience was not comparable among their student sample (enrolment in different courses set to different standards taught by different instructors), the students may have been at different milestones along the online programme which would suggest different levels of experience with online coursework. Essentially, the study did not address confounding factors of (a) content novelty/difficulty behind each discrete course and (b) prior familiarity with navigating online coursework which could bias estimates to relationships.

The lack of more robust research is problematic because if online learning is influenced by basic psychological needs as much as in-person learning, we do not yet have accurate estimates of the shape or scope of such influence. This lack of understanding of such influence is even more problematic as the Covid pandemic prompted Higher Education Institutions (HEIs) to rapidly translate face-to-face coursework to online delivery, while also accommodating widespread stress/trauma among students as they managed disruptions and loss (Aguilera-Hermida, 2020; Blum, 2020, UNESCO, 2020). Consequently, HEIs may be wrongly expecting students to engage in optimal and enduring learning from low to empty levels of BPNs.

Purpose of study and research questions

The present exploratory study seeks to add to the empirical literature by addressing the lack of research that considers the relation between basic psychological needs satisfaction and online coursework engagement and online coursework achievement among first-year university students. To address the gap, the present exploratory study asked the following research questions:

Question 1. After controlling for select student-level characteristics, to what extent do general satisfaction of (a) autonomy, (b) competence, and (c) relatedness discretely relate with online coursework engagement as measured by *quality class reflection submissions*?

Question 2. After controlling for select student-level characteristics, to what extent do general satisfaction of (a) autonomy, (b) competence, and (c) relatedness discretely relate with online coursework achievement as measured by *midterm exam scores*?

Method

Study design and sample characteristics

A descriptive correlational survey design guided this exploratory study in data collection, analysis, and interpretation of results (Darlington and Hayes, 2017). The study protocol and informed consent procedure were given ethical approval by the authors' Institutional Review Board (IRB) as exempt research. The authors prepared an online Qualtrics survey, which prompted participants to note demographic characteristics and answer questions derived from an empirically validated measure of basic psychological needs. The online survey was distributed as a web link in an online learning management system module. This exploratory study adopted convenience sampling in soliciting four consecutive cohorts of first-year undergraduate students enrolled in the same online-asynchronous introductory education course offered across four consecutive semesters. Students were notified when the survey started and stayed open the first week of each semester. Table 1 presents participant characteristics from the final analytic sample. Responses drew from students living in the Upper Midwest United States. The final analytic sample totalled n=159 first-

year undergraduate students. Post hoc power analysis determined that the sample size yielded a power level of β=0.805. This sample met education research conventions for multiple regression analysis in detecting small-moderate relationships (effect size $f^2 = 0.10$ or r^2=0.09) set to $\alpha = 0.05$ given discrete regression models with 8 predictor and control variables at maximum (Faul et al., 2007; Ellis, 2010). Essentially, any significant small-moderate relationships would reflect true relationships 80.5% of the time.

Table 1. Sample characteristics.

	n (x̄)	% (SD)
Participant Age	20.36	3.46
First Generation College		
Yes	29	18.2
No	130	81.8
Disability Status		
Yes	18	11.3
No	141	88.7
Person of Colour		
Yes	20	12.5
No	139	87.5
Female, Transgender, or Non-Binary		
Yes	140	87.5
No	19	12.5
LGBQA		
Yes	28	17.6
No	131	82.4
Home Neighborhood Median Household Income (in US Dollars)	66118.33	17719.91

Note. *N*=159.

Replication and extension

The present study design replicates and extends Chen and Jang's (2010) study on the relationship between BPNs to online course engagement and achievement by addressing the above methodological issues. First, this study sampled first-year university students who were enrolled in the same introductory education course taught by the same instructor with the same assignments over the same content over the same timeline. Doing so was

anticipated to capture a more accurate general snapshot of BPNs satisfaction, online engagement, and online achievement by (a) reducing the confounding influence of idiosyncratic instruction and (b) reducing the confounding influence of dissimilar familiarity/experience with online college coursework. Second, this study measured online engagement as assignment submission quality. This was anticipated to better capture the operational construct of online engagement beyond platform access to instead task completion and cognitive effort. Third, this study measured overall online engagement and achievement to student coursework in weekly assignments and midterm score rather than student self-reports on extent of overall engagement and achievement. This was anticipated to check the innate risk of inflated estimates in post hoc self-reports.

Fourth, this study examined midterm scores rather than final course grades to represent overall achievement. Midterm scores were anticipated to serve as a more focused tighter proxy for achievement because they corresponded to a single assignment/task with the same structure and same evaluation metrics, whereas final course grades serve as aggregate markers to many different types of assignments/tasks with different evaluation metrics and in turn invite the influence of assignment variation as a potential confounding factor. Additionally, the nature of final grades as aggregate marker to end of semester coursework invites greater risk of potential confounding factors in a student's life which could influence final grade scores. Furthermore, midterm scores have been found to be reliable predictors to overall achievement as measured by final course grades (Jensen and Barron, 2014).

Target variable: basic psychological needs

This study focused on three variables. The first variable was the construct of basic psychological needs as measured by the well-established *Basic Psychological Needs Scale in General* (BNSG) (Deci and Ryan, 2000; Gagné, 2003; Johnston and Finney, 2010). The scale prompts participants to consider the extent of autonomy, competence, and relatedness in daily life as they answered questions based on a 7-point Likert scale where 1=not at all true and 7=very true. One item prompts participants to rate: 'Most days, I feel a sense of accomplishment from what I do'. The BNSG was administered on the first week of each new semester. Doing so was anticipated to capture a more stable profile of students' BPNs before coursework demands increase, which may shift students' BPNs.

Target variable: academic engagement

The second variable was academic engagement as measured by online coursework quality from Week 1-Week 5 of each semester. Coursework submissions comprised *Class Reflections* where students noted (a) what was a new concept/idea from the current week; (b) what was a confusing concept/idea from the current week; and (c) what parts of instruction worked/did not work for the student from the current week over the course of five consecutive weeks. As further described in the codebook protocol (see Appendix A), this study defined online coursework quality to mean the extent that *Class Reflections* conveyed either *superficial writing* (coded as 0) or *involved writing* (coded as 1) in content and structure over the course of five consecutive weeks. The highest possible score for class reflection quality then was 5/5 points. The rationale for the Week 5 cut off stemmed from the authors' institutional policy of conducting progress checks at Week 6 each semester. Progress checks flag students who are underperforming or considered at-risk of failing. Faculty members then contact flagged students as outreach to address their current academic trajectory. This check-in with support and encouragement was anticipated to confound the discrete relationship between students' BPNs at the start of a semester and academic engagement.

Target variable: academic achievement

The third variable was academic achievement as measured by midterm scores at Week 8 for each semester. The rationale for midterms rather than final exams is that they serve as predictors of the overall end of coursework achievement (Jensen and Barron, 2014). Furthermore, midterms, by virtue of being in the middle of the semester, were anticipated to capture academic achievement better before potential confounding effects such as illness, fatigue, or personal emergencies manifest as a semester unfolded. The midterm was open-note and weeklong where students may save and resume at any point. The midterm prompted students to draft short answers to the same five questions that asked for definitions and examples around a single course concept. One question asked: 'What does family characteristics mean? And how would family characteristics affect support of a child with a disability? Give an example to illustrate your points'. The midterm also prompted students to draft a short essay to the same question that asked students to synthesise several course concepts and support a position. Specifically, 'Describe and

explain how the concept of Free and Appropriate Public Education (FAPE) changed over the five reviewed landmark court cases. How did each court case build, clarify, or extend the concept of FAPE? And how much would you agree or disagree that society has achieved FAPE?'. As with the class reflections, midterm submissions entailed review of raw qualitative data to generate a scale score between 0-30 points. Adopting a codebook to review the midterm was deemed unfeasible because *achievement* in this context corresponded to accurate answers – independent of superficiality or involvement – which could only be verified by one of the raters as the content expert.

Control variables: student-level characteristics

The online survey also prompted students to disclose common student-level characteristics of (a) age, (b) first-generation university student status, (c) disability status, (d) race/ethnicity, (e) gender identity, (f) sexual orientation, and (g) zipcode to primary hometown to identify neighbourhood median household income levels. Prior empirical research has reported that these student-level characteristics moderate the extent of engagement and achievement with higher education coursework (Kuh et al., 2006; Rizvi et al., 2019). Therefore, the authors included student-level variables to better isolate relationships between the target variables of interest by controlling for confounding extraneous factors. Race/ethnicity, gender identity, and sexual orientation were initially recorded as nominal variables with multiple categories (e.g. race/ethnicity covered eight categories). However, in preparation for regression analysis and in recognition that those multiple categories yielded low numbers of corresponding cases, the authors condensed those categorical variables into dichotomous values which were anticipated to preserve statistical assumptions while still accounting for minoritised backgrounds (e.g. person of colour).

Data analysis

Coding process and codebook criteria

Given that class reflection submissions amounted to raw qualitative data, the authors transformed class reflection submissions into ordinal values in preparation for analysis. Quantitative Content Analysis (Quant-CA) as described by Neuendorf (2017) guided our

approach to examine each class reflection submission as a standalone message unit and then assign a numerical code which represents the extent that each class reflection submission matched a conceptual pattern. These ordinal values in turn permitted descriptive and inferential analyses. Furthermore, Quant-CA prompts researchers to prepare a codebook with *a priori* codes to test for the presence of conceptual patterns rather than affirm conceptual patterns after the fact. Therefore, the authors prepared a codebook protocol (see Appendix A) that explained and justified assignment criteria for each numerical code.

Two rounds of reliability checks were conducted. Author 1 and Author 2 were assigned to code a randomised sample comprised of ~10% (17 cases) of all eligible class reflection submissions in the first week of Semester A. Both authors convened to review and resolve discrepancies and were again assigned to code a randomised sample of ~10% (17 cases) of all eligible class reflection submissions in the second week of Semester B. Research convention has identified review of at minimum 10% of cases for quantitative content analysis (Neuendorf, 2017). Author 2 shared their coded sample with Author 1 to calculate interrater reliability for both rounds. Cohen's fixed kappa value yielded 0.86 and 0.82 respectively, which conveyed strong interrater agreement. Author 1 then proceeded to screen all eligible submissions with the vetted codebook criteria (see Appendix B for example submissions).

Inferential statistics

This study used multiple regression modelling to determine the extent that individual observations across predictor variables form a clear linear relationship to a continuous outcome (Darlington and Hayes, 2017). Specifically, target predictor variables in satisfaction of autonomy, competence, and relatedness were fitted to regression models to predict the continuous outcomes of online coursework engagement and achievement. Collected data was verified to meet multiple regression assumptions before analysis. The authors reviewed visual plots to confirm homoscedasticity, and the authors reviewed tolerance and VIF values to gauge multicollinearity among the predictor variables and control variables. The three predictor variables reported strong correlations to each other (Autonomy-Competence, r=0.656; Autonomy-Relatedness, r=0.704; Competence-Relatedness, r=0.591). In recognition of potential confounding among the predictor variables, the authors conducted discrete regression models that examined predictor

variables standalone rather than conduct an omnibus regression model that simultaneously included all predictor variables. Each regression model included control variables to better isolate the discrete contribution of predictor variables on continuous outcomes.

Results

Table 2 presents descriptive statistics to the target variables and control variables. Cronbach's alpha for each BPN subscale (Autonomy, r=0.61; Competence, r=0.66; and Relatedness, r=0.75) met social science research conventions for sufficient inter-item reliability set to r=0.60 (Taber, 2018). Table 3 and Table 4 present statistics from multiple regression Models 1-6 that estimated the discrete influence of basic psychological needs satisfaction in autonomy, competence, and relatedness to quality class reflection submissions or midterm score. Significant estimates to target predictor variables were marked in bold to support reading clarity. Model fit was reported with F-values. Explanatory power was reported with both R^2 and Adjusted R^2 which respectively conveyed (a) the extent that all predictor variables account for variance in the outcome variables and (b) the extent that only statistically significant predictor variables account for variance in the outcome variables.

Table 2. Descriptive statistics.

	Mean	SD	QCRS	MS	BPN-A	BPN-C	BPN-R	AGE	FGC	DS	POC	FTNB	LGBTQIA
QETS	2.80	1.75	—										
MS	21.39	9.85	0.47**	—									
BPN-A	5.01	0.78	0.07	0.14	0.61								
BPN-C	5.06	0.89	-0.03	0.03	0.65**	0.66							
BPN-R	5.66	0.81	0.13	0.11	0.70**	0.59**	0.75						
AGE	20.36	3.46	0.03	0.03	-0.04	0.06	-0.10	—					
FGC	0.18	0.38	0.04	0.00	-0.03	-0.02	-0.00	0.08	—				

DS	0.11	0.31	-0.41	-0.03	-0.25**	-0.12	-0.16*	-0.09	-0.06	—			
POC	0.13	0.33	-0.09	-0.14	-0.04	-0.00	0.01	0.09	0.16	0.10	—		
FTNB	0.88	0.32	-0.12	-0.13	-0.07	-0.06	-0.10	-0.28**	0.07	0.07	0.02	—	
LGBTQIA	0.18	0.38	-0.11	-0.09	-0.17*	-0.21**	-0.15	-0.06	0.03	0.14	0.74	0.01	—
HNMHI	66118.33	17719.91	-0.09	-0.13	0.13	0.15	0.87	0.09	0.10	-0.05	0.10	-0.00	-0.07

Note. Cronbach's alphas for inter-item reliability in diagonal; QCRS=Quality Class Reflection Submissions; MS=Midterm Scores; BPN-A=Basic Psychological Need of Autonomy; BPN-C=Basic Psychological Need of Competence; BPN-R=Basic Psychological Need of Relatedness; AGE=age; FGC=First Generation College; DS=Disability Status; POC=Person of Colour; FTNB=Female, Transgender, or Non-Binary; LGBQA=Lesbian, Gay, Questioning, or Asexual; HNMHI=Home Neighborhood Median Household Income
*=$p \leq 0.05$
**=$p \leq 0.01$

The regression models yielded several patterns. First, the regression models overall reported that the target variables and control variables together did not explain any statistically significant variance in both quality class reflection submissions and midterm scores. The one exception occurred in Model 4 which reported that the entire model with all its terms explained a substantial portion (R^2=0.10 or 10%) of the variation in midterm scores and that just the statistically significant terms of BPN-autonomy and gender identity explained a non-trivial portion (R^2=0.05 or 5%) of the variation in midterm scores. Second, after controlling for student-level characteristics, Model 4 generated a statistically significant positive relationship (unstandardised β=2.187) between BPN-autonomy and midterm scores. Essentially, for every 1 unit increase in BPN-autonomy, midterm scores increased by 2.187 points. The confidence interval estimated the relationship to exist between unstandardised β values of 0.16 to 4.20. Consequently, the interval range points to – at minimum – a positive relationship rather than an ambiguous or negative relationship.

Table 3. Unstandardised and standardised Beta coefficients on quality class reflection submissions.

	B	95% CI for B		SE	β	R^2/Adjusted R^2	Tolerance	VIF
	`	LL	UL					
Model 1						0.07/0.02		
Constant	0.02	-2.98	3.02	1.52				
BPN-A	0.30	-0.06	0.66	0.18	0.13		0.89	1.11
AGE	0.04	-0.03	0.13	0.04	0.98		0.87	1.14
FGC	0.25	-0.47	0.97	0.36	0.05		0.93	1.06
DS	0.25	-0.65	1.15	0.45	0.04		0.89	1.12
POC	-0.62	-1.46	0.21	0.42	-0.11		0.94	1.06
FTNB	0.83	-0.05	1.72	0.44	0.15		0.89	1.12
LGBTQIA	0.64	-0.09	1.38	0.37	0.14		0.94	1.06
HNMHI	-8.7e-6	0.00	0.00	0.00	-0.08		0.95	1.04
Model 2						0.05/0.00		
Constant	1.46	-1.28	4.22	1.39				
BPN-C	0.02	-0.29	0.34	0.16	0.01		0.91	1.08
AGE	0.04	-0.03	0.13	0.04	0.09		0.87	1.14
FGC	0.23	-0.50	0.96	0.37	0.05		0.93	1.06
DS	0.09	-0.80	0.99	0.45	0.01		0.92	1.07
POC	-0.63	-1.48	0.21	0.43	-0.12		0.94	1.06
FTNB	0.78	-0.10	1.67	0.45	0.14		0.89	1.11
LGBTQIA	0.57	-0.17	1.31	0.37	0.12		0.92	1.08
HNMHI	-7.37e-6	0.00	0.00	0.00	-0.07		0.95	1.05
Model 3						0.09/0.04		
Constant	-0.89	-3.96	2.17	1.55				
BPN-R	0.41	0.07	0.75	0.17	0.19		0.94	1.06
AGE	0.50	-0.03	0.13	0.04	0.09		0.87	1.14
FGC	0.23	-0.48	0.95	0.36	0.05		0.93	1.06
DS	0.23	-0.65	1.11	0.44	0.04		0.92	1.08
POC	-0.67	-1.51	0.16	0.42	-0.12		0.94	1.06
FTNB	0.89*	0.11	1.77	0.44	0.16*		0.88	1.12
LGBTQIA	0.67	-0.05	1.40	0.36	0.14		0.94	1.06
HNMHI	-8.48e-6	0.00	0.00	0.00	-0.08		0.96	1.03

Note. SE=Standard Errors; VIF=Variance Inflation Factor; BPN-A=Basic Psychological Need of Autonomy; BPN-C=Basic Psychological Need of Competency; BPN-R=Basic Psychological Need of Relatedness; AGE=age; FGC=First Generation College; DS=Disability Status; POC=Person of Colour; FTNB=Female, Non-Binary, or Transgender; LGBTQIA=Lesbian, Gay, Transexual, Questioning, Intersex, or Asexual; HNMHI=Home Neighborhood Median Household Income
*=$p \leq 0.05$
**=$p \leq 0.01$
Model 1: $F(8, 158)=1.48$, $p=0.16$
Model 2: $F(8, 158)=1.13$, $p=0.34$
Model 3: $F(8, 158)=1.90$, $p=0.06$

Table 4. Unstandardised and standardised Beta coefficients on midterm scores.

	B	95% CI for B		SE	β	R^2/Adjusted R^2	Tolerance	VIF
	`	LL	UL					
Model 4						**0.10/0.05***		
Constant	5.93	-10.68	22.55	8.41				
BPN-A	**2.18***	**0.16**	**4.20**	**1.02**	**0.17***		**0.89**	**1.11**
AGE	0.29	-0.17	0.75	0.23	0.10		0.87	1.14
FGC	0.74	-3.27	4.76	2.03	0.02		0.93	1.06
DS	0.24	-4.77	5.26	2.54	0.00		0.89	1.12
POC	-4.05	-8.72	0.61	2.36	-0.13		0.94	1.06
FTNB	5.53*	0.62	10.43	2.48	0.18*		0.89	1.12
LGBTQIA	-1.53	-5.59	2.53	2.05	-0.05		0.94	1.06
HNMHI	-8.5e-5	0.00	0.00	0.00	-0.15		0.95	1.04
						0.07/0.02		
Model 5								
Constant	15.39	0.05	29.73	7.76	0.89			
BPN-C	0.41	-1.35	2.19	0.89	0.03		0.91	1.08
AGE	0.25	-0.21	0.73	0.23	0.09		0.87	1.14
FGC	0.60	-3.47	4.67	2.06	0.02		0.92	1.06
DS	-0.84	-5.83	4.13	2.52	-0.02		0.92	1.07
POC	-4.12	0.23	10.16	2.39	-0.13		0.94	1.06
FTNB	5.20*	0.23	10.16	2.51	0.17*		0.89	1.11
LGBTQIA	-1.96	-6.12	2.19	2.10	-0.07		0.92	1.08
HNMHI	-7.75e-5	0.00	0.00	0.00	-0.13		0.95	1.05
						0.09/0.04		
Model 6								
Constant	7.13	-10.12	24.39	8.73				
BPN-R	1.70	-0.20	3.60	0.96	0.14		0.94	1.06
AGE	0.28	-0.18	0.74	0.23	0.09		0.87	1.14
FGC	0.60	-3.43	4.63	2.04	0.02		0.93	1.06
DS	-0.36	-5.32	4.60	2.51	-0.01		0.92	1.08
POC	-4.28	-8.97	0.41	2.375	-0.14		0.94	1.06
FTNB	5.59	0.65	10.53	2.50	0.18		0.88	1.12
LGBTQIA	-1.67	-5.75	2.40	2.06	-0.06		0.94	1.06
HNMHI	-7.98e-5	0.00	0.00	0.00	-0.14		0.96	1.03

Note. SE=Standard Errors; VIF=Variance Inflation Factor; BPN-A=Basic Psychological Need of Autonomy; BPN-C=Basic Psychological Need of Competency; BPN-R=Basic Psychological Need of Relatedness; AGE=age; FGC=First Generation College;

DS=Disability Status; POC=Person of Colour; FTNB=Female, Non-Binary, or Transgender; LGBTQIA=Lesbian, Gay, Transexual, Questioning, Intersex, or Asexual; HNMHI=Home Neighborhood Median Household Income
*=p ≤ 0.05
**=p ≤ 0.01
Model 4: F(8, 158)=2.12, p=0.03
Model 5: F(8, 158)=1.53, p=0.14
Model 6: F(8, 158)=1.92, p=0.06

Conclusion

Empirical research has focused on either identifying online learner characteristics or best practices to support online learning. Yet gaps remain in our empirical understanding of which, where, and to what extent certain factors influence online learning. This exploratory study seeks to contribute to research literature by considering the relationship between basic psychological needs to online coursework engagement and achievement.

Empirical inferences

Several empirical inferences emerge from the results. With respect to the first alternative and null hypotheses, the main relationship results overall conveyed that after controlling for select student characteristics, students' general BPN satisfaction was not associated with online coursework engagement as measured by quality class reflection submissions. With respect to the second alternative and null hypotheses, main relationship results partly conveyed that after controlling for select student characteristics, students' general BPN satisfaction was not associated with online coursework achievement as measured by midterm scores. Yet, there emerged one exception where the basic psychological needs of autonomy were positively associated with midterm scores. Results then present a nuanced portrait of the typical student enrolled in online higher education coursework where their general satisfaction of basic psychological needs appears to have a fragmented influence on online engagement and achievement up to mid-semester. That typical student may express little general satisfaction in autonomy, competence, and relatedness, but yet still submit quality coursework week-by-week. That typical student may express little general satisfaction in competence and relatedness, but yet still ace exams. However, that same

typical student expressing little general satisfaction in autonomy would have lower scores on exams.

Limitations

This study examined the extent that basic psychological needs of autonomy, competence, and relatedness influence online coursework engagement and online coursework achievement. It defined online coursework engagement as the number of quality class reflections submitted; and it defined online achievement as midterm scores. It presents empirical evidence that the one basic psychological need of autonomy conspicuously influences one form of online achievement. And with nuance, the study also presents empirical evidence that basic psychological needs do not unconditionally influence all facets of online engagement or online achievement. However, this study has three major limitations. First, there exists an inherent risk of bias/error with interpreting qualitative data and then translating qualitative data to quantitative form. This study drafted and vetted a codebook protocol with repeat reliability checks to uphold validity and reliability in such interpretation and translations, but the risk of bias/error remains.

Second, the regional sample size – while sufficient in statistical power to support claims to small-moderate estimates for similar student populations – would not count as representative enough nor large enough to reflect the greater diversity of online learners across the nation. It may be the case that online learners across regions report varying ratios to demographic backgrounds which could have ushered more and/or less influence to estimates. Study findings warrant follow-up with a larger and more nationally representative sample. Furthermore, as noted with relatedness approaching statistical significance, a larger and more representative sample may better capture relationships that were missed in this initial analysis.

Third, the study omitted analysis of hierarchical variables at the classroom-, university-, and neighbourhood-levels to account for confounding variables. As with individual backgrounds, it may be the case that the proximal and distal environments which surround the online student present a host of factors (aversive, supportive, and in-between) that increase or diminish the influence of BPNs. With these limitations, study findings do not serve as the definitive comment on the relationship between BPNs to online coursework engagement and achievement. However, study findings do support continued research to

determine where, when, and to what extent BPNs matter in online higher education coursework.

Implications for theory and practice

The results overall buck conceptual intuition and prior empirical findings which have reported clear positive relationships between satisfaction of BPNs to learning processes and outcomes in both face-to-face and online environments (Reeve et al., 2004; Roorda et al., 2011; Buhr et al., 2019; Hsu et al., 2019; Núñez and León, 2019; Müller et al. 2021; Chiu, 2022). With respect to Chen and Jang's (2010), Hsu et al.'s (2019) and Wang, C. et al.'s (2019) studies which reported that BPNs related to online coursework engagement (as measured by self-report of hours studied) and coursework achievement (as measured by expected final grade), this study found that BPNs overall did not relate with coursework engagement (as measured by quality class reflection submissions over several weeks). The standalone influence of autonomy satisfaction on midterm scores however does affirm prior empirical findings which found autonomy as the most influential BPN to achievement across learning environments (Reeve and Cheon, 2021).

In turn, findings generate the nuanced inference where BPNs may influence specific dimensions rather than all dimensions of online higher education learning as a catch-all construct. This is a reasonable claim given that prior empirical studies measured and operationalised the link between BPN satisfaction to learning processes and outcomes across myriad forms and settings (Conesa et al. 2022). Engagement has been partly defined as interest in math activity following presentation of math exercises with different tiers of difficulty (Baten et al., 2020); as student self-report on study habits (Pitzer and Skinner, 2017); and as classroom observations to on-task learning behaviours (Oga-Baldwin et al., 2017). Achievement has been partly defined as reading comprehension level (Marshik et al., 2017); as final grades in courses (Hsu et al., 2019; Zhou et al., 2021); and as general factual knowledge (Gorissen et al., 2015). Furthermore, this is a reasonable claim that finds resonance in recent studies like Chanal and Guay's (2015) and Paumier and Chanal's (2022) which examined the related construct of motivation and found that autonomously-regulated motivations like intrinsic motivation – but not controlled motivations – exuded distinct influence on specific academic subjects. Essentially, if we were to use the analogy of gazing at a piece tapestry from afar, the many discrete studies coalesce to generate a broad green colour/pattern of agreement that BPN satisfaction

appears to matter with online learning. Yet as we approach the tapestry and review each discrete study, we notice discrete threads of white, blues, or yellows that intertwine with the green. Those contrary threads represent non-relationships in discrete studies, but do not detract from or wash away the greater emergent hue of a relationship among studies at aggregate.

With respect to practice in fostering achievement in online higher education instruction, findings affirm prior empirical commentary which have recommended design and implementation of coursework which embeds more opportunities for students to exercise autonomy (Reeve et al., 2004; Jang et al., 2012; Núñez and León, 2019). Reeve (2016) identified several characteristics that mark autonomy-supporting learning environments in contrast to autonomy-thwarting learning environments: chiefly such environments (a) consider student perspective and life context; (b) anchor coursework from more internally-motivating stakes; and (c) permit flexibility in how to engage with coursework. Essentially, results suggest that the typical online student, assuming all other factors as equal, would more likely succeed in online coursework that presents parallel options to demonstrate subject competence; allows for flexibility to participate in activities solo, partner, or as group member; and grants automatic freebies that cover missing/late assignment submissions without hassle.

Acknowledgements

Both authors wish to thank Dr. Megan Breit-Goodwin, Dr. Catherine Ford, the 22'-23' SoTL Cohort of the Minnesota State Colleges and Universities System, and anonymous reviewers for carving time and thought to review the manuscript's scope and shape.

The authors did not use generative AI technologies in the creation of this manuscript.

Author contributions

Jed Locquiao: conceptualisation; methodology; software; data curation; formal analysis; validation; investigation; visualisation; writing – original draft; writing – review and editing; funding acquisition; project administration.
Abby Gronlund: conceptualisation; data curation; formal analysis; validation.

Data availability

Data available upon vetted request to ensure participant confidentiality.

Conflict of interest statement

This study does not serve the financial interest or benefit of the authors. No external organisation influenced the design, execution, interpretation, or reporting of the study.

Funding

This study was supported by a Scholarship of Teaching and Learning Grant through the Minnesota State Colleges and Universities System.

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Licence

Appendix A. Codebook protocol

Methodological framework

Quantitative content analysis as described by Neuendorf (2017). Researchers generated *a priori* codes that guided the coding phase in interpreting and transforming student responses into ordinal variables.

Case inclusion criteria for class reflection frequency counts, class reflection quality, and midterm score

- Student must have not withdrawn from class for inclusion.
- Student must have submitted initial survey at first week of semester for inclusion.
- For qualified cases mentioned above, not submitting midterms yielded a zero score.

WK 1-5 class reflection quality (before progress check-ins)

a priori-[N/A, Superficial, Involved]

N/A (0)=Class reflection **is missing or does not address all parts** of class reflection with pertinent weekly coursework content and instruction.

Superficial (1)=**all parts of the** class reflection comments upon pertinent weekly coursework content and instruction according to only Remember-Level activity as described in Bloom's Revised Taxonomy.

Involved (2)=**any part or all parts** of class reflection comments upon pertinent weekly coursework content and instruction according to Understand-Level through Create-Level activity as described in Bloom's Revised Taxonomy.

Note 1

In preparation for data analysis of class reflection quality, **N/A and Superficial codes were combined to code (0) and Involved is turned into single code (1).** Rationale is that not answering and mere repetition defeats point of exercise to actively consider and commit subject content to one's knowledge networks.

Note 2

Rationale to distinguish between [Superficial] and [Involved] comes from education psychology research which identified how deep engaged learning marked by accuracy, automaticity, and fluency derives from not merely memorising information but from actively transforming it to connect with one's background knowledge (Anderson & Krathwohl, 2001). Activity beyond Remember-Level suggests diligence in seeking to learn for conceptual mastery rather than to regurgitate items for grade points.

The major distinction between superficial submissions and involved submissions is that entries in the former category merely rephrased or repeated points presented in the course content. Superficial entries did not elaborate upon the course content by posing examples to ideas/concepts; did not explain why ideas/concepts were important; nor did they connect ideas/concepts to other coursework or related experiences. Furthermore, superficial entries posed recall questions whose answers were found directly in the course content instead of asking understanding, analysis, or evaluative questions that elaborated upon the course content.

Screening with two categories (instead of six categories) and screening for 'any part or all parts' invited charitable approach/latitude in defining what counts as superficial over involved coursework engagement. But it does account for the reality that students hold different readiness/proficiency levels in assigning meaning to subject content and when prompted to reflect upon their learning experiences. Student A may very well engage content at an understand level as they classify concepts with different examples; Student B may very well engage content at an analysis level in wondering how a single concept can manifest across different contexts; and Student C may very well be engaged with content an evaluative level with expressing appreciation over how an instructional exercise illustrated a major idea for a given week. All would amount to purposeful cognitive activity beyond rote recall.

Appendix B. Class reflection submission examples

NA or Superficial

(Submission Student-3547505, Semester 1-Week 3):

> Fresh idea: During week 3 I learned about the Endrew V Douglas case. Endrew was in SPED services through his school under ADHD and Autism. His parents noticed that his goals were the same every year. Then they moved him to a private school and he made significant progress. So his parents filed for reimbursement for tuition. That leads to what does public school services really do for the children. So, the court agreed that schools must design SPED services with reasonably goals and objectives.
> Muddy Idea: I don't understand what FAPE is, along with I don't know what IDEA stands for.
> What worked/didn't work: What worked for me was taking the court case step by step and describing the plaintiffs first and so on.

(Submission Student-3276115, Semester 2-Week 3):

> Fresh Idea: The least restrictive environment helps students with special needs adapt to their learning environment in the best possible way they can.
> Muddy Idea: How do you decide what learning environment a student can handle?
> What worked and what did not work: Taking notes and participating in the activities during the lecture really helps me stay focused and engaged and makes the lecture a bit more fun.

(Submission 3721553, Semester 3-Week 3):

> Fresh Idea: One fresh idea from this section was that SPED is still young. It's not this idea that has been around forever, and we are still figuring it out. Special Education is forever evolving to better students with disabilities. Students with disabilities learn in the general education setting first and if that is not possible then they must learn in a setting closest to the general education setting. Each students learning arrangement may look different, everyone has different needs.
> Muddy Idea: One muddy idea I had from this section was the full inclusion of mid-1990s slide. It states that all students no matter their abilities are to be taught in general education classrooms but then also SPED must be eliminated in some instances. I am confused on why they would want to take away special education. It seems that they have the students' best interest in mind because they want them in the general education classes. However, everyone is different, and some students may not learn best in the general education classrooms.
> What worked/what did not work: [Blank Section]

Involved

(Submission 3071212, Semester 1-Week 3):

> Fresh Idea: Until today I did not know much about the Endrew versus Douglas case. However, I completely understood taking Endrew to a private school where they served just students with autism. It clearly benefited Endrew by being there where he made significant academic and behavioral gains from being at the new school. I didn't even know that we as people could hypothetically even take schools to court to pay for tuition for going to another school based on the fact that they did not meet the students needs based on their IEP's. I thought it was interesting how that court case went overall. I understood the parent's frustration but, personally I don't know if I would have made the school pay for the tuition.
> Muddy Idea: I mainly understand the least restrictive environment (LRE) and I agree with how first we should see how students with disabilities adapt and learn in those current environments. However, I think that sometimes like in the Endrew case if the student learns better at a private school where they focus on students with only autism would they not benefit more from being there versus in a public general education setting? I am not saying always it is one hundred percent up to the parents discretion. But, not all schools offer or have the personnel to accommodate to the needs of some students and then those students don't advance at the same rate as the other students. I get this from the personal view of the last school I worked at just this year in fargo where the school did not have personal paraprofessionals and it was very obvious to see that some students would have benefited from them being there but, they were not available.
> What did and Didn't work: I thought you did very well throughout the last few lectures personally. I have noticed that you talk slower and the PowerPoints are more thorough along with you being plenty informative on the topics especially with the examples. Overall, I think this all is going very well. Other than the group project it is hard to communicate with peers that do not reply very well if at all.

(Submission 3279242, Semester 2-Week 3):

> Fresh Idea: My fresh idea for this week is the Endrew v Douglas School District (2017) case. Even though it happened recently, I had never heard of it before, even though I had heard about some of the other cases. It really made me think about the "bare minimum" of Special Education. It is also something for me to keep in mind as a future educator. Just because a child is making minor improvements, does not mean that that can be the best that they do. Some improvements do not always mean that something is working. When planning an IEP in the future I want to always keep this in mind. I want to keep in mind that yes, small improvements are still improvements, however that does not mean that there is not a better way to go about things in order to make more improvements. We can always do better.
> Muddy Idea: A muddy idea I had this week has to do with intense instruction and integration. I feel like with the No Child Left Behind act that it is a common thought to want to include children with disabilities into the general classroom as much as possible. However, what if that certain child learns best when they can have more intense instruction with a one-on-one type setting which happens to be away from the classroom? What if a child has a disability, such as Autism or social anxiety, and they do not do well in groups larger than two or three? Are these types of scenarios where developmentally appropriate practices come into play

> when deciding how to go about certain children with disabilities? Is there a way for a child to still be included in the classroom when they learn and do better in a different setting under intense instruction?
> What worked and what did not work? What worked well for me this week were the Jigsaw presentations on the different court cases! I felt like this was a great way to work together to help further our learning. Creating my own PowerPoint and researching my case helped me learn a lot about that case as well. I also like how the presentations were designed to "cut right to the point" and helped me have a clear learning experience. I would say that I learn best when using more "simple" learning practices. What did not work well for me were the full inclusion arguments. I felt like the wording was a little confusing and that I could not tell which arguments were for or against as clearly.

(Submission 3071264, Semester 3-Week 3):

> Fresh Idea: One fresh idea that I had from this section of notes had to do with all of the back and forth happening in history in regard to needing SPED. I had no idea that at one point in time after many parents and families fought so hard to get SPED, it was then under an attempt to become abolished. I can understand both sides of the Full Inclusion argument, however I seem to side with the argument against Full Inclusion.
> Muddy Idea: One thing that was muddy for me from this section of notes had to do with REI and how SWD were expected to fit into the classrooms, but the classrooms were not adapted to fit them and their own learning needs. It does not make sense to me that the classrooms were not adapted, granted it was known that these children had specific learning environments and learning needs.
> What worked and what didn't work: What really worked for me during this section of notes was thinking of my own line of work, specifically within the section of LRE. I work at an ABA clinic and LRE is something we discuss frequently. So, it helped me to understand by already having that background. What also really helped was seeing the LRE on a least to most restrictive scale and being able to envision what each of those would look like plus, I also have background within the school setting. One thing that didn't work for me was overall just trying to grapple in my mind the reasonings behind REI and Full Inclusion. I can see why, but also why not.