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How Demographics, Devices, and Course Characteristics Impact Introductory Psychology Course Outcomes during COVID-19

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Title (15 / 15 words):

How Demographics, Devices, and Course Characteristics Impact Introductory Psychology Course Outcomes during COVID-19

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Short Descriptive (50 / 50 words):

We explored factors predicting student learning outcomes ($N=1303$) in online Introductory Psychology sections at an open-enrollment college in the Northeastern United States in Fall 2020. Use of computers/laptops to complete assignments predicted higher pass rates and quiz grades. Scores on low-stakes quizzes tended to be higher in smaller class sections.

Summary (992 / 1000)

Study Purpose

The COVID-19 pandemic brought about rapid changes to higher education by abruptly increasing reliance on remote, online instruction (Adredoyin & Soykin, 2020; Ober et al., 2021). Although students, instructors, and institutions may have felt better prepared for online instruction by Fall 2020, challenges to student success remained. This study examined the extent to which digital access contributed to learning outcomes in an Introductory Psychology course taught at an open-enrollment public college in the Northeastern United States. We also explored how student demographics and features of course sections (e.g., class size, synchronous meetings) impacted retention and learning.

Theoretical Framework

Many factors may affect the quality of students' learning in online courses. Few large-scale studies have examined the effects of student-level (i.e., demographics and digital access) and course-level (e.g., class size, synchronous meetings) factors on student retention and learning outcomes during the COVID-19 pandemic. At the student-level, there is evidence of a disproportionately negative effect of COVID-19 on the educational experiences of Hispanic/Latinx and Black/African American students (Molock & Parchem, 2020). Additionally, the so-called "digital divide," wherein groups of individuals are systematically cut off from accessing and using digital technologies to the extent needed, can hinder students' ability to participate in online courses (Scheerder et al., 2017). Course characteristics, such as class size, may also moderate instructors' ability to support students' learning, though findings are mixed (Bettinger et al., 2017; Parks-Stamm et al., 2017).

Research Questions

We sought to address the following research question: To what extent are *student-level (demographics)*, *course-level factors (class size, synchronous meetings)*, and *students'*

use of a handheld device to submit assignments (i.e., smartphone/tablet vs. computer/laptop) associated with course outcomes (course withdrawal, pass/fail, quiz and test grades)?

Methodology

Course Section and Student Characteristics

For purposes of course outcomes assessment, data were collected from Introductory Psychology sections taught in Fall 2020. Students were enrolled in 22 sections of a 15-week fully online Introductory Psychology course, taught by 18 instructors at a non-selective Hispanic-serving public institution in the northeastern United States in Fall 2020. Course sections varied in enrollments (2 small sections < 30 students, $M = 27.19$, $SD = 3.87$; 14 regular sections ≤ 67 students, $M = 51.22$, $SD = 5.22$, 6 large sections with ≥ 119 students, $M = 130.88$, $SD = 6.54$) and number of synchronous meetings (range 0–2 per week, $M = 1.37$, $SD = 0.71$). (Note that all synchronous meetings occurred with cameras off for students at all times to preserve Internet bandwidth, as per institutional policy.) Half of the sections were taught by graduate student instructors, the other half by adjunct or full-time faculty; four instructors (two graduate students) each taught two sections. The research protocol was approved by the university Institutional Review Board and classified as exempt (Category 1: normal educational practices).

Analytic Sample

Of the 1549 students initially enrolled in the class, 246 students did not complete the first homework (HW1) and thus were missing measures reported in this paper. An additional 33 students officially withdrew from the course, leaving a sample of 1303. When these students were dropped, we had a final analytical sample of 1270 students.

Demographic information collected in HW1 was as follows: 843 students (64.7%) identified as female, 444 (34.1%) as male, 7 (0.5%) as another gender identity, with 9 (0.7%) preferring not to disclose. Students had a mean age of 19.23 years ($SD = 3.72$), range 16 to

51, including 74 (5.7%) who were 25 years of age or older. For the purposes of analysis, students' self-reported gender was dichotomously recoded as *1* for males and *0* for non-males, and students' age was dichotomously recoded such that students 25 years of age or older were recoded as *1* while students aged 24 years or younger were recoded as *0*. Most reported that they were in their first semester of college (990 students; 76.0%).

Students self-reported race/ethnicity using non-mutually exclusive codes as follows: White/European American ($n = 527$, 40.4%), Hispanic/Latinx/Chicanx/other Spanish origin ("Hispanic/Latinx"; $n = 337$, 25.79%), Black/African American ($n = 278$, 21.3%), Asian/Asian American ($n = 133$, 10.2%), Middle Eastern/North African ($n = 106$, 8.1%), American Indian/Alaska Native ($n = 14$, 1.1%), Native Hawaiian/Other Pacific Islander ($n = 5$, 0.4%), other ($n = 39$, 3.0%), prefer not to disclose ($n = 31$, 2.4%). Race / ethnicity variables were dichotomized for analysis such that *1* indicated self-reported group membership and *0* indicated non-membership. More than half ($n = 752$, 57.7%) reported speaking a language in addition to English at home. Students who spoke an additional language at home were recoded as *1*, while students who reported only speaking English were recoded as *0*.

Results

We examined pass rates, quiz, and homework grades using mixed-effects models, with a random effect of course section. Fixed effects for student characteristics, aspects of course sections, and devices used for assignments were entered in a block-wise manner. Tables 1-4 show the results of these analyses.

Of the 1303 students enrolled who completed HW1, 33 (2.5%) formally withdrew. Students who were older than 25 years of age were less likely to withdraw from the course ($\beta = -.28$, $z = -2.49$, $p = .025$; see Table 1)

Of the 1270 students who completed the course, 82.9% achieved passing grades. Black/African American ($\beta=.31, z=3.32, p=.001$), Hispanic/Latinx ($\beta=.32, z=3.73, p<.001$), and male ($\beta=.18, z=-2.32, p=.021$) students were more likely to fail the course than their peers (Table 2). Students who submitted the first online assignments with a computer/laptop ($\beta=-0.24, z=-3.67, p<.001$) were less likely to fail.

Both Black/African American (quiz: $\beta=-0.11, t=-3.17, p=.001$; test: $\beta=-0.15, t=-4.39, p<.001$) and Hispanic/Latinx (quiz: $\beta=-0.10, t=-3.28, p=.001$; test: $\beta=-0.09, t=-2.72, p=.007$) students performed worse on quizzes (Table 3) and tests (Table 4). Male students ($\beta=-0.10, t=-3.62, p<.001$) and those enrolled in large sections ($\beta=-0.12, t=-2.18, p=.046$) also tended to perform worse on the quizzes but not the tests. In addition, students who submitted the first assignment with a desktop/laptop computer tended to receive higher quiz scores ($\beta=0.07, t=2.59, p=.01$).

Conclusions

In Fall 2020, instructors, students, and institutions were still adapting to remote, online teaching while grappling with the ongoing pandemic. Hispanic/Latinx and Black/African American were more likely to struggle on critical course outcomes, perhaps reflecting the disproportionate impact of the COVID-19 pandemic on these communities (Molock & Parchem, 2020). Students who submitted more assignments on computers/laptops had better course outcomes. It is unclear whether students who used handheld devices made a deliberate choice to do so (Bomhold, 2013), or if they simply could not use another device due to family, work, or financial circumstances (Fox, 2016).

At the section-level, students in sections with lower enrollments had higher quiz scores than those in large sections. Students in larger sections may not have benefitted from interactions with teachers and peers to the same extent as students in smaller classes

(Bettinger et al., 2017; Biette & Thiele, 2016; Lin et al., 2019; Taft et al., 2011), and students may not have sought help to the extent needed (Lee, 2009; Orellana, 2009; Song et al., 2018). None of the other section-level variables explained variation in the course outcomes.

Educational Implications

These findings suggest that (1) certain students may already be at-risk at the beginning of the semester and may need additional supports; (2) students should be advised to use desktop/laptop computers to complete online coursework, when possible, and (3) smaller class sizes in online courses may promote optimal performance on low-stakes course outcomes.

Table 1. Predicting likelihood of withdrawing from the course (1=withdrew, 0=completed)

Variable	β	SE	z value	Pr(> z)	
Intercept	-3.671	0.364	-10.094	<.001	***
Gender (Male = 1)	0.203	0.175	1.163	0.245	
Age (>=25 = 1)	-0.279	0.124	-2.248	0.025	*
Race/Ethnicity: African American (=1)	0.081	0.213	0.379	0.705	
Race/Ethnicity: Hispanic/Latinx (=1)	0.185	0.202	0.919	0.358	
Race/Ethnicity: Asian American (=1)	0.118	0.196	0.602	0.547	
Race/Ethnicity: European American (=1)	-0.375	0.263	-1.428	0.153	
Language Background: Multi-lingual (=1)	-0.684	0.399	-1.713	0.087	
Instructor Status (Grad Student = 1)	0.130	0.265	0.491	0.624	
Enrollment Size (Large=1)	-0.112	0.273	-0.410	0.682	
Meetings per Week (0, 1, 2)	-0.016	0.241	-0.066	0.947	
HW 1 Submitted with Desktop/Laptop (=1)	0.128	0.215	0.595	0.552	

Table 2. Predicting likelihood of failing the course (1=fail, 0=pass)

Variable	β	SE	z value	Pr(> z)	
Intercept	-1.743	0.166	-10.489	0.000	***
Gender (Male = 1)	0.175	0.076	2.317	0.021	*
Age (>=25 = 1)	0.162	0.101	1.605	0.109	
Race/Ethnicity: African American (=1)	0.306	0.092	3.321	0.001	**
Race/Ethnicity: Hispanic/Latinx (=1)	0.315	0.084	3.725	<.001	***
Race/Ethnicity: Asian American (=1)	-0.010	0.095	-0.111	0.912	
Race/Ethnicity: European American (=1)	0.081	0.103	0.786	0.432	
Language Background: Multi-lingual (=1)	0.026	0.169	0.152	0.880	
Instructor Status (Grad Student = 1)	0.134	0.130	1.027	0.304	
Enrollment Size (Large=1)	0.079	0.135	0.583	0.560	
Meetings per Week (0, 1, 2)	-0.218	0.119	-1.829	0.067	
HW 1 Submitted with Desktop/Laptop (=1)	-0.240	0.065	-3.673	<.001	***

Table 3. Predicting quiz scores

Variable	β	SE	t value	Pr(> t)	
Intercept	-0.075	0.061	-1.229	0.229	
Gender (Male = 1)	-0.097	0.027	-3.618	0.000	***
Age (>=25 = 1)	-0.035	0.027	-1.279	0.201	
Race/Ethnicity: African American (=1)	-0.108	0.034	-3.173	0.001	**
Race/Ethnicity: Hispanic/Latinx (=1)	-0.102	0.031	-3.278	0.001	**
Race/Ethnicity: Asian American (=1)	0.014	0.030	0.451	0.652	
Race/Ethnicity: European American (=1)	0.014	0.036	0.378	0.706	
Language Background: Multi-lingual (=1)	0.116	0.059	1.955	0.051	
Instructor Status (Grad Student = 1)	-0.023	0.050	-0.453	0.656	
Enrollment Size (Large=1)	-0.116	0.053	-2.181	0.046	*
Meetings per Week (0, 1, 2)	0.060	0.046	1.305	0.208	
HW 1 Submitted with Desktop/Laptop (=1)	0.070	0.027	2.594	0.010	*

Table 4. Predicting aggregate test scores

Variable	β	SE	t value	Pr(> t)	
Intercept	-0.036	0.071	-0.503	0.620	
Gender (Male = 1)	-0.026	0.027	-0.954	0.340	
Age (>=25 = 1)	0.000	0.027	-0.010	0.992	
Race/Ethnicity: African American (=1)	-0.149	0.034	-4.386	<.001	***
Race/Ethnicity: Hispanic/Latinx (=1)	-0.085	0.031	-2.724	0.007	**
Race/Ethnicity: Asian American (=1)	-0.015	0.030	-0.489	0.625	
Race/Ethnicity: European American (=1)	0.014	0.036	0.392	0.695	
Language Background: Multi-lingual (=1)	0.044	0.059	0.747	0.455	
Instructor Status (Grad Student = 1)	-0.068	0.060	-1.133	0.273	
Enrollment Size (Large=1)	-0.056	0.065	-0.868	0.400	
Meetings per Week (0, 1, 2)	0.017	0.055	0.313	0.758	
HW 1 Submitted with Desktop/Laptop (=1)	0.051	0.027	1.894	0.058	

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