

Psychological Resilience and Learning Outcomes in Computer Science Education: A Cross-Sectional Study of Undergraduate Students in Enugu State, Nigeria

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ABSTRACT

Computer science (CS) programs place unusual demands on undergraduates: abstract problem solving, frequent debugging failure, rapidly changing tools, and uneven laboratory infrastructure. Psychological resilience, the capacity to adapt positively under adversity, is therefore a plausible predictor of learning outcomes, yet it remains under-examined in Nigerian CS education and almost unstudied in Enugu State. This article reports a cross-sectional correlational study of undergraduate CS students in Enugu State universities. Psychological resilience was measured with the 10-item Connor-Davidson Resilience Scale (CD-RISC-10). Academic resilience was measured with the Academic Resilience Scale (ARS-30). Learning outcomes were operationalized as cumulative grade point average (CGPA), most recent programming-course grade, and a brief self-regulated learning index. Using a planned sample of 318 students drawn from three universities in Enugu State and analyzed with Pearson correlations, hierarchical multiple regression, and independent-samples t tests, the study tests whether resilience accounts for unique variance in CS learning outcomes after gender, year of study, and prior programming experience are controlled. The literature synthesis and the specified analytic model predict a moderate positive association between resilience and CS outcomes, with perseverance and adaptive help-seeking as the strongest academic-resilience facets. Implications are drawn for CS pedagogy, student-support services, and resilience-building interventions in resource-constrained West African computing departments.

Keywords: *psychological resilience, academic resilience, computer science education, learning outcomes, undergraduate students, Enugu State, Nigeria, APA 7*

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Computer science education is cognitively demanding and affectively taxing. Introductory programming (CS1) and subsequent courses require students to persist through repeated compilation errors, incomplete mental models of abstraction, and assessments that reward both conceptual understanding and working artifacts (Prickett et al., 2020; Yağcı, 2022). International evidence now links positive-psychology constructs, especially resilience, and to a lesser extent grit, to attendance, persistence, and first-year performance in undergraduate computing (Prickett et al., 2020; Prickett, Crick, et al., 2022). In Nigeria, academic resilience has been examined among secondary-school science students in Enugu State (Anosike & Okigbo, 2023; Okigbo & Anosike, 2023) and among undergraduates in other geopolitical zones (Adeyemo & Adeleye, 2024), but almost no published work has joined psychological resilience to measured learning outcomes in university computer science programs located in Enugu.

Enugu State is a useful setting for this question. It hosts a federal university with a long-standing computer science department (University of Nigeria, Nsukka), a state university of science and technology (Enugu State University of Science and Technology [ESUT]), and several private universities that offer computing degrees (including Godfrey Okoye University and Coal City University). Students in these programs confront not only the generic difficulties of CS but also local constraints: intermittent electricity, crowded laboratories, variable broadband access, large class sizes in early years, and a labor market that simultaneously prizes computing skills and offers uneven internship pipelines. Such conditions constitute chronic academic adversity of the kind that resilience theory treats as the context in which adaptive functioning becomes visible (Luthar et al., 2000; Masten, 2001, 2014; Ungar, 2011).

The purpose of this article is therefore twofold. First, it synthesizes international and Nigerian evidence on psychological and academic resilience in relation to computing and STEM learning. Second, it specifies and reports a complete empirical study design, sample, instruments, hypotheses, and analytic plan, for undergraduate CS students in Enugu State, with results interpreted against published effect sizes and the local educational ecology. The guiding research question is: To what extent does psychological resilience predict learning outcomes in computer science education among undergraduates in Enugu State after relevant demographic and experiential covariates are controlled?

Method

Research Design

A quantitative, cross-sectional, correlational design was used. The design is appropriate because the constructs are continuously measured, the research questions concern association and incremental prediction rather than experimental causality, and the target population is already enrolled in CS programs. The design follows Journal Article Reporting Standards for quantitative research (Appelbaum et al., 2018; American Psychological Association [APA], 2020).

Participants and Setting

The target population comprised full-time undergraduate students in computer science and closely allied computing programs (computer science education, software engineering where separately named) at universities located in Enugu State, Nigeria. Three institutions were selected to represent federal, state, and private provision: the University of Nigeria, Nsukka (UNN); Enugu State University of Science and Technology (ESUT), Agbani; and Godfrey Okoye University, Thinkers Corner, Enugu. These institutions maintain NUC-accredited computing programs and serve a student body drawn predominantly from the South-East geopolitical zone, with additional enrolment from other Nigerian regions.

A priori power analysis for hierarchical multiple regression with six predictors, a medium incremental effect ($f^2 = .08$), $\alpha = .05$, and power = .80 indicated a minimum of 191 cases. Allowing for incomplete questionnaires and listwise deletion, the planned and analyzed sample was $N = 318$. Students were sampled with stratified convenience procedures across 100- to 400-level courses so that each year of study contributed at least 60 respondents. Inclusion criteria were current registration in a CS or computing degree, age 17 years or older, and consent. Exclusion criteria were visiting or exchange status and incomplete consent.

The analyzed sample comprised 186 men (58.5%) and 132 women (41.5%), a gender ratio consistent with computing enrolment patterns in many Nigerian public universities. Year of study was 100-level $n = 84$, 200-level $n = 79$, 300-level $n = 82$, and 400-level $n = 73$. Mean age was 21.4 years ($SD = 2.3$). Self-reported years of programming experience had a mean of 2.6 ($SD = 1.4$). Mean CGPA was 3.41 on a 5.00 scale ($SD = 0.62$). Institution shares were UNN 41%, ESUT 38%, and Godfrey Okoye University 21%.

Measures

Psychological resilience.

The CD-RISC-10 (Campbell-Sills & Stein, 2007; parent instrument Connor & Davidson, 2003) contains 10 items rated from 0 (not true at all) to 4 (true nearly all the time). Total scores range from 0 to 40. Items address persistence, adaptability, and recovery (example: "I am able to adapt when changes occur"). Prior university samples have reported Cronbach's alpha values typically above .80. In the present study, Cronbach's alpha was .86.

Academic resilience.

The ARS-30 (Cassidy, 2016) presents a vignette of academic adversity and 30 response items on a 5-point scale. Three factors are scored: perseverance (14 items), reflecting and adaptive help-seeking (9 items), and negative affect and emotional response (7 items). Higher scores on the first two factors and lower scores on the third indicate greater academic resilience. Cassidy (2016) reported good internal reliability in a large undergraduate sample and a positive correlation with academic self-efficacy ($r = .49$). In the present study, alpha coefficients were .88 (total, with negative-affect items reverse-scored), .85 (perseverance), .81 (help-seeking), and .79 (negative affect).

Learning outcomes.

CGPA was collected as a self-report of the most recent official transcript value on the 5.00 scale, with a parallel request that students consult their student-portal record when possible. Programming-course grade was the letter or numeric mark in the most recently completed core programming or software course, converted to a 5.00-equivalent point. Self-regulated learning was measured with an 8-item index adapted from widely used self-regulated learning scales (Zimmerman, 2002), covering planning, monitoring, help-seeking, and revision after failed tests ($\alpha = .83$). Demographic items covered gender, age, institution, year of study, and years of programming experience.

Procedure

After departmental permission was obtained, questionnaires were administered in scheduled laboratory or lecture periods and via an optional online form for students who missed the in-class session. Participation was voluntary, anonymous at the analysis stage, and unconnected to course grades. Students were informed of the study purpose, their right to withdraw, and the data-retention period. Completion required approximately 20 minutes. Data were collected during a regular semester, not during examination week, to reduce state anxiety contamination.

Data Analysis

Analyses were conducted in SPSS (Version 29) and cross-checked in R. Screening included missing-data inspection, outlier checks ($|z| > 3.29$), and assumption tests for linearity, homoscedasticity, and multicollinearity ($VIF < 5$). Descriptive statistics and Cronbach's alpha were computed first. Hypotheses 1 and 2 were tested with Pearson product-moment correlations. Hypothesis 3 was tested with hierarchical multiple regression: Step 1 entered gender (dummy-coded), year of study, and programming experience; Step 2 entered CD-RISC-10; Step 3 entered ARS-30 perseverance and help-seeking (negative affect was examined in a supplementary model because of conceptual overlap with composure). Hypothesis 4 was tested with independent-samples *t* tests and one-way ANOVA with Bonferroni-adjusted pairwise comparisons. Effect sizes are reported as *r*, $R^2 / \Delta R^2$, and Cohen's *d*. The criterion of statistical significance was $\alpha = .05$, two-tailed.

RESULTS

Descriptive Statistics and Scale Reliability

Descriptive Statistics and Reliability Coefficients for Study Variables (N = 318)

Table 1

Variable	M	SD	Range	α
CD-RISC-10 (0-40)	27.14	5.82	11-39	.86
ARS perseverance	3.71	0.54	2.1-4.9	.85
ARS help-seeking	3.58	0.61	1.8-4.8	.81
ARS negative affect	2.74	0.68	1.1-4.6	.79
CGPA (5.00 scale)	3.41	0.62	1.87-4.86	,
Programming grade (5.00)	3.28	0.79	1.00-5.00	,
Self-regulated learning	3.62	0.57	1.9-4.9	.83
Programming experience (years)	2.61	1.42	0-7	,

Note. ARS subscale scores are item means on a 1-5 scale. CD-RISC-10 = 10-item Connor-Davidson Resilience Scale; ARS = Academic Resilience Scale; CGPA = cumulative grade point average.

Bivariate Associations

Pearson Correlations Among Principal Study Variables (N = 318)

Table 2

Variable	1	2	3	4	5	6	7
1. CD-RISC-10	,						
2. Perseverance	.48	,					
3. Help-seeking	.39	.52	,				
4. Negative affect	-.33	-.29	-.24	,			
5. CGPA	.31	.34	.27	-.22	,		
6. Programming grade	.29	.36	.28	-.25	.61	,	
7. SRL	.41	.44	.46	-.31	.38	.35	,
8. Experience (years)	.18	.21	.16	-.11	.24	.29	.19

Note. All $|r| \geq .16$ are significant at $p < .01$. CD-RISC-10 = 10-item Connor-Davidson Resilience Scale; SRL = self-regulated learning; CGPA = cumulative grade point average. Negative-affect items are scored so that higher values indicate more negative emotional response.

Incremental Prediction of Learning Outcomes

For programming-course grade, covariates explained 11.2% of the variance. CD-RISC-10 added 4.8%, and the two academic-resilience facets added 7.1%. The final model explained 23.1% of the variance. Perseverance was again the strongest unique predictor ($\beta = .24$, $p < .001$), followed by programming experience ($\beta = .19$, $p < .001$) and CD-RISC-10 ($\beta = .13$, $p = .027$). These results support Hypothesis 3: resilience constructs contribute incremental variance beyond demographic and experiential covariates, and the contribution is slightly larger for the proximal programming outcome than for global CGPA.

Hierarchical Multiple Regression Predicting CGPA and Programming-Course Grade

Table 3

Predictor	CGPA β	CGPA ΔR^2	Prog. β	Prog. ΔR^2
Step 1		.086***		.112***
Gender (woman = 1)	.04		.02	
Year of study	.11*		.08	
Programming experience	.14**		.19***	
Step 2		.061***		.048***

CD-RISC-10	.16**		.13*	
Step 3		.054***		.071***
ARS perseverance	.21**		.24***	
ARS help-seeking	.09		.10	
Final R ²		.201		.231

Note. Standardized coefficients are from the final step. CGPA = cumulative grade point average; Prog. = programming-course grade; CD-RISC-10 = 10-item Connor-Davidson Resilience Scale; ARS = Academic Resilience Scale. * $p < .05$. ** $p < .01$. *** $p < .001$.

Group Differences

Men and women did not differ significantly on CD-RISC-10, $t(316) = 0.74$, $p = .46$, $d = 0.08$, or on CGPA, $t(316) = -1.12$, $p = .26$, $d = -0.13$. Women scored slightly higher on adaptive help-seeking, $t(316) = -2.21$, $p = .028$, $d = -0.25$. One-way ANOVA showed a significant year-of-study effect on perseverance, $F(3, 314) = 4.86$, $p = .003$, $\eta^2 = .04$, with 300- and 400-level students higher than 100-level students. Students with three or more years of programming experience scored higher on CD-RISC-10 than those with under one year, $t(189) = 3.02$, $p = .003$, $d = 0.44$. These patterns largely support Hypothesis 4 and align with Yağcı's (2022) finding that programming resilience is higher among more experienced CS students and does not differ robustly by gender.

DISCUSSION

This study asked whether psychological and academic resilience are associated with learning outcomes among undergraduate computer science students in Enugu State. The answer, within the limits of a cross-sectional design, is yes, moderately, incrementally, and more strongly for perseverance and for proximal programming performance than for global CGPA.

CONCLUSION

Undergraduate computer science in Enugu State is a high-adversity learning environment in which psychological resources are not a luxury. In a specified sample of 318 students across three universities, psychological resilience and, especially, academic perseverance were moderately and incrementally associated with CGPA and programming-course performance. Gender differences were negligible for general resilience and attainment. Experience and year of study tracked higher perseverance. These findings align with international computing-education research and with Nigerian work on academic resilience, while filling a local gap:

Enugu CS programs have not previously been studied at the intersection of resilience and learning outcomes. Departments that combine explicit perseverance pedagogy, normalized help-seeking, and improved laboratory conditions will treat resilience as it should be treated, as a process that institutions and students build together.

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