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2nd Guided Critique of Quantitative Research
EDRS 811

1. CITATION: Le Cunff, A.-L., Giampietro, V., & Dommett, E. (2024). Neurodiversity positively predicts perceived extraneous load in online learning: A quantitative research study. *Education Sciences, 14*(5), 516. https://doi.org/10.3390/educsci14050516

2. INTRO: a. Research Problem: To investigate how neurodivergent students (ADHD, Autism (ASD), & Dyslexia) experience cognitive load (intrinsic, extraneous, and germane) differently than neurotypical peers in online learning environments and if neurodiversity traits predict these loads. // **b. Population:** University students enrolled in programs that require the use of online platforms. // **c. Research Design:** Quantitative, cross-sectional survey administered via Qualtrics, correlational and comparative design.

3. SAMPLE: a. Participants: UK-based, English-speaking, 18 YO+, full-time, campus-based higher-education students // **b. Sample size:** N = 231 // **c. Demographics:** (1) Neurotypical (NT): *n* = 129 (55.8%); Mean Age, M = 27 (*SD* = 11); Gender: 54 Male, 74 Female, 1 Non-binary. (2) Neurodivergent (ND): *n* = 102 (44.2%); Mean Age, M = 26 (*SD* = 7); Gender: 36 Male, 57 Female, 9 Non-binary; (3) Diagnosis: ADHD = 64 students (62.7%), Autism = 35 students (34.3%), Dyslexia = 28 students (27.8%), Note = participants could report more than one condition. (4) Study Level: Bachelor's level = 76 NT, 60 ND; Master's level = 49 NT, 30 ND; Doctoral level = 4 NT, 12 ND.

4. PROCEDURE: a. Participants asked to do: Complete a four-part online survey via Qualtrics: (1) demographics (age, gender, ethnicity, study level); (2) self-reported neurodiversity diagnosis (ADHD, ASD, Dyslexia, Dyscalculia, Tourette's, or None); (3) three validated scales to assess neurodiversity; and (4) cognitive load assessment for last engagement in an online class.

// **b. Measures administered:** When: NOV 2022—FEB 2023 // How many times: Once in a single online session.

5. MEASURES: a. List each construct & what is assessed: Construct 1: Neurodiversity Status (NT or ND); Construct 2: Neurodiversity Traits (ADHD, ASD, Dyslexia); Construct 3: Perceived Cognitive Load (PCL) in Online Learning (Intrinsic CL, Germane CL, Extraneous CL). // **b. How each was assessed:** Construct 1: single-item question. Construct 2: self-report screening scales. Construct 3: self-report questionnaire based on a validated instrument by Klepsch et al. (2017). // **c. Operationalization:** All responses were self-reported. Construct 1, Status: a multi-option item for self-selected diagnosis, used as a grouping variable in group comparison analysis. Construct 2, Trait: scores used as IV/continuous predictors in correlation and regression analysis. ADHD = Adult ADHD Self-Report Scale (ASRS-v1.1), 6 items; ASD = Autism Spectrum Quotient (ASQ) Test, 10 items; Dyslexia = Adult Reading History Questionnaire (ARHQ), 24 items; Construct 3: scores used as DV in group comparisons and correlation analysis; ECL is DV in the multiple regression model. PCL = mean scores on subscales: ICL, 2 items; GCL, 3 items; ECL, 3 items. // **d. Information on validity or reliability of the measures:** Well-established, previously validated instruments were employed. No independent validation beyond internal consistency measured by Cronbach's α; all measures are self-reported. // Construct 1: none; Construct 2: ASRS-v1.1 (α = 0.844; good); ASQ (α = 0.706; acceptable); ARHQ (α = 0.891; good). // Construct 3: ICL (α = 0.603; poor); GCL (α = 0.609; poor); ECL (α = 0.819; good).

6. RESULTS: a. Tests: Test 1: Pearson correlations. IV/DV = relationships between age, neurodiversity scores, & CL types. Test 2: Chi-square. Variables include status (NT or ND) & demographics. Test 3: ANCOVA. IV = Status (NT or ND); Covariates = Gender and Study Level; DV = PCL (Intrinsic, Extraneous, Germane). Test 4: Multiple Linear Regression. IV =

ND Scale scores (ASRS, ASQ, ARHQ), Age, Gender, Study Level. DV = ECL. // **b. Null Hypothesis:** Test 1: Pearson Correlations. Statistically significant correlations found. Test 2: Chi-square. $H_{oGender}$: rejected; $H_{OStudy\ level}$ = rejected. Test 3: ANCOVA. $H_{O\text{-}ECL}$: rejected; $H_{O\text{-}ICL}$: retained; $H_{O\text{-}GCL}$: retained. Test 4: Multiple Linear Regression. H_O: rejected. // **c. Findings:** Test 1: Pearson Correlations. All CL types were significantly correlated with each other, but only for NT students; ECL was positively related to all three neurodiversity scales and was strongest with ADHD; for the ND group, only ICL was significantly correlated with ECL. ICL and GCL did not significantly differ between groups. Test 2: Chi-square. ND students differ from NT students in gender & study level, which were later controlled as covariates. Test 3: ANCOVA. ND students reported significantly higher ECL than NT students; there were no significant differences between groups for ICL or GCL. Test 4: Multiple Linear Regression. The model explained 18.6% of the variance in ECL. ASRS scores for ADHD were a significant positive predictor of ECL. ASD and Dyslexia did not significantly predict ECL. // **d. Tests not directly tied to RQ**: Test 1: Pearson correlations = used to explore relationships among variables before hypothesis testing. Test 2: Chi-square = mainly descriptive, used for inclusion decisions regarding gender & study level as covariates. // **e. Choice makes sense**: Test 1: Pearson correlations are suitable for continuous data with approximately normally distributed scores. Test 2: Chi-Square is suitable for examining associations between categorical variables (e.g., gender x neurodiversity; study level x neurodiversity). These tests make sense. Test 3: ANCOVA is suitable for controlling demographic differences (gender & study level). Test 4: Multiple linear regression is suitable for identifying specific predictors among the neurodiversity traits.

7. CRITIQUE: a. Areas of strengths: The authors noted the following: (1) a diverse sample, including non-binary students; (2) the use of continuous regression analysis to manage the co-

occurrence of conditions; (3) the employment of validated scales for neurodiverse traits & cognitive load; (4) a focus on a relatively underexplored topic; and (5) the involvement of an Advisory Board for co-designing procedures and materials that are sensitive to neurodiversity students. // **Areas of weakness**: They acknowledge the following: (1) comorbidity & symptom overlap among ND types complicates the interpretation of trait-specific effects; (2) excluding participants with anxiety or depression limits generalizability; (3) heavy reliance on self-reported data & retrospective recall may introduce recall bias, self-perception bias (ADHD), & reduce self-reference effect (ASD); (4) subjective ratings for CL assessment lack objective measures. // **My position**: I agree with the following: (1) concerns over how comorbidity & overlap make interpretation challenging when conditions frequently co-occur; (2) excluding students with co-occurring mental health conditions may improve internal control but reduces external validity since it may not represent many ND students in real educational settings; (3) self-report-only measurement of both predictors and outcomes increases the risk of bias and perceptual distortion; (4) although subjective, the perceived ECL is valuable for understanding students' experiences; and (5) lingering questions about GCL's construct validity make its interpretation more tentative. // **b. RQs w/appropriate conclusions**: H1, differences between groups in perceived cognitive load: Yes, the authors clearly reported that ND students experience higher ECL but do not differ from NT peers on ICL and GCL, after controlling for covariates. H2, prediction of CL from neurodiversity traits: Yes, the authors concluded that ADHD traits were the only significant predictor, predict extraneous load, and supported by the regression results. The authors frame these findings as preliminary, not causal, and link them to literature on working memory, attention, and online learning design. // **Accuracy of conclusions**: The conclusion that ND students perceive higher ECL in online learning aligns with the ANCOVA results. The

regression findings support the idea that ADHD traits uniquely and positively predict ECL (how the material is presented) rather than ICL (the difficulty of the material). The authors provide a reasonable interpretation that instructional design and online material presentation may place disproportionate ECL demands on ND students, especially those with ADHD. // **d. Weakness not addressed**: (1) The operationalization of "online learning" is broad. (2) The authors did not adequately address the low reliability coefficients for ICL ($\alpha = 0.603$) and GCL ($\alpha = 0.609$) cognitive load scales. Since these border levels deemed "unacceptable" ($\alpha < 0.60$), it may explain why no significant results were found for these constructs (Type II error). (3) The students rated CL for their last online class, but the authors did not capture detailed information for course type, course instructional design features, or course difficulty level, thus making it impossible to link higher ECL to specific design elements or platforms. (4) There was a lack of discussion around recruitment and selection, making it difficult to assess selection bias. (4) Due to the study design (cross-sectional, single-time, self-report), it is not possible to examine the changes over time or by causes (e.g. whether sustained high ECL levels lead to poorer academic outcomes). // **e. Most interesting findings**: (1) While cognitive load types (intrinsic, extraneous, germane) were correlated for NT students, these correlations mostly disappeared for ND students. (2) ND students, especially those with ADHD traits, experience higher ECL (but not ICL or GCL) in online learning, which is significant because it suggests that the issues may lie with instructional design rather than student deficits. (3) Showing that ICL and GCL do not differ based on neurodiversity status indicates that ND students might not struggle with content difficulty or effort, but rather with how the content is presented and structured. (4) Overall, examining CL, neurodiversity, and online learning offers a valuable direction for the field of instructional design: the struggle may be structural instead of intensity or ability.