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Working

Electrochemical Gradients Assessment Device (EGAD)

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ABSTRACT

The basis for understanding neurophysiology is understanding ion movement across cell membranes. Students in introductory courses recognize ion concentration gradients as a driving force for ion movement but struggle to simultaneously account for electrical charge gradients. We developed and validated a 17-multiple-choice item assessment of students' understanding of electrochemical gradients and resistance in neurophysiology, the Electrochemical Gradients Assessment Device (EGAD). We investigated the internal validity of the assessment by analyzing item characteristic curves of score probability and student ability for each question, as well as a Wright Map of student scores and ability. We used linear mixed-effect regression to test student performance and ability as well as learning gains. Our assessment discriminated students with average ability (*WLE* -2 to 1.5 Θ), however, was not as effective at discriminating students at the highest ability (*WLE* > 2 Θ). We determined the assessment could capture changes in both assessment scores (model $r^2 = 0.51$, $p<0.001$, $n=444$) and ability estimates (model $r^2= 0.47$, $p<0.001$, $n=444$) after a simulation-based lab and course instruction for 222 students. Our Differential Item Function analysis determined that each item on the assessment performed equitably for all students regardless of gender, race/ethnicity or economic status. Overall, we found that males scored higher ($r^2 = 0.51$, $p=0.014$, $n=444$) and had higher ability scores ($p=0.003$) on the EGAD assessment. Caucasian students of both genders were positively correlated with score ($r^2 = 0.51$, $p<0.001$, $n=444$) and ability ($r^2= 0.47$, $p<0.001$, $n=444$). Based on the evidence gathered through our analyses, the scores obtained from the EGAD can validly and reliably distinguish between levels of content knowledge on introductory neurophysiology principles for students in introductory plant and physiology courses.

SupplementaryEGAD Assessment MC.pdf