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Society’s increasing reliance on technology has highlighted the importance of promoting space weather literacy through educational research and outreach. Despite this need, space weather education lacks validated assessment tools capable of diagnosing misconceptions and measuring conceptual understanding across diverse audiences. This study describes the development and validation of the Space Weather Concept Inventory (SWCI), a 24-item diagnostic assessment designed to measure space weather literacy. Instrument development was guided by expert consultation and the identification of common misconceptions, followed by pilot testing and psychometric refinement. Participants were recruited through the Prolific research survey platform. A pilot sample of approximately 250 participants supported exploratory item analysis, followed by a larger validation sample of approximately 750 participants, with a final analytic sample of 719 respondents used for confirmatory evaluation. Analyses included classical test theory reliability, confirmatory factor analysis, Rasch modeling, and regression analyses examining demographic and engagement predictors. Results indicate strong internal consistency (Cronbach’s ? ? .88), stable measurement properties across a broad range of item difficulty, and a correlated two-factor structure consistent with interconnected domains of space weather understanding. Regression results indicate that engagement with space weather information and prior training were more strongly associated with performance than education level, occupation, age, or gender. These findings indicate that the SWCI provides a psychometrically grounded framework for diagnosing misconceptions and characterizing space weather understanding.


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