Title: A Wearable Intelligent System for Encoding Systems of Tiered-Support: Project WISE
Topic: Social, Emotional, and Behavioral Competence
Project Type: Measurement

Project Summary

Purpose: The purpose of this project is to develop and validate the Wearable Intelligent System for Encoding (WISE), a measurement tool that uses low-cost wearable technologies and machine learning (ML) algorithms to efficiently assess general and special education elementary school teachers' implementation of Tier 1 behavior management practices. Unless schools have access to tools that help them identify teachers in need of additional coaching and support in the implementation of Tier 1 practices, it is likely schools will waste limited resources on the delivery of more intensive behavior interventions at Tier 2 or Tier 3 when they could instead more efficiently meet students' needs by improving teacher implementation of Tier 1 practices.
Project Activities: The research team will conduct a series of activities to develop and validate WISE. In Year 1, the research team will conduct initial field testing and collect teacher and student behavioral data using low-cost wearable technologies and systematic direct observations (SDO). Using these data, the research team will develop an initial prototype of WISE including identifying a combination of low-cost wearable technologies and machine learning (ML) algorithms that accurately classify and quantify teacher and classroom behaviors. This field testing will expand in years 2, 3, and 4 to further refine ML algorithms and validate WISE. Validation activities include: (1) the use of confirmatory factor analysis to confirm WISE measures the targeted construct of Tier 1 behavior management practices; (2) the use of a combination of extant data analyses, a meta-analysis, and confirmatory factor analysis to establish standard setting and scoring procedures; and (3) establishing evidence for convergent and criterion validity through the use of other validated screening and progress monitoring measures. Generalizability and decision studies will be conducted to ensure WISE and the scoring procedures WISE employs are valid and reliable across different types of classrooms and teachers.
Products: The products will include a fully developed measurement tool to identify teachers in need of additional coaching in the implementation of Tier 1 behavior management practices and to measure teacher progress over time in the implementation of Tier 1 behavior management practices. This project will also result in peer-reviewed publications and presentations and additional dissemination products aimed at practitioners, technical assistance providers, school and district administrators, and policymakers. Finally, this project will result in an application for a Phase 1 Small Business Innovation Research grant that will fund further development of WISE to ensure it is commercially viable and highly feasible for school-based use.

Structured Abstract

Setting: Data will be collected from elementary school classrooms in Tennessee.
Population/Sample: Field testing will include 200 elementary school teachers and their students.
Instrument: WISE is a measurement tool that uses low-cost wearable technologies and machine learning (ML) algorithms to efficiently assess general and special education elementary school teachers' implementation of evidence-based behavior management practices. WISE will be designed to assess teacher implementation of Tier 1 behavior management practices during academic instruction and intervention (i.e., literacy, mathematics, science, social studies) across diverse instructional contexts (e.g., large group instruction, small group instruction, one-on-one

instruction, independent work). WISE will measure (1) teacher implementation of evidence-based behavior management practices (i.e., praise, reprimands, opportunities to respond, pre-corrections, instructional talk) and (2) classroom behaviors associated with these practices (i.e., engagement, disruptive behavior). WISE will be developed for use across different types of elementary school classrooms (i.e., special education and general education), instructional contexts (e.g., large group instruction, small group instruction, one-on-one instruction, independent work), instructional content (i.e., literacy, mathematics social studies, science), types of students (i.e., students with disabilities, students without disabilities, racially and socio-economically diverse students), and types of teachers (i.e., special education, general education, racially and ethnically diverse teachers).

Research Design and Methods: The research team will employ an iterative approach to develop WISE. Year 1 activities include developing an overall plan for the development of WISE, establishing content definitions for targeted teacher and student behaviors, and developing initial machine learning (ML) algorithms that accurately classify and quantify teacher and student behaviors. In years 2 and 3, the research team will identify a sub-set of low-cost wearable sensors and develop a customized wearable technology for WISE. Years 2 and 3 will also include further testing and refinement of ML algorithms. Data collected during field testing in years 2, 3, and 4 will inform standard setting and scoring procedures for WISE and will also provide information about the feasibility and psychometric validity of WISE.

Control Condition: Due to the nature of the project and research design, there is no control condition.

Key Measures: To develop and validate WISE, the research team will use gold standard measures of teacher and student behavior. The research team will conduct systematic direct observations using the Multiple Option Observation System for Experimental Studies (MOOSES; Tapp & Wehby, 1995) to collect teacher and student behavioral data. This observation system uses real-time recording and enables simultaneous collection of discrete and continuous behaviors. The research team will also use the Classroom Management Rating Form (CMRF; Downs et al., 2019) to establish evidence for convergent and criterion validity. This rating scale is a modified version of the Classroom Atmosphere Rating Scale (CARS; Wehby et al., 1993) and is a valid and reliable measure of teachers' classroom management practices (Downs et al., 2019).

Data Analytic Strategy: WISE will be developed iteratively across all four years of the project. The research team will employ a combination of machine learning (ML) methods, Generalizability Theory (GT), and Confirmatory Factor Analysis (CFA) to develop and validate WISE. The research team will use established methods for assessing the accuracy and sensitivity of ML algorithms and to ensure ML algorithms are free from bias across diverse groups of teachers and students. A series of generalizability and decision studies will be used to inform standard setting and scoring procedures for WISE. Confirmatory factor analysis will also be used to inform scoring and standard setting and to ensure scores on WISE represent the target domain of Tier 1 behavior management practices. To assess convergent and criterion validity, we will determine the degree to which scores on WISE are associated with established measures of classroom management practices (i.e., CMRF, MOOSES).

Related IES Projects: None