

Session Title: Get the GIST: Exploring Self-regulation and Cognitive Strategy use in Geographic Information Science & Technology (GIST) in a Hybrid Learning Program for Autistic Students

Abstract:

This study highlights the application of self-regulated learning and cognitive strategy use research in the Connecting Students with Autism to Geographic Information Science & Technology (CSA-GIST) study, an NSF-funded project. This study investigated the program's impact on autistic high school students' self-regulated learning (SRL) and cognitive strategy use during STEM instruction. Though the findings were not significant regarding the impact of the program on students SRL and cognitive strategy use at the midpoint of the program, increased interest in math, science, and technology were reported for each cohort during year one. These findings provide implications for adaptations to this workforce development program to increase students' SRL and cognitive strategy use for GIST and STEM careers among autistic students. Implications for research and practice are discussed.

Keywords: *Hybrid, Self-regulation, Self-regulated Learning, Cognitive Strategy Use, Autism, Geospatial, Information Science, Technology, Secondary, Post-secondary*

Introduction/study context

The purpose of this study was to explore the impact of the Geographic Information Systems and Technology (GIST) program on autistic students' self-regulated learning and cognitive strategy use. The goal is to utilize this research to build a workforce development program that will aid in increasing the use of SRL and cognitive strategies among autistic students interested in GIST and STEM careers. The goal is that programs like this can be replicated for use by special educators, curriculum designers, and university faculty who support students with disabilities preparing for STEM careers or postsecondary education. This paper is a review of preliminary findings from year one of this three-year NSF-funded project.

Theoretical/ Conceptual Framework

Self-regulated learning (SRL) is a framework for understanding how individuals purposefully initiate and implement self-directed processes such as time management and help seeking in learning environments. SRL encompasses three primary dimensions (cognition, motivation/affect, observable behavior) and is best understood by examining three phases of self-regulation (forethought, performance, self-reflection). This paper focuses on understanding general dimensions of SRL among autistic students makes Zimmerman's three-part framework (2011) and emphasis on principle, long-standing concepts appropriate.

Literature review

Autism is the fastest-growing developmental disability in the US (CDC, 2020) and autistic adults have significantly higher unemployment rates than other disabled adults, despite having skills that can lend themselves well to STEM careers. This research highlights ways to utilize blended learning and self-regulated learning techniques to begin addressing this challenge. The purpose of this study was to explore the relationship between Geographic Information Systems and Technology (GIST) career preparation through drone piloting, and self-regulation and motivation for autistic students. The goal of this study was to identify pedagogical approaches and program design methods that can be replicated for use by special education teachers, curriculum designers, and university faculty and staff who support disabled high school students preparing for STEM careers or study in higher education.

This paper will highlight preliminary findings from year one of this three-year project, focusing on tools that attendees can implement in their own virtual or blended-learning environments. Though autistic students are *less* likely to attend college than their non-disabled peers, when they do enter a postsecondary degree program, they are *more* likely to earn STEM workforce credentials and enter corresponding careers (Lee, 2014). Therefore, restructuring learning to foreground evidence-based practices such as modeling, prompting, task analysis, and self-regulation, in combination with exposure to innovative technologies (mini drones, simulation software, mapping software) in a blended learning environment, can support autistic youth to be motivated, inspired, and prepared to continue along STEM educational and career paths.

U.S. business and policy leaders have made it a priority to aid in increasing the number of students who pursue STEM careers. Yet, one source of STEM talent is often overlooked: young autistic people. Autistic adolescents are a particularly underserved group within an underrepresented group; that is, people with disabilities. Autistic teens are less likely to attend college or find work than their peers. However, when autistic students defy the odds and enter collegiate degree programs, STEM disciplines emerge as preferred areas of study. Wei and colleagues' (2017) analysis of a nationally-representative data set for autistic students revealed that 34.3% of autistic college students selected STEM majors, with 12% picking science and 16% entering computer science. Notably, movement into STEM majors is higher among autistic college students (34.3%) than for the general population (22.8%), including for science and computer science sub-disciplines. Thus, autistic students are less likely to attend college than their non-disabled peers, but when they do enter a postsecondary degree program, they are more likely to earn STEM workforce credentials and enter corresponding careers. Therefore, restructuring learning to foreground evidence-based practices such as modeling, prompting, task analysis, and self-regulation, in combination with exposure to innovative technologies (mini drones, simulation software, mapping software) will support autistic youth to be motivated,

inspired, and prepared to continue along STEM educational and career paths. Further, our scholarship will advance the research frontier by facilitating insight into centering intersectionality in autism research as well as education research overall.

Methods/research methodology

This study explored the impact of the Geographic Information Systems and Technology (GIST) program on autistic students' self-regulated learning and cognitive strategy use using a quantitative. Participants were selected by engaging school and community leaders who work with autistic students and their families. There was a particular focus on area public schools in two local school districts to increase the likelihood of a more diverse sample, particularly socioeconomic diversity, level of support needs, and race/ethnicity. Seventeen participants were recruited and enrolled in Cohort 1 of this study. The first two research questions are as follows:

RQ1: Does hybrid GIST instruction positively influence self-regulation for learning among autistic high school students, as measured by the MSLQ?

RQ2: Does hybrid GIST instruction positively influence cognitive strategy use for learning among autistic high school students, as measured by the MSLQ?

It was the goal of this study to examine the ways in which participants engaged in self-regulation during online GIST instruction, and identify the supports that are needed during hybrid GIST instruction to build and sustain self-regulation among autistic students.

To examine the ways in which hybrid GIST instruction influences self-regulation and cognitive strategy use for learning among autistic high school students, this study employed the Motivated Strategies for Learning Questionnaire (MSLQ). The pre/post program survey was administered prior to the first GIST session of Year 1, and again following the completion of the summer session (i.e., at the end of Year 1) for the first cohort of participants. The survey data was analyzed via descriptive statistics to describe demographics and explore preliminary findings. Given the small sample size, this study utilized nonparametric statistics (i.e, Wilcoxon) to discern within group differences before and after the GIST project activities.

Results/findings

Data collection and analysis is complete for year one of Cohort 1. Findings from the MSLQ indicated an increase in students' pretest and posttest scores, though they were not statistically significant. These analyses indicate that the hybrid GIST instruction positively influenced self-regulation and cognitive strategy use for learning among autistic high school students, as measured by the MSLQ. These findings further highlight the need for specific strategies for

self-regulation skills among autistic students while also highlighting barriers that would promote facilitators to support student self-regulation during GIST instruction.

Discussion/Implications

Achievement in STEM coursework in high school is one of the best predictors for college enrollment for many students (Bottia et al. 2015; Ganley and Lubienski 2016; McEachin et al. 2017). Moreover, autistic students are more likely to enroll in college if they identify as a person interested in STEM-related subjects. Findings from this study indicate that intentional STEM-focused interventions like the GIST program could have a positive impact on student SRL and cognitive strategy use in STEM while promoting postsecondary education. Though there is limited research regarding programmatic interventions for the impact of SRL and cognitive strategy use in STEM specifically for students on the spectrum (Chen et al., 2022), the presented study contributes to the growing body of literature that highlights further investigation of research that include students with disabilities specifically in STEM related interventions.

While the results of this study revealed positive differences in pretest and posttest mean scores before and after participating in year 1 of the GIST program, they were not statistically significant. This suggests that the GIST program was effective at increasing students' awareness of learning skills including critical thinking, communication, collaboration, and creativity. The current study serves as an example of how an extracurricular STEM education program can positively impact students' ability to incorporate SRL and cognitive skills. Given this study was completed at the midpoint of the program, the effect of the program in its entirety may indeed reflect significantly increased SRL and cognitive strategy use upon its completion. The lack of statistically significant results may also point to a need for additional content in the early modules of the program; currently these modules are focused almost exclusively on how to fly a drone.

The results of this investigation contribute to the literature by presenting a unique approach to program development and implementation that is specifically geared toward students with Autism. The integrations of programs akin to the GIST program can be useful to both researchers and practitioners in creating future STEM curricula and interventions. To promote student involvement with STEM activities in real-world settings, research and policy should support the integration of STEM into both formal and informal learning environments. To solve significant challenges like accessibility, underrepresentation, and the relationship between programs and schools, efforts to provide students with STEM education opportunities in and out-of-school contexts will play a vital role.

References

- Anderson, K. A., McDonald, T. A., Edsall, D., Smith, L. E., & Taylor, J. L. (2016). Postsecondary Expectations of High-School Students With Autism Spectrum Disorders. *Focus on Autism and Other Developmental Disabilities*, 31(1), 16–26.
- Greene, J. C. (2007). Mixed methods in social inquiry. Jossey-Bass.
- Lee, A. (2014). Students with Disabilities Choosing Science Technology Engineering and Math (STEM) Majors in Postsecondary Institutions. *Journal of Postsecondary Education and Disability*, 27(3), 261.
- Steinbrenner, J. R., McIntyre, N., Rentschler, L. F., Pearson, J. N., Luelmo, P., Jaramillo, M. E., Boyd, B. A., Wong, C., Nowell, S. W., Odom, S. L., & Hume, K. A. (2022). Patterns in reporting and participant inclusion related to race and ethnicity in autism intervention literature: Data from a large-scale systematic review of evidence-based practices. *Autism : The International Journal of Research and Practice, Journal Article*, 13623613211072592–13623613211072592
- Wei, X., Yu, J. W., Shattuck, P., & Blackorby, J. (2017). High School Math and Science Preparation and Postsecondary STEM Participation for Students With an Autism Spectrum Disorder. *Focus on Autism and Other Developmental Disabilities*, 32(2), 83–92.