

Caleb Vatral

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PRIMARY RESEARCH INTERESTS

Artificial Intelligence, Machine Learning, Deep Learning, Multimodal data-driven intelligent systems applied to open-ended education and training environments, multimodal learning analytics, cognitive modeling and distributed cognition, experiential learning and training, automated assessment and feedback generation

EDUCATION

VANDERBILT UNIVERSITY

Ph.D., Computer Science

Focus Area: Applied Artificial Intelligence

Advisor: Gautam Biswas

Dissertation title: *Computational Methods to Support Learner Modeling and Explainable Feedback in Competency-Based Experiential Training Environments*

Nashville, TN
July 2024 (Expected)

EASTERN NAZARENE COLLEGE

Bachelor of Science in Computer Science and Math

Advisor: Pierre-Richard Cornely

Quincy, MA
May 2019

PROFESSIONAL RESEARCH EXPERIENCE

RESEARCH ASSISTANT, OPEN-ENDED LEARNING ENVIRONMENTS LAB

Vanderbilt University, Advisor: Gautam Biswas

May 2020 – Present
Nashville, TN

- Developed a multimodal analysis system for learner assessment and feedback generation of cognitive and psychomotor constructs in a mixed reality Army training environment, resulting in three peer-reviewed conference papers and five refereed workshop and symposium papers.
- Designed and implemented a debriefing assistant application to aid instructors in conducting evidence-based debriefing after nursing simulation training events. The system performs multimodal assessment and feedback generation to aid instructors in understanding and interpreting learner data in order to generate evidence-based personalized feedback. The work has resulted in one peer-reviewed journal article and three peer-reviewed conference papers.

UNDERGRADUATE RESEARCH ASSISTANT, ENGINEERING DEPT.

May 2016 – May 2019

Eastern Nazarene College, Advisor: Pierre-Richard Cornely

Quincy, MA

- Analyzed and interpreted atmospheric total electron content (TEC) data and showed statistically significant disturbances in TEC data around the time of a large-scale seismic earthquake event in Napa Valley, California when compared to baseline data, resulting in one journal publication.

TEACHING EXPERIENCE**Vanderbilt University – Teaching Assistant (2019 – 2020)**

- *Program Design and Data Structures*
 - Mid-Level Undergraduate Course
 - Responsible for debugging and grading student programming assignments focusing on fundamentals of data structures.
 - Held open office hours for students at least once per week.
- *Data Science Methods for Smart Cities Applications*
 - Joint Upper-Level Undergraduate and Lower-Level Graduate Course
 - Designed homework assignments for this brand-new university course focusing on applications of data science methods (statistics, machine learning, etc.) to smart cities data.
 - Lectured and showed custom-designed demos about data science methods to a widely interdisciplinary student audience.
 - Debugged and graded student programming assignments focusing on fundamentals of applied data science.
 - Held open office hours for students with widely interdisciplinary backgrounds.

Eastern Nazarene College – Teaching Assistant (2016 – 2019)

- *General Physics – Mechanics and Electromagnetism*
 - Lower-Level Undergraduate Course
 - Facilitated hands-on student lab activities focusing on the demonstration of beginner mechanics and electromagnetism concepts once per week.
 - Responsible for timely grading of student lab reports and exams.
 - Held open office hours for students at least once per week.
- *Digital Logic*
 - Upper-Level Undergraduate Course
 - Facilitated computer-based student lab activities focused on the fundamentals of digital logic systems once per week.
 - Responsible for timely grading of student lab reports and projects, and proctoring and grading of student exams.
 - Held open office hours for students at least once per week.

Eastern Nazarene College – Peer Tutor (2016 – 2019)

- Facilitated one-on-one and group tutoring sessions for coursework in physics, math, and computer science for a variety of skill levels ranging from elementary level to university junior-level classes.
- Promoted to Senior Tutor in 2017

INDUSTRY EXPERIENCE

DATA SCIENCE INTERN

May 2018 – Aug 2018

HCL Technologies

Cary, NC

- Developed a new method for automated analysis of software performance data using machine learning models for root cause analysis.
- Designed a REST API for automated analysis, storage, and retrieval of software performance data.

HONORS & AWARDS

- I/ITSEC Best Paper in the Human Performance Subcommittee Nov 2022
- Graduated Valodictorian and Summa Cum Laude, Eastern Nazarene College May 2019

SCHOLARSHIP

Journal Publications

- Vatrak, C., Biswas, G., Cohn, C., Davalos, E., and Mohammed, N. (2022). Using the dicot framework for integrated multimodal analysis in mixed-reality training environments. *Frontiers in Artificial Intelligence*, 5
- Pierre-Richard J Cornely and Caleb Vatrak. (2022). Statistical Significance of Pre-Seismic Anomalies in Total Electron Content in Napa Valley, California. *Novel Research in Science*. 12(3).

Conference Publications

- Vatrak, C., Biswas, G., and Goldberg, B. S. (2022). Multimodal learning analytics using hierarchical models for analyzing team performance. In *Proceedings of the 15th International Conference on Computer-Supported Collaborative Learning-CSCL 2022*, pp. 403-406. International Society of the Learning Sciences
- Vatrak, C., Biswas, G., Mohammed, N., and Goldberg, B. S. (2022). Automated assessment of team performance using multimodal bayesian learning analytics. In *Proceedings of the 2022 Interservice/Industry Training, Simulation and Education Conference (I/ITSEC)*. National Training and Simulation Association
- Davalos, E., Vatrak, C., Cohn, C., Horn Fonteles, J., Biswas, G., Mohammed, N., Lee, M., and Levin, D. (2023). Identifying gaze behavior evolution via temporal fully-weighted scanpath graphs. In *LAK23: 13th International Learning Analytics and Knowledge Conference*, pages 476–487
- Vatrak, C., Biswas, G., Mohammed, N., and Goldberg, B. S. (2023). A framework for performance assessment across multiple training scenarios using hierarchical bayesian competency models. In *Proceedings of the 2023 Interservice/Industry Training, Simulation and Education Conference (I/ITSEC)*, page In Press. National Training and Simulation Association

- Vatrak, C., Cohn, C., Davalos, E., Biswas, G., Lee, M., Levin, D., Hall, E., and Holt, J. E. (2023c). A tale of two nurses: Studying groupwork in nurse training by analyzing taskwork roles, social interactions, and self-efficacy. In Proceedings of the 16th International Conference on Computer-Supported Collaborative Learning-CSSL 2023, pp. 217-220. International Society of the Learning Sciences
- Vatrak, C., Lee, M., Cohn, C., Davalos, E., Levin, D., and Biswas, G. (2023). Prediction of students' self-confidence using multimodal features in an experiential nurse training environment. In International Conference on Artificial Intelligence in Education, pages 266–271. Springer

Workshop and Symposium Publications

- Vatrak, C., Mohammed, N., Biswas, G., and Goldberg, B. S. (2021). Gift external assessment engine for analyzing individual and team performance for dismounted battle drills. In Proceedings of the Ninth Annual GIFT Users Symposium (GIFTsym9), page 107. US Army DEVCOM–Soldier Center
- Vatrak, C., Mohammed, N., and Biswas, G. (2022). Promoting explainable feedback in simulation based training through contrasting case exemplars. In Virtual Workshop Proceedings: Advances and Opportunities in Team Tutoring, page 11
- Vatrak, C., Mohammed, N., Biswas, G., and Goldberg, B. (2022). Moving beyond training doctrine to explainable evaluations of teamwork using distributed cognition. In Generalized Intelligent Framework for Tutoring (GIFT) Users Symposium (GIFTsym10), page 127
- Vatrak, C., Mohammed, N., Biswas, G., Roberts, N., and Goldberg, B. (2023). A comparative analysis interface to streamline after-action review in experiential learning environments. In Proceedings of the 11th Annual Generalized Intelligent Framework for Tutoring (GIFT) Users Symposium (GIFTsym11), page 101. US Army Combat Capabilities Development Command–Soldier Center
- Vatrak, C., Biswas, G., and Goldberg, B. (2023). A theoretical framework for multimodal learner modeling and performance analysis in experiential learning environments. In Guided Experiential Learning Workshop at 2023 International Conference on Artificial Intelligence in Education. CEURWS

REFERENCES

Gautam Biswas, Professor of Computer Science
Vanderbilt University
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