# Let's Code Visualization: A Taxonomy-Based Multimodal System Supporting Students in Improving Visualization Literacy Through Coding

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Abstract

Visualization literacy involves the ability to critically interpret and create effective visualizations, which is essential in today's data-driven world. Existing approaches like gamification, focus on introducing fundamental information but ignore visualization programming skills, which is important in the future to create complex and dynamic visualizations. Furthermore, students possess varying levels of knowledge and unique needs when it comes to visualization literacy, making it challenging for lecturers to address all these differences effectively. Thus, there is a need for a system that supports students in learning visualization literacy through coding by providing personalized guidance tailored to their learning progression and promoting independent learning which can reduce lecturers' workload. To address this need, we first conduct interviews with domain experts to identify objectives to focus on when trying to improve visualization literacy. Based on our findings, we developed a taxonomy-based multimodal system, VL-Mentor, aimed at improving students' visualization skills through coding. Grounded in constructivist principles and aligned with revised Bloom's Taxonomy, our system integrates three key components: a cheat sheet, a linter, and a large language model (LLM), designed to guide students through various levels of learning progression. We evaluated our materials with lecturers and students to assess their effectiveness and usability in enhancing visualization literacy.
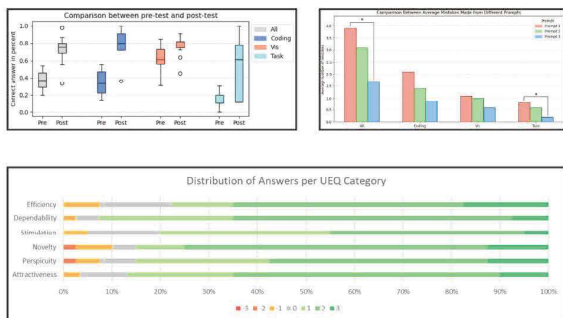
Visualization Literacy Objectives
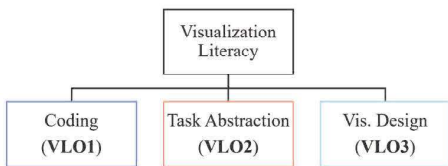
Our Contribution

1. VL-Mentor, a system with three components created to provide students with personalized feedback and promote independent learning.
2. User study from both students and lecturers evaluating the effectiveness and usability of VL-Mentor.

VL-Mentor

1. Cheat Sheet 2. Visualization Linter 3. Large Language Model (LLM)

Result

Conclusion

This study introduced VL-Mentor, a taxonomy-based multimodal system aimed at improving students' visualization literacy skills through coding. VL-Mentor is grounded in constructivist principles, which emphasize learning by doing and align with Bloom's revised taxonomy, providing structured learning progression. VLMentor was designed to support lecturers in teaching visualization literacy by providing personalized feedback that facilitates independent learning for students, thereby reducing the workload for lecturers. VL-Mentor focuses on improving three Visualization Literacy Objectives (VLO): coding, task abstraction, and visualization design. VL-Mentor integrates three components: a cheat sheet, a Vega-Lite linter, and a large language model (LLM), to support students through various levels of learning progression. The evaluation demonstrated VL-Mentor's effectiveness in enhancing visualization literacy and its usability for both students and lecturers.

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