The Future of Engineering Education
2024 Annual Conference & Exposition

Oregon Convention Center
Portland, OR . June 23 - 26, 2024

ASEE

Paper ID #43507

Board 239: Developing an Instructor's Interface for FossilSketch Application to Provide Knowledge-Sharing Collaborations Between Science Educators

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Developing an Instructor's interface for FossilSketch application to provide knowledge-sharing collaborations between science educators

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Abstract

We developed FossilSketch software for teaching the identification of microfossils in undergraduate geoscience classes. The FossilSketch application was used for outreach and classroom activities in various courses, including geology, paleontology, and biology. We have been continuously improving the existing student dashboard to provide more autonomy and to improve motivation and knowledge retention for students. Many instructors expressed their interest and need in the tool and associated projects and the need for broader sustainability. Based on the identified need, we are developing the instructors' dashboard to allow instructors to create, share, and customize classroom activities.

Background and motivation

To provide authentic context and activities to students enrolled in geoscience courses, we developed the Fossilsketch software with the support of a previous National Science Foundation grant #1937827. Results of Fossilsketch testing in a paleontology course for junior and senior geology majors showed that students who used Fossilsketch were able to understand the process of microfossil identification, recognize morphological characteristics, and achieve a correct identification better than those who did not use it [1–4]. Analysis of Hispanic student survey responses showed that their perception of learning micropaleontology improved with the introduction of FossilSketch, and hybrid learning mode was the most favourable learning mode for Hispanic students, when the flexibility of class mode during 2021-2022 and use of FossilSketch improved Hispanic students' attitudes to learning [5]. Additionally, we observed statistically significant improvement in all students' attitudes towards micropaleontology. Students' survey feedback after using Fossilsketch showed more positive feelings towards learning about microfossils (authors unpublished data). The pilot version of Fossilsketch currently can teach students the basics of specimen identification and ecological interpretations using benthic Foraminifera and Ostracoda. Foraminifera and Ostracoda are commonly used in industrial, environmental, and scientific applications [6, 7]. Fossilsketch educational materials include educational videos, mini-games, and practice exercises/assessments. It provides automatic feedback and allows for self-paced learning, a list of suggested exercises are available at the National Association for Geoscience Teachers website (NAGT) [8].
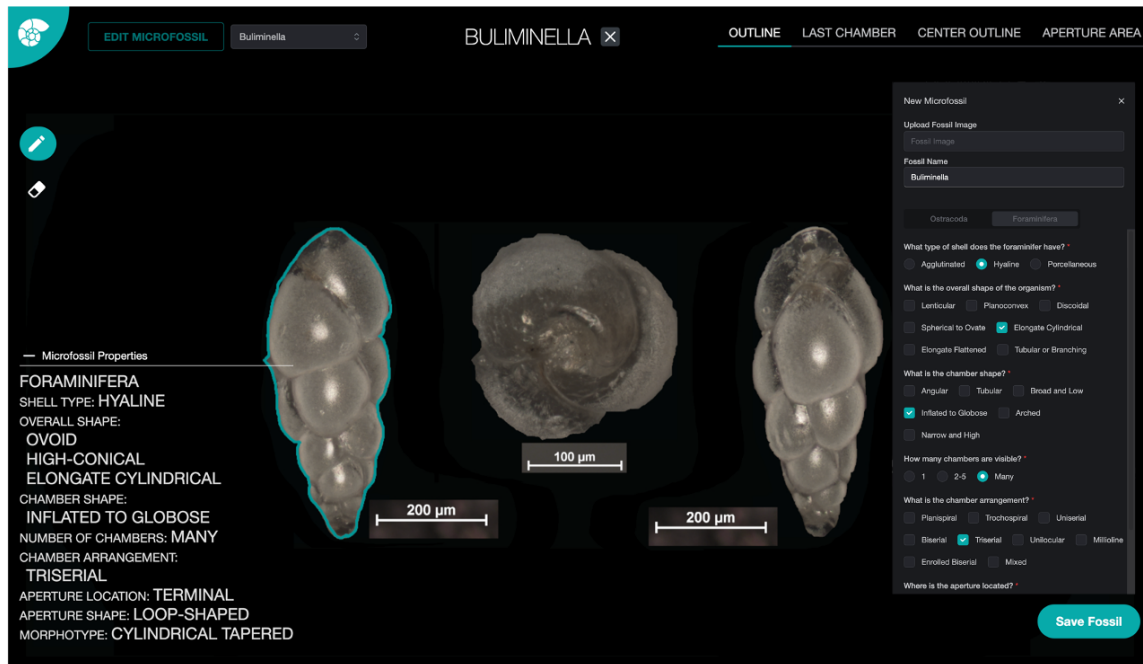
Figure 1: Mock-up of the screen that will allow instructors to upload new microfossils and/or edit existing microfossil properties

Instructors expressed their interest in the tool and associated projects and expressed the need for enhancement for broader sustainability. Post COVID-19 pandemic, faculty have recognized the need to provide technology-mediated learning environments with online components that could enhance students' learning experiences. Based on the identified need, with this project, we propose to advance the features and capabilities of FossilSketch by: 1) developing an instructor dashboard to help them create, share, and customize classroom activities (Fig.1); and 2) improving the existing student dashboard to provide more autonomy to users and to improve motivation and knowledge retention.

Study Goals and Future directions

The overarching research goal for this project is to enhance the existing Fossilsketch software by adding the instructor's interface, as well as novel features for the student's interface to improve and assess students' learning and knowledge retention in geosciences, and create a platform for instructors to collaborate and share their educational resources to enrich student classroom and research experiences.

The project team will assess the effect of the Fossilsketch in three courses taught in the Department of Geology & Geophysics, and in several courses at TAMU Galveston at Texas A&M University. Additional testing will be done by instructors and micropaleontologists at other universities who expressed their interest in using Fossilsketch for their classes or research projects, both experts and non-experts in micropaleontology.

Methods

We propose an explanatory sequential mixed methods research design to develop and evaluate the effectiveness of FossilSketch. The approach will allow us to use both qualitative and quantitative data for the convergence of Fossilsketch results on both students and instructors. Specifically, the data will help us to triangulate students' self-regulation, as well as instructors' perceptions on the use of FossilSketch.

Broader Impacts

FossilSketch will be introduced and evaluated at Texas A&M University, an HSI with a diverse student population. As the core principle of the tool relies on an interactive interface, with authentic context and activities, it will help to engage students effectively. The tool will help students better understand, retain, and engage with the topics they learn. Students will learn valuable skills that may open job opportunities and inspire research interests. Approximately 300 undergraduate students will participate in our study and once the novel software features are fully developed, many students will be potentially affected through secondary effects, including outreach activities.

FossilSketch will transform the geoscience community by providing a resource to share and collaborate between geoscience educators for lessons, activities, assessment, outreach, and pedagogical practices. It will enable instructors to teach students in their courses and assign research projects. We envision that virtual learning will continue to be in high demand. In the future, the FossilSketch can be implemented across the nation in undergraduate science, biology, and paleontology classes. This application has great potential to be developed into an online version of the course (MOOC).

1 Acknowledgements

References

[1] A. Stepanova, C. Belanger, S. Anwar, C. Stanley, A. Nath, J. Cherian, and T. Hammond, "Using the interactive software fossilsketch to teach micropaleontology to undergraduate students," *Journal of Geoscience Education*, pp. 1–21, 2024.

[2] A. Stepanova, C. Belanger, R. Lara-Garduno, T. Hammond, C. Stanley, and S. Raven, "Fossilsketch - an innovative way to teach micropaleontology in undergraduate geoscience classes, first results of classroom testing," in *19th International Symposium on Ostracoda*, Lyon, France, July 20 2022.

[3] A. Stepanova, C. Belanger, T. Hammond, B. Williford, R. Lara-Garduno, C. Stanley, and S. Raven, "Fossilsketch - an innovative way to teach micropaleontology in undergraduate geoscience classes," in *AGU Fall 2021 meeting*, New Orleans, LA, December 13 2021.

[4] A. Stepanova, S. Anwar, C. Belanger, T. Hammond, and C. Stanley, "Board 416: Undergraduate student experiences with FossilSketch software to learn basics of micropaleontology." in *In 2023 ASEE Annual Conference & Exposition.*, Baltimore, June 2023, https://peer.asee.org/board-416-undergraduate-student-experiences-with-fossilsketch-software-to-learn-basics-of-micropaleontology.

[5] A. Stepanova, S. Anwar, and T. Hammond, "Work-in-progress paper: Using active learning educational software to improve hispanic students learning at an HSI," in *2023 IEEE Frontiers in Education Conference (FIE)*. IEEE, 2023, pp. 1–5.

[6] H. A. Armstrong and M. D. Brasier, "Foraminifera," *Microfossils, Second Edition*, pp. 142–187, 2005.

[7] A. J. Smith and L. D. Delorme, "Ostracoda," in *Ecology and classification of North American freshwater invertebrates*. Elsevier, 2010, pp. 725–771.

[8] C. Belanger and A. Stepanova, "Fossilsketch: Identify and analyze microfossils for environmental interpretation," in *National Association of Geoscience Teachers (NAGT). Teach the Earth.*, July 2023, https://serc.carleton.edu/teachearth/activities/277504.html.