SedimentSketch, teaching tool in and beyond the sedimentology classroom

Anna Stepanova[1], Saira Anwar[2], Juan Carlos Laya[3], Carlos A. Alvarez Zarikian[4], Nancy E. Martinez[3], Tracy Hammond[1]

[1]Dept. of Computer Science & Engineering; [2]Dept. of Multidisciplinary Engineering; [3]Dept. of Geology; and [4]International Ocean Discovery Program at Texas A&M University, College Station, TX

Abstract

Hispanic student performance indicators are markedly different from students of other ethnicities, with Hispanic students consistently having lower GPAs at graduation (Fig. 1). The *SedimentSketch* application is a visual, personalized, and dual language tool that combines new curricular materials and sketch recognition algorithms to improve student learning through sketching exercises and automatic, instantaneous feedback. We hypothesize that *SedimentSketch* can transform the higher-education geoscience curriculum for Hispanic Serving Institutions (HSI) by enabling geoscience students to interact with the material and receive helpful feedback outside of class, and by cultivating a more inclusive learning environment. The goal of this project is to use SedimentSketch to help close the gap between Hispanic and non-Hispanic students' GPAs, situational interest in geoscience courses, and STEM career trajectories.

Study Goals

Develop and evaluate the effectiveness of the *SedimentSketch* application with the goal of closing the gap between Hispanic and non-Hispanic students' GPAs in geoscience and STEM fields.

This project will provide a new educational tool for instructors to teach the basics of sedimentology, enrich undergraduate geoscience course curricula, and support Hispanic students by improving accessibility, reducing the language barrier (providing Spanish language support), and facilitating learning through sketching and visualization.

Methods

Our team will assess the effectiveness of *SedimentSketch* in several courses in the College of Arts & Sciences (CoAS) at Texas A&M University (TAMU).

Different types of classroom testing will be used to evaluate the effectiveness of *SedimentSketch* in students' learning. For this purpose, we will collect pre- and post- surveys, students' demographics, surveys on situational interest, career trajectories, and technology acceptance. Additionally, conceptual assessment has been designed and will be implemented at multiple time points within a school semester. The data will be processed and analyzed to quantify the students' progress and assess the effectiveness of *SedimentSketch* as a teaching tool.

Preliminary Results

We developed the *SedimentSketch* interface (Figs. 2-6) and educational materials following a sedimentology course curriculum, and added additional elements such as 3D sedimentary rock models, interactive games, and exercises (Fig. 4).

We collected Control Group data in undergraduate geoscience courses teaching sedimentology at TAMU in Spring 2024. Although many assessment instruments have been developed for geosciences, no validated sedimentology-specific assessments exist. We designed and validated the conceptual assessment to assess students learning before and after they learned sedimentology in traditional class, and later by using *SedimentSketch*. For the validation process, we conducted conceptual assessments at two time points in the traditional instruction of two geoscience courses: 'Sedimentology & Stratigraphy' and 'Geology of Petroleum'. Results showed students often don't know how to explain basic sedimentology terms and simple routine steps to identify sedimentary rocks. Students were lacking understanding of the applications of sedimentology for climate and sea-level change reconstruction. In contrast, they performed much better when providing examples of industry applications. These results may suggest students understand the end application, but lack conceptual knowledge on how to perform sedimentological activities.

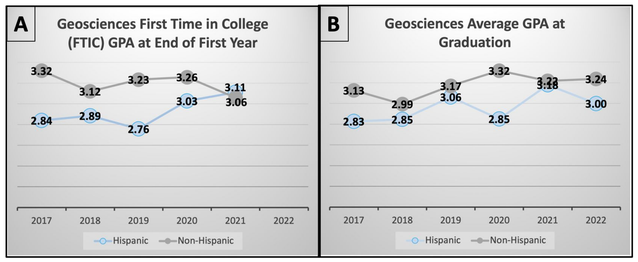

Fig. 1. Geoscience students GPA: **A**) First Time in College (FTIC) students at the end of the 1st year; and **B**) Average GPA at graduation.

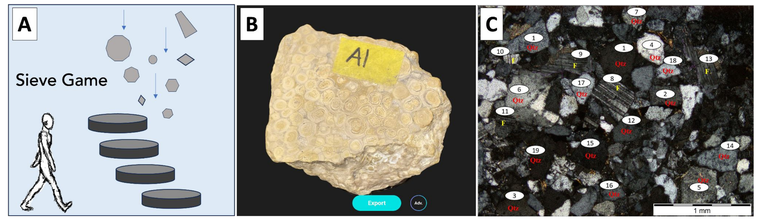

Fig. 2. Examples of content of SedimentSketch Modules: **A**) Sieve game to learn about sediment grain size. **B**) 3D Sedimentary Rock image. **C**) Thin section with different types of mineral grains marked up.

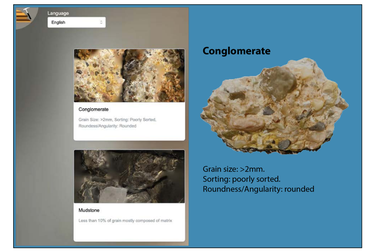

Fig. 3. Example of 3D Sedimentary rock image.

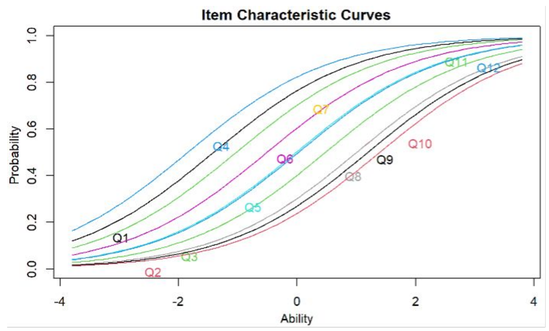

Fig. 7. Questions characteristics curves reflecting questions' difficulty level, based on students' ability and probability

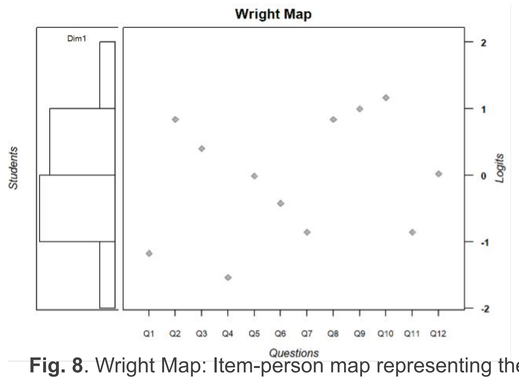

Fig. 8. Wright Map: Item-person map representing the location of students and questions on the same scale

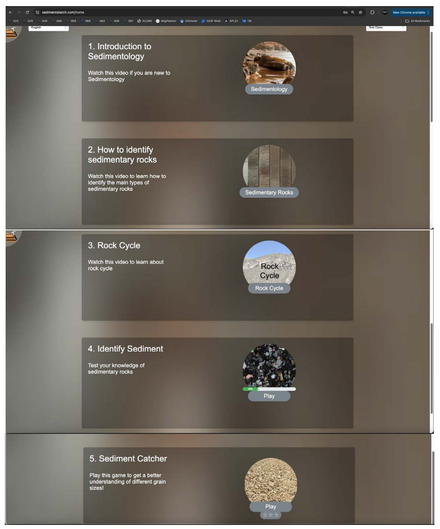

Fig. 4 (right). *SedimentSketch* modules:
A) Educational videos.
B) 3D rock images.
C) Games and Exercises.

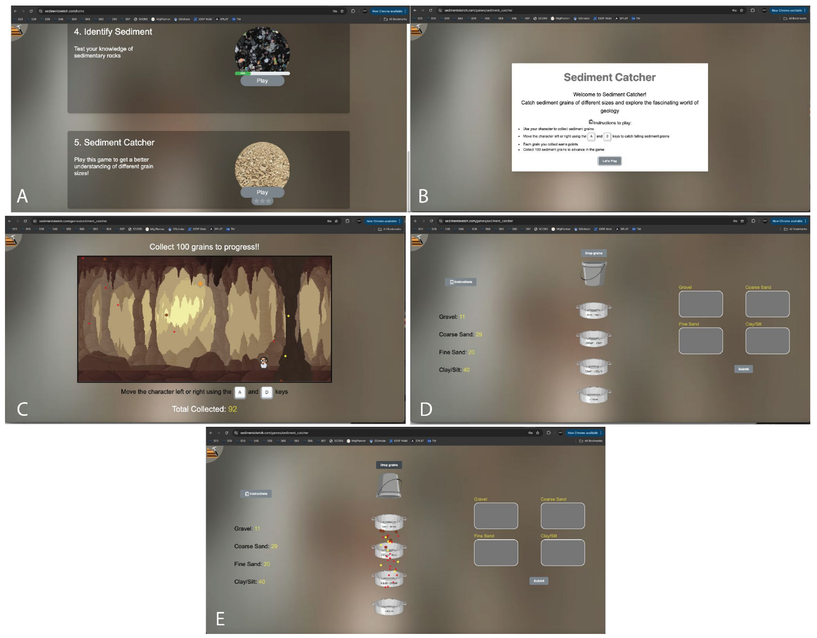

Fig. 5. Sediment Catcher game. **A**) View of the main landing page. **B**) Instructions. **C**) Catching grains to reach a 100 count. **D-E**) Sieving and sorting sediments by grain size.

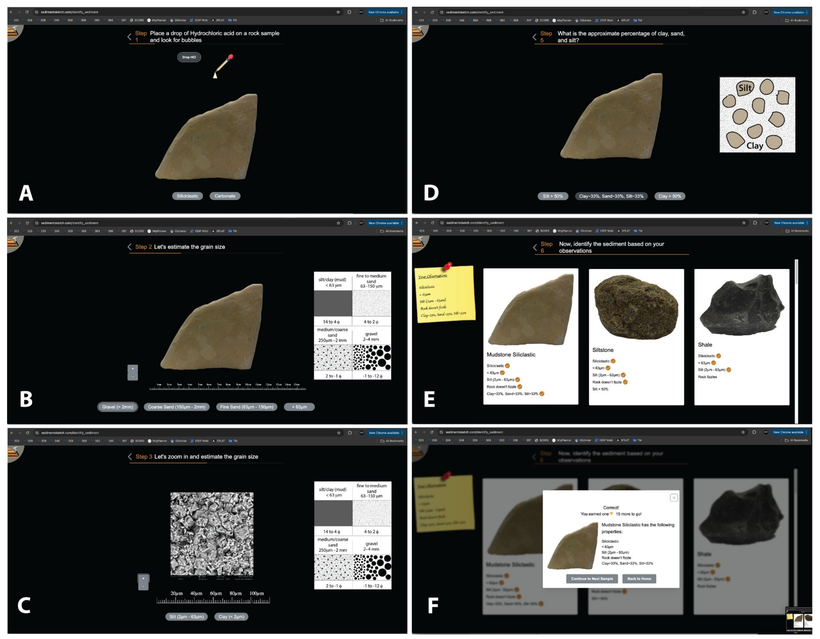

Fig. 6. Sedimentary rock identification exercise. Steps: **A**) Add HCl. **B–D**) estimate the grain size. **E**) Identify sediment based on one's observations. **F**) Final screen with sediment identification result.

This work is supported by the National Science Foundation Grant #2318386.

TEXAS A&M UNIVERSITY Department of Multidisciplinary Engineering | TEXAS A&M UNIVERSITY Department of Computer Science & Engineering | IEEI INSTITUTE FOR ENGINEERING EDUCATION & INNOVATION | TEXAS A&M UNIVERSITY Geology & Geophysics | SRL SKETCH RECOGNITION LAB TEXAS A&M UNIVERSITY | IODP INTERNATIONAL OCEAN DISCOVERY PROGRAM