

Supporting Secondary Students Earth Science Knowledge and Engineering Design Skills with Mobile Design Studio

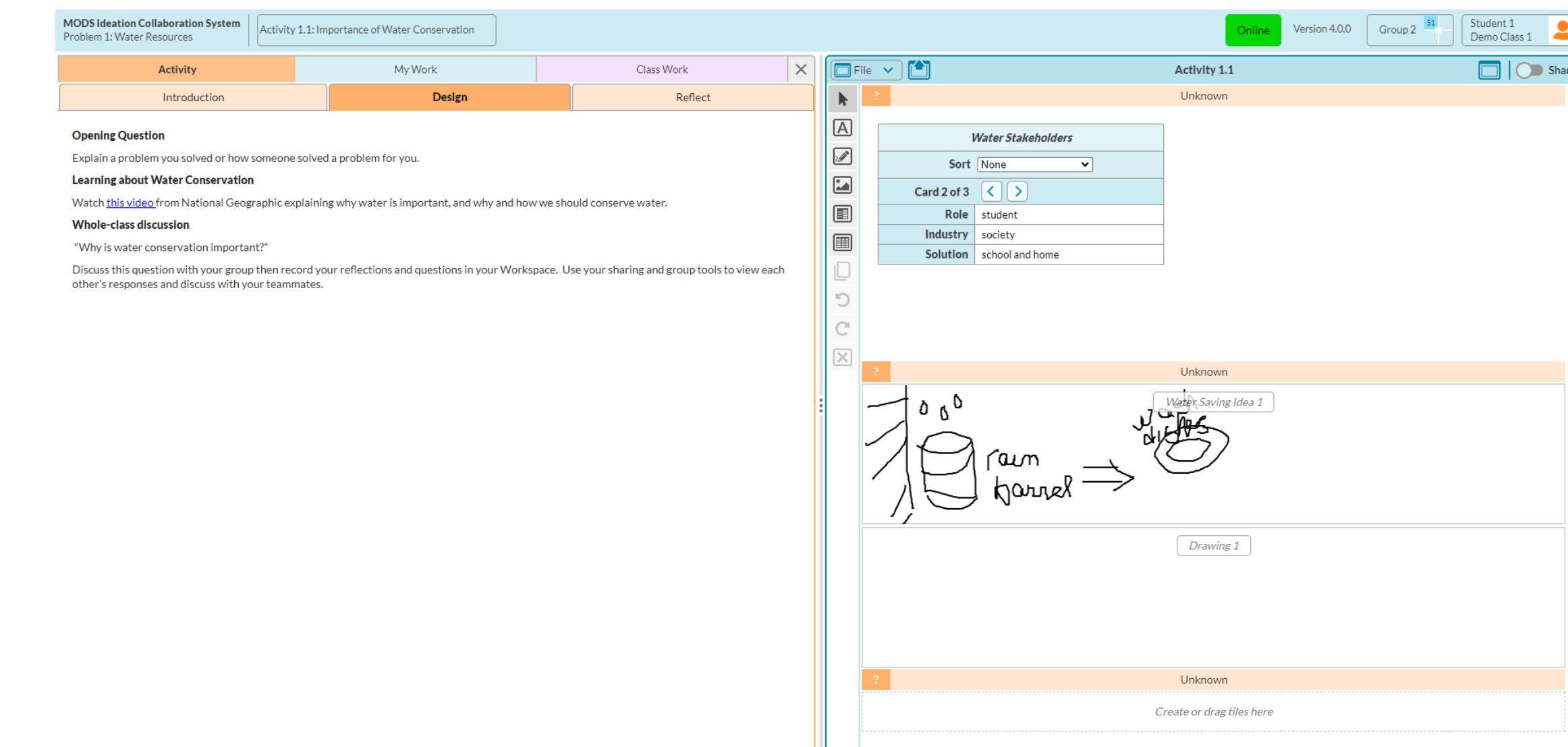
Project Objectives

1. Conduct **fundamental** and **design-based** research with secondary students
2. Develop design challenges for complex **Earth science** problems
3. Develop Mobile Design Studio as a Collaborative **Front-End Design Platform**
4. Develop and integrate an **AI-powered** design mentor

What We've Done So Far

Problem Statement In what ways can your community access water through collecting it, reducing its use, or leveraging other resources?		
Lesson Title and Objectives	Main Activities	Deliverables
1.1 Importance of Water Conservation Students will be able to explain at least one reason why water conservation is important in their lives and/or communities.	<ul style="list-style-type: none"> → Reading about water conservation → Small group and whole class discussion → Introducing a problem statement 	Engineer notebook: Why is water conservation important to me and my community?
1.2 Stakeholder Mapping Students will be able to identify at least five stakeholders. Students will be able to identify commonalities among groups of stakeholders.	<ul style="list-style-type: none"> → Creating a stakeholder map → Reframing the problem statement 	Stakeholder map Notes in engineer notebook
1.3 Scoping Students will be able to organize factors they find most relevant to the design problem in a scoping table.	<ul style="list-style-type: none"> → Whole-class listing of different factors → Creating a scoping table 	Scoping table Notes in engineer notebook
1.4 Stakeholder Interviews Students will be able to craft at least three interview questions. Students will be able to analyze interview data to determine at least one need for their design solution.	<ul style="list-style-type: none"> → Developing interview questions → Conducting short interviews with other students → Reading data to learn new things and develop requirements 	Interview Interview data Needs, written Notes in engineer notebook
1.5 Research Learning Objectives: Students will be able to discuss solutions to water conservation. Students will be able to craft additional needs based on research (if needed).	<ul style="list-style-type: none"> → Reading infographics about water conservation solutions → Crafting "I wonder" statements → Independent research 	Research notes Notes in engineer notebook
1.6 Concept Generation, Drawing Ideas Students will be able to sketch five or more solutions to the design problem that meet the needs they identified	<ul style="list-style-type: none"> → Ideating with multiple strategies <ul style="list-style-type: none"> ◆ Design Heuristics ◆ Radical and Incremental Framing 	5 or more design sketches Notes in engineer notebook
1.7 Presentation & Reflection Students will be able to explain their design story.	<ul style="list-style-type: none"> → Explaining most important moments in the design process. → Providing feedback to other students → Reflecting in their engineer notebook 	Storyboard Oral presentation Engineer notebook

MODS & Design Mentor

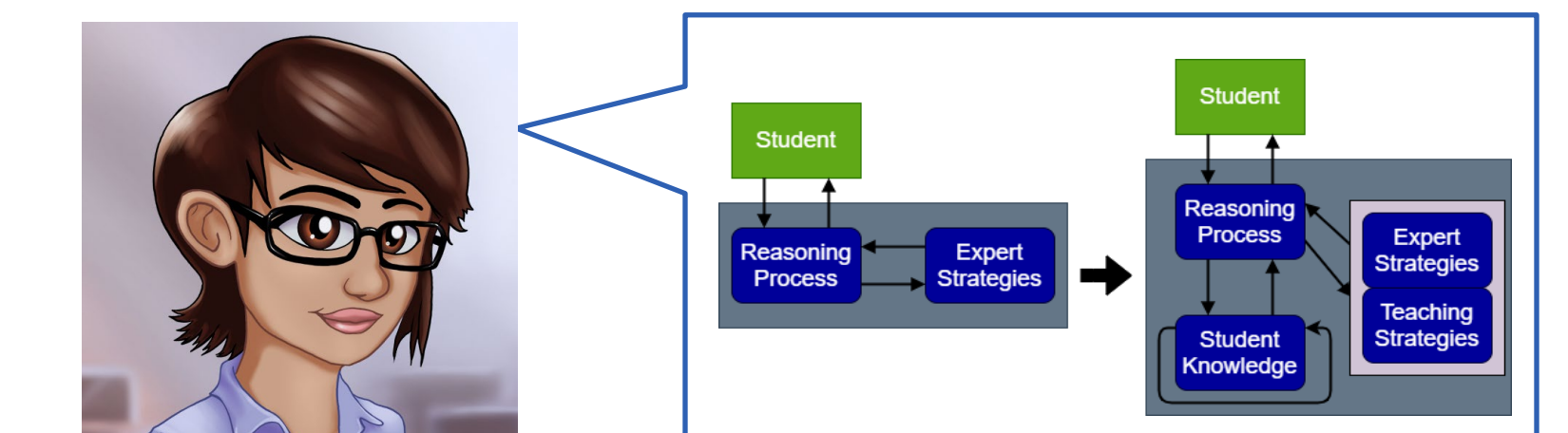


MODS student interface view

Research Questions

RQ1: How do students engage in design thinking in the project? What informed designer behaviors related to social and contextual awareness and creativity are promoted through the intervention?

RQ2: In what ways and to what extent do students integrate science, engineering, and social considerations, into their understanding of the problem, concept generation and justification?

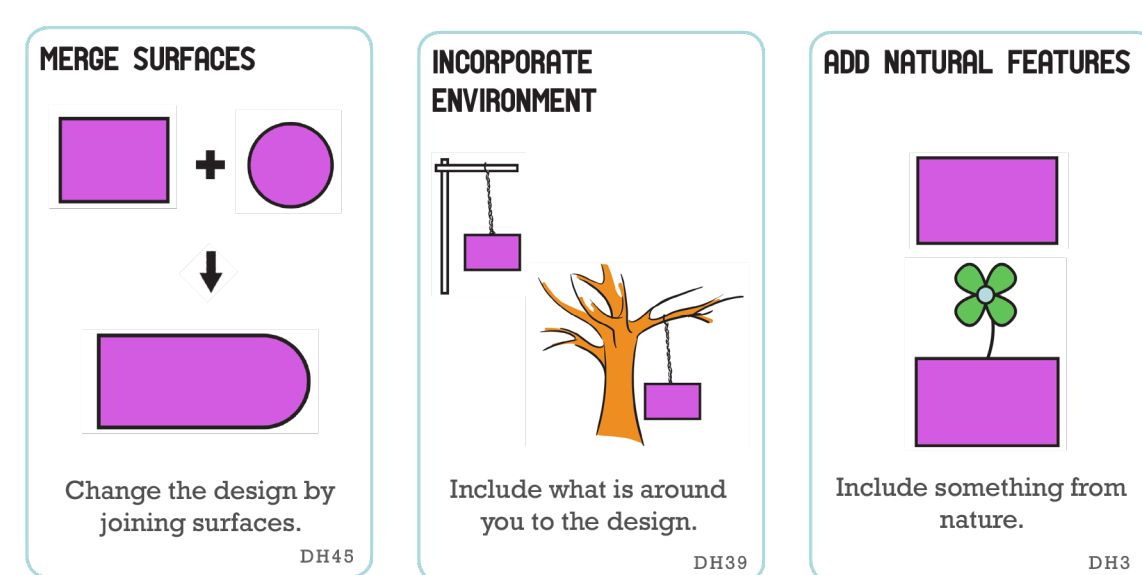


Agent Architecture



Design Mentor

Curriculum Overview



Design Heuristic Cards Example

RQ3: How do students interact with the design mentor while designing, and to what extent do students' design practices, and STEM integration outcomes differ across versions of the design mentor?

RQ4: In what ways and to what extent do these design activities, impact students' interests, perceptions of science and engineering and engineering self-efficacy?

	2022			2023												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Technology Development																
MODS design methods vision and benchmarking																
Design mentor research and conceptualization																
MODS design methods development																
Design mentor development																
Curriculum Development																
Envisioning engineering design challenges																
Co-design of curriculum with expert teachers																
Professional development planning																
Research Design																
Initial user testing																
Teacher professional development training																
Initial piloting																

Development Plan

Research Team & Acknowledgements

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