ML Support: Requirements

Goal:

- Provide educators with a tool that makes it easier and more practical to personalize their instruction by using generative AI as their thought partner.

Activities

Below are various activities undertaken within the scope of this project. The progress of each activity will be tracked and regularly updated, with status reports available as needed.

- Educators, SMEs, and project team co-designs a phased approach.
- SME provide their expertise for the design and development of the AI App.
- Teachers receive professional development on addressing learner variability, a general background on Generative AI, and how to use the AI App.
- Vanguard educators beta test the AI App as we iterate through phases.
- Teachers remix units, lessons, and worksheets as needed and are alerted when content standards are missing.
- Teachers deliver customized lessons to students.
- Teachers use finished products to determine the success of the revised curriculum.

AI App Roadmap:

Start with a minimal viable product and then spiral additional requirements as time, funding, and resources permit. Our NSF DRK-12 plan outlines some ideas for this work.

- Phase I: Build an AI App that provides personalization unit planning, lesson planning, including teacher and student-facing materials based on learner variability knowledge bases
  - Knowledge bases:
    - Universal Design for Learning (UDL)
    - Best practice for supporting multilingual learners (MLL)
    - Inclusive practices to support equitable teaching strategies: Culturally Relevant/Sustaining Education (CRE)

- - - Best practices for supporting learners with social and emotional needs (SEL)
      - Students with special education accommodations: Individualized Education Program (IEP), including Neurodiversity
      - Students with socioeconomic challenges (Low-SES)
      - Students at all levels of academic readiness (below grade level, at grade level, above grade level - gifted and talented)
    - Target Users - Maryland computer science educators in PreK-5.
    - Design and implement in subphases:
      - Phase Ia: Provide Retrieval Augmented Generation (RAG) based on curated knowledge bases.
      - Phase Ib: Fine-tune the model by employing subject-matter-experts (SME)s who are knowledgeable on the above domains of learner variability.
      - Phase Ic: Elevate the professionalism of educators using the App by supporting critique of units based on Undertanding by Design (Ubd), the critique of lessons using the Danielson Framework for Teaching (FFT), and elements of productive struggle.
    - Evaluation of generative AI outputs
      - SME rating
      - [Differentiation Rubrics](#)
- Phase I: Extend the App to support coaching on additional knowledge bases
  - Knowledge Bases
    - CS best practices (Big Book of Computer Science Pedagogy, Big Book of Computer Science Content)
    - AI TPACK
    - SAMR
- Phase 3: Extend the App to support coaching on integrating CT and/or CT into other content areas (e.g., ELA, Math, Science, Social Studies, Health).
- Phase 4: Expand the App to target K-12 educators nationwide.

Exemplars:

- [Sharing Culture: Algorithms 2-3](#)
- [Acorn Was a Little Wild: Algorithm K-1](#), (Beebots) [slide deck](#)
- [Agent Lion: ScratchJr_K-2](#), (ScratchJr) [slide deck](#), [student handout](#)

Design Phase

I: Personalization Unit and Lesson Planning

a: RAG with Personalization Knowledge Bases

1. For the first minimal viable product (MVP), the design below will be used; however, it will initially focus on implementing multilingual learner variability at the lesson level.

Lesson Planning

Call Function Personalize all student clusters
For each student cluster:
  Call process a student cluster
    For each knowledge base in a student cluster
      Call Process a Knowledge Base
    Evaluation Differentiation
Evaluate Revised Lesson plan

Note: may want to synthesize knowledge bases into checklist.

Input	Process	Prompt Template	Output	Next
Function: Personalize all student clusters				
Lesson to be personalized Student Cluster(s) for the personalization See the Student Clusters tab in the [personalization spreadsheet](#). Matching Knowledge Bases URLs (Also found in the Student Clusters tab of this spreadsheet.)	Read the lesson to be personalized. For each applicable student cluster, call the **Function: Process a Student Cluster.** The modified lesson should adhere to the lesson plan format of the original lesson plan.		Modified lesson plan with accepted recommendations for adapting the lesson incorporated.	Ask the user if they want to Call the **Function: Evaluation Differentation**
Function: Process A Student Cluster				
Lesson Plan Student Cluster	For each student cluster, call the **"Process A Knowledge Base"** function.		Recommendations for adapting a Lesson to address a	

			specific Student Cluster.	
Function: Process A Knowledge Base				
Lesson Plan Knowledge Base Link	Make recommendations for how to adapt the lesson. Ask the user whether they would like to accept or reject these changes. Here is a sample prompt for this work: You are an expert instructional designer and I am an elementary school teacher, ask me to supply the file with the lesson plan to work on, as well as, a spreadsheet to personalize lessons for my class. With this input, make suggestions on how I can adapt the lesson to suit the needs of the clusters of learner variability. Prompt me to accept, reject, or modify these recommendations. Format the output as a new lesson plan with all the accepted recommendations included.		Recommendations for adapting the lesson based on the knowledge base.	
Evaluate Recommendations for				

adaptations.				
Adapted Lesson Differentiation Rubric (To be developed - a mashup of what exists plus input by SME).	Users can ask the AI app to critique the differentiated lesson based on this rubric, and ask if they want any further changes based on this evaluation.		Revised Lesson	Ask if the user wants to call the **Function: Overall Evaluation.**
Evaluation lesson overall				
Revised Adapted Lesson Danielson Framework for Teaching	Users can ask the AI App to critique the lesson based on the Danielson framework and request any further changes based on this evaluation.		Revised Lesson	Ask if the user wants any further edits.

Resource Generation

When a user has an acceptable version of a lesson plan, they may need adapted student handouts or teacher-facing materials (like a choice board or slide deck). At some point, the AI app will help reduce the teacher's workload and generate these materials.

Unit planning

We have not beta tested this in real classrooms. When we do, we may find that this process of personalization at the individual lesson level may be too onerous for the teacher's limited time and resources. If so, we may find it is more practical to accomplish this at a unit level. In this use case, the standards to be assessed would be supplied to the AI app, and it would recommend variations for a final summative assessment.