Software Support for "A's for All"

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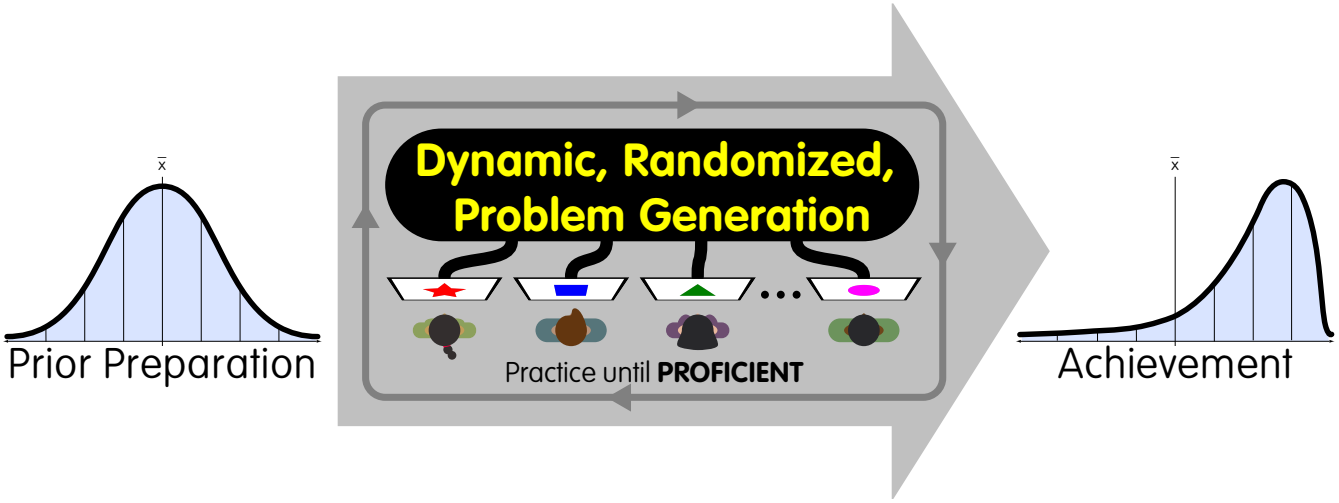

Figure 1: Our proficiency learning model that allows us to achieve "A's for All".

CCS CONCEPTS

• **Social and professional topics** → **Student assessment**.

KEYWORDS

assessment, pedagogy, communities of practice, scalable

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1 MERIT AND NATURE

The SIGCSE-MEMBERS mailing list of the ACM Special Interest Group in Computer Science Education is the main forum for educators worldwide to discuss computing education research, pedagogy, and curriculum [8]. In early 2022 it was abuzz with several connected movements: *growth mindset* [3, 5], *proficiency (aka mastery) learning* [2], *grading for equity* [1, 4], and *specifications grading* [7]. Each of these is an important step toward the Holy Grail: *A's for All (as time and interest allow)*; the "A" line doesn't move, but *every* student should be given an opportunity to achieve proficiency and earn it, as long as they are willing to put in the time and effort it might take [6]. The mantra is not *"fixed time, variable learning"*, but *"fixed learning, variable time"* [10].

Many of us have been associated with this movement for quite some time, and it is only now that the software, curriculum, and policies have evolved to the state that we are ready to demonstrate how it works "at scale". The goal of this demo is to highlight the software infrastructure required for educators to achieve it in their courses and institutions; this is associated with the workshop *Achieving "A's for All (as time and interest allow)"*.

2 HOW THE DEMO WILL BE EXECUTED

From ten miles up, the process to move a course to an "A's for All" paradigm can be divided into two parts: *pre-term* before the class starts, and *in-term* work of actually delivering the course and

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monitoring student progress. We also want to demonstrate the student view of the experience, which is quite customizable. Our demonstration will show these in reverse order.

2.1 Student Experience

When a student signs up for an *"A's for All"* course, the most important initial element is messaging through the syllabus and first class meeting. We will share best practices we have learned here to reset their thinking that the course will be assessed through a "bag of points" to earn [4], that the grading will be a zero-sum game, and that the pace of the course is fixed, whether they are able to succeed or not.

When the students first enroll, a custom link is shared with them that serves as their private dashboard to their progress. As they achieve proficiency with the material, their dashboard updates with their progress through the course. Here, the instructor can customize the experience in countless ways, through visualizations, custom *Concept Maps* of the course that change color over time, or with notes of encouragement. We will give all demo attendees a sample link and show how it will update as the course elements are completed. We will also show how the students interact with practice and higher-stakes exams, as well as complete skills-based projects, how these are auto-graded, and finally "pushed" to update the single source-of-truth record that keeps track of it all.

2.2 In-term Instructor Experience

Instructors also need a dashboard to see progress of their students; our "spreadsheet" interface could certainly be modified to suit the needs of the instructor. We chose a *Google Sheet* as our single source-of-truth; scripts can *push* information into it when auto-graders run or exams are completed, and at any point the instructor can *pull* the current data to see the pulse of the class.

2.3 Pre-term Instructor Experience

This is where the real work is involved to make this happen. We will show how we build a concept map to encode the dependencies of the topics in the course. This guides the creation of assessment items and course projects, as well as the view the students see in their dashboard.

We author *formative* and *summative assessments* using software created for Computer-Based Testing (CBT) called *PrairieLearn*, a free and open-source student learning tool that provides almost unlimited flexibility in the types of questions it can support and auto-grade. PrairieLearn (PL) was developed at the University of Illinois, Urbana-Champaign as a platform for mastery-based online homework in STEM courses [9] and has evolved to support computer-based exams [11], formative assessments of many types, and auto-graded programming projects. It is currently being used in over 100 courses across a broad range of STEM disciplines (CS, Engineering, Math, Chemistry, Nutrition) and has seen significant recent uptake by other prominent large CS departments. Two aspects of the tool particularly appeal to CS instructors. The tool is free and open-source, so faculty maintain control of their content and can freely share it with students. Also, it provides an unconstrained question-authoring API that allows for sophisticated auto-grading question generators (rather than individual question instances).

3 HOW VISITORS WILL INTERACT WITH IT

Participants at Learning @ Scale may want to focus on one of the three roles we highlighted earlier, that of the *student*, *in-term instructor*, *pre-term instructor*, or all three. If they want all three, then it will be similar to that of a demo at a trade show – they can just follow along as we show these one by one. We will share URLs that will give them a view of a sample student dashboard, as well as how it changes when an assignment is submitted or an exam is completed. We will enroll attendees in our sample course and let them take some of the PrairieLearn assessments and complete sample programming projects, which will be assessed by the auto-grader. Then we will share the link for the in-term instructor view of the course, which will update as other participants are completing their assignments.

Most of the time we will dedicate to the pre-term instructor experience. After showing how to create the concept map (which involves editing a text file and then rendering it using open-source GraphViz software), we will spend the remaining time having the participants learn how to create questions in PrairieLearn. This involves adding them as instructors to a sample course, and having them follow along in the system to customize the questions and add them to a draft assessment. We will also have our demonstration detailed in a webpage, so if anyone wants to skip to the section they are interested in, they can work independently.

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