Expanding Prospective and Practicing Teachers’ Mathematics and Pedagogical Content Knowledge at CSU Long Beach
CSU Long Beach–Final Report
Dr. Babette Benken: October 2021

Overarching Goal and Primary Outcomes of the Project
CSU Long Beach (CSULB) focused their use of EdReady on teacher preparation and development. The goal was to enhance prospective (pre-service) and practicing (in-service) secondary mathematics teachers’ content and pedagogical content knowledge, as well as their understanding of how digital resources might enhance student learning in practice.

For this project three EdReady learning modules were developed, two of which were embedded in courses at CSU Long Beach (secondary mathematics student teaching seminar - EDSS 473; mathematics education technology course - MTED 301). Approximately 440 students experienced the two coursed-based modules.

OUTCOMES: The overwhelming majority of these students believed the units helped them to expand and/or review their understanding of grades 6-12 mathematics and they enjoyed exploring this content in EdReady. Further, over 90% of students (EDSS 473) could envision how to utilize EdReady as a learning tool in a secondary mathematics course.

Specific Project Goals
The project goals focused on the development, pilot, revision and evaluation of three types of prospective and current teacher learning modules (EDSS 473, CSET, MTED 301).

Detailed descriptions of these modules are provided below.
EDSS 473 Module
The first module has two portions that are for teacher candidates in CSULB’s Single Subject Credential Program. The first and original portion was embedded in the student teaching seminar course (EDSS 473). The goal of the module was to both enhance candidates’ mathematical content understanding and to help them experience and consider the potential of leveraging online learning components in secondary mathematics education.

Specifically, the following goals framed the development of the EDSS 473 module:
1. identify gaps in and expand preservice student teachers’ (PSTs) mathematical content knowledge;
2. have PSTs experience an online format for math education from the perspective of the learner;
3. scaffold PSTs’ examination of how online learning tools are being used to support secondary students’ understanding of math in student-teaching sites; and expand PSTs’ vision for how to use tools like EdReady in their future practice.

CSET Module
The goal of the second module was to support certified and prospective teachers in content preparation for the first two California Subject Exams for Teachers (CSET), which would assist them in gaining a Single Subject Credential in Foundational Mathematics, either as an initial or add-on credential for those with an existing Multiple Subject Credential or Single Subject Credential in a discipline other than math. As the project developed, a few content gaps in EdReady were noted and the primary focus became mapping existing NROC Project math content and resources to the content embedded in the first CSET exam (CSET I). Now that this process has been completed, the focus is on supplementing needed content (gap filling) and developing additional test items for the diagnostic exams to be embedded in EdReady. Once completed, this module will be piloted with both prospective teachers at CSULB and other CSU campuses, and credential teachers in surrounding school districts seeking to add licensure.

MTED 301 Module
MTED 301 is a mathematics education technology course (Computer Applications in Mathematics for Teachers) at CSULB that satisfies the California technology (level I) requirement for initial licensure. Students in this course are typically either undergraduate math majors, who intend to eventually seek a secondary math teaching credential, or post-baccalaureate students already in the credential program (occasionally practicing teachers seeking additional professional development also enroll). The goal of the module was to have these students to experience, as a learner, an online learning platform that can support K-12 students in learning mathematics. Additionally, we intended that the module would support the students in learning/reviewing fundamental math content. This module was less extensive than EDSS 473 (i.e., shorter diagnostic, shorter reflection assignment, less class discussion), as the focus in MTED 301 is on technology tools for teaching math and not pedagogical content knowledge critical to the student teaching experience.
Summary of Outcomes

EDSS 473 Module
The EDSS 473 course module and post-module reflection surveys for both students and instructor were developed in Winter 2017. The module consists of students completing the Algebra Readiness diagnostic in EdReady, remediation of at least one EdReady-identified topic area, course discussions, and two written assignments. The module was piloted during Fall and Spring semesters from 2017 to 2020, and also in Spring 2021. Data included students’ written assignments, completion data in EdReady, and a post-module online anonymous student survey (n=180) and an online instructor survey (n=1; same instructor taught all 9 sections). Both the student and instructor surveys had Likert-type and open-ended questions. The findings for students represent data aggregated across all nine (9) course sections.

One faculty member (Project PI–Dr. Benken) and one lecturer (EDSS 473 instructor–Mr. Alfi), both from the Department of Mathematics and Statistics at CSULB, worked on the project. Mr. Alfi is also a full-time high school mathematics teacher and Department Chair in a local district.

An overwhelming majority of students believed the units helped them to expand and/or review their understandings of grades 6-12 mathematics and they enjoyed exploring math in EdReady (Table 1). Two representative student comments included, “I liked how the units allowed you to reflect and learn more about topics” and “Great program to brush up on math skills.” It is worth noting that most students explored more than the one (1) required unit in EdReady, further suggesting that they perceived it to be a useful tool for revisiting essential math content. The overwhelming majority of students communicated that the experience both enhanced their understanding of the capability of online learning formats as a tool for grades 6-12 math courses and allowed them to envision how an online learning format can be used in grades 6-12 math courses (Table 1).

As one student explained:

“I do think this tool could be useful in any math course in high school, specifically lower-level classrooms. It is good to catch issues early before students get deep into high school math and feel frustrated because they don’t understand the content.”

Another student explained that this tool would also support students gaining confidence as math learners:

“Having an online assistive technology for grades 6 to 12 mathematics will give the students the ability to gain confidence in their learning. The students are initially tested when other formats do not have a diagnostic test and then the students have an individual pathway to complete for their growth of knowledge.”

As a result of this experience, most students (91.7%) believed they would use an online learning tool in their future math teaching and that the EdReady module should continue to be part of the credential program courses (Table 1). Most communicated that EDSS 473 (student teaching seminar) was the correct course for such a module; of those not agreeing (9.5%), most believed that it might be better suited for one of the math methods courses, with some students specifically suggesting that the platform should be used throughout the credential program (i.e., in multiple courses).
Table 1: EDSS 473 Student Survey Likert-type Response Data (Spr 2017–Spr 2021; n=180)

<table>
<thead>
<tr>
<th>Question</th>
<th>% Agree</th>
<th>% Neutral</th>
<th>% Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The units helped to expand my understanding of grades 6-12 math content.</td>
<td>82.2%</td>
<td>13.9%</td>
<td>3.9%</td>
</tr>
<tr>
<td>The units helped me to review grades 6-12 math content.</td>
<td>94.4%</td>
<td>5.6%</td>
<td>0%</td>
</tr>
<tr>
<td>I enjoyed exploring math in this online learning format.</td>
<td>86.1%</td>
<td>7.2%</td>
<td>6.7%</td>
</tr>
<tr>
<td>The experience enhanced my understanding of the capability of online learning formats as a tool for grades 6-12 math courses.</td>
<td>91.7%</td>
<td>6.7%</td>
<td>1.6%</td>
</tr>
<tr>
<td>The experience allowed me to envision how an online learning format can be used in grades 6-12 math courses.</td>
<td>92.2%</td>
<td>4.4%</td>
<td>3.4%</td>
</tr>
<tr>
<td>I believe I will use an online learning tool in my future math teaching.</td>
<td>91.7%</td>
<td>6.7%</td>
<td>1.6%</td>
</tr>
<tr>
<td>This experience should continue to be part of the Single Subject Credential Program courses.</td>
<td>76.5%</td>
<td>14.0%</td>
<td>9.5%</td>
</tr>
</tbody>
</table>

Looking across sections where the EDSS 473 module was deployed, the overwhelming majority (79%) of students indicated on the survey that EdReady (diagnostic and/or study paths) was a valuable aspect of the experience of this module (other options included class “class discussions” and “class assignments”). Within the EdReady study resources, they found the practice problems, worked examples, videos and review to be most useful to learning/reviewing math content. Per the EdReady EDSS 473 student data, approximately 90% of students improved their EdReady module scores after using the studying resources (average score gain was ~7 points); students spent an average of 36 minutes studying, and average time using EdReady (study + assessment time) was over four (4) hours.

The instructor strongly agrees that the EdReady remediation unit(s) helped the pre-service teachers to review and expand their understandings of grades 6-12 math content and that the students enjoyed exploring math in this online learning format. As he commented following the first implementation of the module in Spring 2017:

“All this data showed me that the EdReady system enhanced my students’ learning and I love that this format helped them with skills they might have forgotten from 6-12 grade math...The way I know my students seemed to enjoyed the online formatting was they not only spent a lot of time on the system (average of 4 hours), but I noticed that the majority of the students used the system repeatedly during the semester even after all the EdReady assignments were turned in.”

The instructor also strongly agrees that the experience both enhanced his students’ understanding of the capability of online learning formats as a tool for grades 6-12 math courses and allowed them to envision how to use such an online learning format in secondary math. Further, he considered all aspects of the module to be extremely valuable (i.e., diagnostic test, remediation units, class discussion, written reflection assignments). The instructor was so happy with his experience using the module in Spring 2017 that he remained with the project and has used it every semester since (including the current semester, Fall 2021).
CSET Module

The CSET module consists of two sub-modules, one for the CSET I exam and one for the CSET II exam. We began creating these modules in December 2016, and then continued development during the 2017-18 academic year. By end of Summer 2017, we had identified all of the needed content and student learning outcomes; we had also identified online resources available (either in EdReady or elsewhere) for most of the content areas (e.g., practice problems and video lessons). As the project developed, the primary focus became mapping existing NROC Project math content and resources to the content embedded in the CSET I exam. Now that this process has been completed, the focus is on supplementing needed content and developing additional test items for the diagnostic exams to be embedded in EdReady. Once completed, this module will be piloted with both prospective teachers at CSULB and other CSU campuses, and credential teachers in surrounding school districts seeking to add licensure.

Two faculty members (Project PI—Dr. Benken and beginning August 2017 a newly hired math education faculty member), one lecturer (Winter, Spring, Summer 2017), and two masters students as an independent study with the Project PI (Spring 2017), all from the Department of Mathematics and Statistics at CSULB, have worked on the project. It is worth noting that both graduate students were full-time high school mathematics teachers in local districts. NROC Project staff and consultants have also contributed to the mapping, assessment item development, and testing of online resources.

Since this module has not yet been piloted, the only findings thus far are what the two graduate students communicated they learned from the experience of working on this project in a reflection assignment.

MTED 301 Module

The MTED 301 course module and post-module reflection surveys for both students and instructor were developed in Summer 2017. The module requires students to complete an Algebra Readiness diagnostic in EdReady, remediate at least one EdReady-identified math topic area, participate in a brief class discussion, and complete a post-module reflection survey. The module was piloted during the Fall and Spring semesters from 2018 to 2020, and also in Spring 2021. Data included the post-module survey and completion data in EdReady for students (n=256), and an online instructor survey (n=1; same instructor taught all eight (8) sections). The instructor survey had Likert-type and open-ended questions; the student survey had open-ended and multiple-choice questions. The findings for students represent data aggregated across all eight (8) course sections.

One faculty member (Project PI—Dr. Benken) and one lecturer (MTED 301 instructor—Mr. DiOrio), both from the Department of Mathematics and Statistics at CSULB, worked on the project. Mr. DiOrio is also a full-time high school mathematics teacher.

Looking across all sections where the MTED 301 module was deployed, all students indicated on the post-module survey that they could envision how to utilize EdReady as a learning tool in a secondary math course. The overwhelming majority (~80%) believed that such a tool would be most useful as a supplement/student support in a secondary math class, as opposed to the central curriculum (e.g., as practice for lower-level students, as math review, and as a diagnostic tool at beginning of the class). A few students specifically noted it would be a great way to review, if students need it, in a more advanced course (e.g., Calculus). The majority of students also appreciated the experience of using the tool from the perspective of a student and that they could work at their own pace. Some additionally commented that they were surprised that they needed remediation in fundamental math content.
Within the EdReady study resources, similar to the EDSS 473 students, the MTED 301 students believed the practice problems, worked examples, and videos were the most useful. Per the EdReady MTED 301 student data, approximately 61% of students improved their scores on the diagnostic after using the study resources (average score gain was ~2 points); students spent an average of 33 minutes studying, and average time using EdReady was over four (4) hours. This percentage gain is noticeably less than that of the EDSS 473 students for two primary reasons: 1) all of the students were not yet student-teaching (some more than three years away from student-teaching), and thus likely did not feel the urgency of remediating content not yet mastered, and 2) the focus of this assignment was on utilizing an online learning platform as an example of a technology tool that could help students learn math, and not the mathematical content itself. Thus, many explored EdReady with the focus on exploring the tool to see what was there and not on revisiting essential content.

The instructor believed his students appreciated experiencing an example of an online platform to support K-12 students’ learning of math content and that reflecting on using EdReady from both a student’s and teacher’s perspective supported their ability to envision how they would integrate it into curriculum for a future secondary math class. He was surprised that a decent percentage of the students didn’t like that the format was similar in style a typical standardized test, as many prospective teachers worry about how best to prepare students for such tests. The instructor felt it was a good experience for his MTED 301 students and thus has used it every semester since (including the current semester, Fall 2021).

OUTCOMES: The overwhelming majority of students believed the units in EDSS 473 and MTED 301 helped them to expand and/or review their understanding of grades 6-12 mathematics and they enjoyed exploring this content through the EdReady online learning environment. Further, over 90% of students (EDSS 473) could envision how to utilize EdReady as a learning tool in a secondary mathematics course.