EdReady Investigation

Phase II

Final Report

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Abstract

At the behest of the Office of the Commissioner of Higher Education for Montana, the Department of Educational Leadership at the University of Montana has partaken in a multiphase analysis of EdReady Montana. In Phase II, quantitative methods were applied to determine if there was a difference in students' grades in their first college math course after using EdReady in lieu of a developmental math course. Results showed that EdReady students, on average, performed better in their first college math course than did students who went through one or two semesters of developmental math. In some cases, EdReady students who took Math 090 were able to skip Math 095 and proceed directly into college-level math. The second part of the study was a qualitative analysis of the lived experiences of students, instructors, and administrators involved with EdReady. Themes emerged that confirmed the important role EdReady played in student success and that will inform best practices in the future implementation of EdReady. Participants expressed satisfaction with EdReady's impact on students' mathematical ability and on their confidence. Instructors appreciated EdReady's flexibility and scalable applications. Administrators provided valuable information about the implementation process, showing the depth of experience that now exists in Montana, which can be a resource for other states and other institutions that are considering implementing EdReady.

Introduction

EdReady is a tool developed by the National Repository of Online Courses (NROC) to support mathematics skill development. EdReady was brought to Montana by a generous contribution from the Dennis and Phyllis Washington Foundation, with additional support from the Bill and Melinda Gates Foundation. EdReady is housed at the Montana Digital Academy at the University of Montana (UM). EdReady has become part of Montana's Developmental Education Reform Movement and Math Pathways Initiative.

EdReady is a free, individualized math curriculum in which students begin with a skills assessment, then receive a personalized learning path to meet their goals. Most students use EdReady as a tool for college math readiness. Increasingly it is being integrated into developmental math courses as a supplemental learning tool.

EdReady was piloted with 37 UM students. A study conducted on the pilot, referred to as Phase I, provided evidence that EdReady was having a positive impact on academic performance in college math courses. In the fall semester 2013, 25 students who had used EdReady during the pilot took a college math course. Their average GPA was 3.03, compared to 2.34 for students who ascended to college math through a developmental math course. Table 1 shows the distribution of the sample and average GPA by course.

Table 1

EdReady versus Developmental Math as Preparation for College Math

	Course	105	115	121	135	151	162	171
EdReady	m	3.25	2.78	2.87	3.00	3.78	2.665	3
	n	4	3	10	1	3	2	2
Developmental Math	m	2.28	2.09	2.58	2.11	2.67		
	n	39	69	84	22	7		

Phase II Research Outline

Phase II of the study consisted of two separate but integrated parts that expanded on Phase I. The quantitative portion expanded on Part 2 of Phase I, where first-semester college math grades for students who used EdReady were compared to grades of students who went through developmental math. The qualitative portion involved exploring the lived experiences of students, instructors, and administrators with EdReady.

Phase II involved the following institutions:

University of Montana – Missoula

University of Montana – Western

Highlands College of the University of Montana

Gallatin College of Montana State University

Each institution represented a unique application of EdReady. Although each was studied individually, relationships among cases and implementation strategies were also explored.

Quantitative Data

Grades in the first college math course were compared between those who went through EdReady and those who went through developmental math or directly into college math (see Table 2).

Table 2

Criteria for Comparison of Ed Ready and Developmental Math

Variables	
Independent	• EdReady • Developmental Math (090, 095) • Direct to college math
Dependent	• Final grades in first college math course
	For each EdReady case the final grades for all students taking their first college math class were compiled. College math courses are defined as 100 level or above. These data were divided into three groups: those who went through EdReady, those who went through developmental math, and those who went directly to college math. Multiple regression was applied to these data to explore relationships between variables.

Qualitative Data

Interviews were conducted with purposefully selected participants from the four institutions listed above to explore EdReady student experiences.

Case Study

This portion of the study was based on both quantitative and qualitative methods. The case study employed an embedded analysis (Yin, 2003), where a specific aspect of each case was examined. In each case, pertinent information regarding EdReady was collected and analyzed, and the case was described in order to understand its context (Yin, 2003), followed by an analysis of themes (Creswell, 2013). The final narrative explains the meaning of the case based on analysis of the data derived from multiple sources (observations, interviews, document analysis).

Phase II Results

Quantitative Comparison of First College Math Scores

Grades for first college math courses were compared for students who went through EdReady and those who went through developmental math. Data were also considered for students who went through a blended form of developmental math that included work with EdReady. These use cases were considered individually because each case used a unique approach to blending EdReady with a developmental math course.

College math courses were defined as a math course at the 100 level or higher. Courses taken by students in this population were Math 105, 107, 108, 111, 112, 115, 118, 119 121, 122, 127, 135, 145, 149, 151, 161, 162, 171 and 191 (see Table 3).

Table 3

Math Courses Offered at Participating Institutions

Course #	Course Name
105	Contemporary Mathematics
107	Introductory Geometry
108	Business Mathematics
111	Technical Mathematics
112	Trigonometry and Complex Numbers
115	Probability and Linear Math
118	Math for Math Enthusiasts
119	Introduction to Number Theory
121	College Algebra
122	College Trigonometry
127	Topics in Mathematics
135	Mathematics for K-8 Teachers
145	Math for the Liberal Arts
149	Secrets of the Infinite
151	Precalculus
161	Survey of Calculus
162	Applied Calculus
171	Calculus I
172	Calculus II
191	Special Topics

These courses are not offered on all campuses in the study group. The only course offered at all four campuses was Math 121, College Algebra (see Table 4).

Table 4

Distribution of Math Courses by Institution

Course #	Course Name	UM - Missoula	UM - Western	Highlands	Gallatin	Total
105	Contemporary Mathematics	122				122
107	Introductory Geometry		16			16
108	Business Mathematics				3	3
111	Technical Mathematics			15	4	19
112	Trigonometry and Complex Numbers		3			3
115	Probability & Linear Math	432				432
118	Math for Math Enthusiasts	10				10
119	Introduction to Number Theory		9			9
121	College Algebra	136	16	16	2	170
122	College Trigometry	5				5
127	Topics in Mathematics		8			8
135	Mathematics for K-8 Teachers	37				37
145	Math for the Liberal Arts				3	3
149	Secrets of the Infinite				1	1
151	Precalculus	82		2	1	85
161	Survey of Calculus		3		2	5
162	Applied Calculus	33				33
171	Calculus I	38	1			39
172	Calculus II	13				13
191	Special Topics	13				13
						1026

Table 4 shows the number of students who completed each course as their first college-level course. Note that other students may have taken the course during the same period but were not included in this study because they were not taking the course as their first college math course.

The determination of which course one takes as a first college math course depends on one's major and/or entrance math assessment score. To quantify the data, letter grades were assigned grade points according to the following scale:

A = 4.0; A- = 3.67; B+ = 3.33; B = 3.0; B- = 2.67; C+ = 2.33;

C = 2; C- = 1.67; D+ = 1.33; D = 1; D- = .67; F = 0

For non-EdReady students who spent a semester (or more) in developmental math (Math 090 or 095) that was not blended with EdReady, the mean GPA for their first college math

course was 2.53. For students who used EdReady, the mean GPA in their initial college math course was 2.81—approximately a quarter grade higher.

Three participating institutions use EdReady in their developmental math program. This portion of the study considered only students who used EdReady as a stand-alone tool. Those who used EdReady as part of a developmental math course were treated separately and are not included in this initial comparison. The average GPA for students who went through a blended developmental math course and then went on to take a college math course was 2.77. Students who went directly into a college math course without EdReady or developmental math had a mean GPA of 3.02. This outcome was not unexpected because students who tested directly into college math had initially higher math skills.

Table 3 shows the mean GPAs for EdReady students and developmental math students according to initial college math course. EdReady students had higher GPAs than did students who ascended from developmental math in each course except Math 105, Contemporary Mathematics. It is important to note variations in the number of students in each group.

Table 3

EdReady versus Developmental Math Students by Course

	105	115	118	121	122	135	151	162	171	172	191
Developmental Math	2.83	2.41	0.59	2.39	2.67	2.94	0.86	2.78	2.10	3.00	2.59
362	77	151	4	18	1	17	7	21	29	12	6
EdReady	2.76	2.89	2.17	2.48	2.92	3.18	2.88	3.44	2.74	4.00	2.81
578	45	281	6	117	4	20	75	12	9	1	7

In the most-frequented initial college math course, Math 115 (Probability and Linear Math), EdReady students scored 0.45 grade points higher than did students who went through the developmental math track. In Math 121 (College Algebra), there was a variation of 0.09 grade points. It is important to note the disparity in number of participants in each group. For example, only seven students took Math 151 (Precalculus) after developmental math, whereas 75 EdReady students moved straight into Precalculus.

Which college math course students take as their first course is determined by several factors. A student's major plays a large role, as does the math placement score. The purpose of EdReady is to prepare students for the math course they are required to take, with the least time and expense. Although the goal of EdReady is to prepare students for College Algebra, it has proven to be a useful tool for all levels of mathematics.

College math scores for students who took developmental math and used EdReady were compared with students who went directly into college math (see Table 4). Eligibility for college math was determined by a placement assessment. It was expected that students whose placement

score qualified them for college math would outperform those who needed remedial services. That was the case for all courses studied, except Math 107, Introductory Geometry.

Table 4

EdReady Blended Developmental Math versus Direct Placement in College Math

Blended		W = UM Western H = Highlands							
	W	H	W	W	W & H	W	H	W	W
	107	111	112	119	121	127	151	161	171
Direct	2.67	3.40	2.89	3.47	3.20	3.25	NA	2.11	3.33
35	9	5	3	5	5	4	0	3	1
EdReady Blended	2.86	2.90	NA	3.09	2.80	2.67	1.00	NA	NA
54	7	10	0	4	27	4	2	0	0

EdReady was used by 26 students to move from Math 090 (Introduction to Algebra) directly into Math 115 without taking Math 095 (Intermediate Algebra). These 26 students saved a total of 78 credit hours. Tuition and fees for each 3-credit course are approximately $758, meaning the total savings was $19,708. Those students had an average GPA of 2.4, compared to 1.92 for students who ascended from Math 095.

The quantitative data in this study were drawn from the population of students in the four participating institutions who took their first college math course during the 2015 academic year. There were 2,438 students in the initial database, and 1,045 students took their first college math course during the 2015 academic year. A multiple regression was performed to explore the relationship between the independent variable, mode of preparation for college math (EdReady, blended EdReady, developmental math, or direct to college math) and the dependent variable, GPA of first college math course. Because no *p* values for the regression coefficients were less than .05, no statistically significant relationships were identified.

Qualitative Exploration of Lived Experience with EdReady

Data Collection

Data collection for the EdReady cases involved interviews with administrators, instructors, and students who had recently used the EdReady program. Participants were contacted by e-mail, with follow-up phone calls as necessary. All interviews were conducted on the respective campus, with the exception of students from Gallatin College, who provided written answers to interview questions. In all face-to-face interviews, a prepared and IRB-approved protocol (Appendix A) with informed consent (Appendix E) was followed. This protocol included six open-ended questions for the administrator (Appendix D), eight open-ended questions for instructors (Appendix C), and eight open-ended questions for students (Appendix B). When necessary and possible, probing questions were asked by the researchers, and member checking was used (allowing interviewees to review interview transcripts and affirm their intent) for clarification. The interviews were recorded using two digital recorders and transcribed using Express Scribe® voice-recognition software. To ensure accuracy, two research assistants were trained with the software. In addition to the interview recordings, notes and memos were kept by the interviewer during the interview. Each interviewee was given the option to be entered into a drawing for an IPad.

Data Analysis

Data for each of the four cases were analyzed by the researcher who conducted the interviews. Each researcher created a description of the data from the administrator, faculty, and student responses. The data were then decontextualized as each of the four subcases was brought together into a single case. Within this single case, categories were identified. The data were then recontextualized into categories, from which themes emerged.

Trustworthiness of Data and Findings

Data collected in this study are considered trustworthy for several reasons. Participant responses were recorded and then transcribed using voice-recognition software. To ensure accuracy in transcriptions, only two research assistants used the software. They listened to the interviews, repeating what was said on the tape recorder word for word. This process allowed the researchers to clarify any unclear words or spelling errors. In the case of student responses from Gallatin College, analyzed data came directly from the written responses provided by students. In addition to these data collection procedures, researchers used personal notes and memos during the interviews to record any pertinent information.

Several verification strategies (also referred to as validation strategies) were implemented during data analysis: (a) triangulation utilizing multiple sources to provide collaborating evidence, (b) peer review and debriefing as an external check of the research process, (c) member checking, (d) rich, thick descriptions in the form of direct quotations supporting categories and themes and thereby aiding in transferability of findings, and (e) an external audit

to examine both the process and the product. These five verification strategies go beyond the minimum recommendation of two (Creswell, 2013) and add to the overall quality of the qualitative section of this study.

Case 1: University of Montana Missoula

UM is situated in western Montana amidst the area's stunning natural landscape. The UM website (http://www.umt.edu/homepage/about/) describes the university as

> a place where top-tier students, educators and researchers from across the country and around the globe come and thrive. UM is located in Missoula, Montana's second-largest city, with a population of 80,000 residents. The University draws a diverse population to Missoula and helps cultivate an educated, engaged and vibrant community.
>
> Roughly 13,000 students attend UM and Missoula College, where they receive a world-class education in a broad range of subjects that include the trades, liberal arts, graduate and postdoctoral study and professional training.

Guided by a central mission statement, the university's academic programs are aligned with the UM mission:

> The University of Montana – Missoula pursues academic excellence as demonstrated by the quality of curriculum and instruction, student performance, and faculty professional accomplishments. The University accomplishes this mission, in part, by providing unique educational experiences through the integration of the liberal arts, graduate study, and professional training with international and interdisciplinary emphases. The University also educates competent and humane professionals and informed, ethical, and engaged citizens of local and global communities; and provides basic and applied research, technology transfer, cultural outreach, and service benefiting the local community, region, state, nation and the world. (http://www.umt.edu/president/mission.php)

Case 2: Gallatin College – Montana State University

This small 2-year college in southwest Montana offers courses throughout Gallatin and Park Counties, with three locations in Bozeman, one in Livingston, and one in West Yellowstone. The three Bozeman locations are downtown, at Bozeman High School, and on the campus of Montana State University (MSU). The main campus of Gallatin College is housed on the MSU campus. The college provides associate degrees and 1-year professional certificates in a local setting. The student body comprises 39% part-time and 61% full-time students, with about half over age 24 (Gallatin College website).

The mission statement of 2-year colleges in Montana is "to provide a comprehensive, accessible, responsive, student-centered learning environment that facilitates and supports the achievement of individuals' professional and personal goals, and enhances the development of

Montana's citizens, communities and economy" (Gallatin College website). Specifically, the mission at Gallatin College MSU is "to provide an accessible student-centered education that supports individuals' personal and professional goals and enhances Montana's economy" (Gallatin College website).

The full time equivalent (FTE) in all five locations for FY2015 was 442 students. The completion rate for Gallatin College during the 2013-14 academic year was 21.6%. The retention rate for returning second-year students for the Fall 2013 cohort was 79%. Enrollment in remedial education, which includes at least one math or writing course, for Fall 2013 was 27.8%. Success in remedial courses taken by first-time freshmen during Fall 2012 was 9%. Success means passing a college math class within 2 years of completing remedial math (Complete College America Outcome Metrics).

Case 3: University of Montana – Western

> The University of Montana – Western, located in Dillon, Montana . . . is nestled in a scenic valley in the Rocky Mountains of southwestern Montana. Montana Western has over 60 full-time faculty members, features small classes for all students, and has been recognized for excellence by U.S. News and World Report. Montana Western's small size and focus on education innovation have earned it the reputation of being a place where faculty and staff chose to collegially and creatively make a difference in the education of students. (University of Montana – Western Website, 2015)

The University of Montana – Western recently adopted the following mission statement: "The University of Montana Western differentiates itself and achieves academic excellence by sustaining a culture of concentrated experiential education."

In FY 2015, the University of Montana – Western had 1,355 students (FTE), an increase of 286 students (27%) over the previous 10-year average. In 2014, the university had a 20.7% completion rate (undergraduate degrees and certificates awarded per 100 FTE undergraduate students). The institutional retention rate for the Fall 2013 B.A. cohort (returning Fall 2014) was 65%, and the system-wide rate was 71% for the same cohort. The institutional A.A. retention rate was 64%, and the system-wide rate was 72%.

Of the 245 freshman enrolled in Fall 2013, 155 (63.3%) were enrolled in at least one remedial writing or math course (a course number less than 100). For the Fall 2012 first-time freshman cohort, 148 students enrolled in remedial math. Of those, 86 (58%) went on to successfully complete a college math course within 2 academic years (Complete College America Outcome Metrics).

Case 4: Montana Tech of the University of Montana – Highlands College

Originally chartered as the Montana State School of Mines, Montana Tech has evolved into a dynamic institution composed of two colleges and one school (College of Letters, Sciences, & Professional Studies; Highlands College; School of Mines and Engineering) and the Montana Bureau of Mines and Geology. Founded as one of the four original campuses of the Montana University System in 1893, Montana Tech now has an enrollment of 2,694 students focused on education and research in science, engineering, health, business, and communications. The institution offers degree programs at the certificate, 2-year, 4-year, and graduate levels. The student body presents a national and global snapshot, with over 35 states and 15 foreign countries represented (Montana Tech Website, 2015).

The Montana University System was restructured in 1994, when Montana Tech become affiliated with the University of Montana. Additionally, Highlands College came under the administrative umbrella of Montana Tech. Highlands College provides occupationally specific higher education programs in business, health, information technology, and technical and trades. Successful completion of a 1- or 2-year program leads to a certificate, associate of applied science, or associate of science degree (Montana Tech Website, 2015).

In FY 2015, Highlands College had 361 FTE students, an increase of 81 students (29%) over the previous 10-year average. The college had a 2014 25.7% completion rate (undergraduate degrees and certificates awarded per 100 full-time equivalent undergraduate students). The institutional retention rate for the Fall 2013 cohort (returning fall 2014) was 57%, and the system-wide rate was 60% for the same cohort.

Of the 178 freshman enrolled in Fall 2013, 153 (86%) were enrolled in at least one remedial writing or math course (a course number less than 100). For the Fall 2012 first-time freshman cohort, of the 138 students enrolled in remedial math, 16 (12%) went on to successfully complete a college math course within 2 academic years (Complete College America Outcome Metrics).

Montana Tech's mission statement is as follows: "To meet the changing needs of society by supplying knowledge and education through a strong undergraduate curriculum augmented by research, graduate education and service." Highlands College prepares traditional and nontraditional students for their personal and/or educational goals through the integration of technology, communications, problem solving, and technical skills. We are committed to expand educational opportunities through:

- Service learning with work-based activities
- A blend of theory and practice
- Alternative course delivery
- Computer literacy

Phase II Qualitative Analysis

Qualitative interview data from students, instructors, and EdReady administrators in the four subcases previously described were analyzed. Data from each subcase were combined in a single case for analysis and then deconstructed for further analysis through a variety of procedures.

Single-case analysis was guided by the work of Miles and Huberman (1994), who recommended that qualitative analysis consist of "three current flows of activity: data reduction, data display, and conclusion drawing/verification" (p. 10). These processes were supplemented by data reduction through decontextualizing and recontextualizing data, as suggested by Tesch (1990). This process enabled the researchers to see the data in new ways, as emerging relationships became evident, resulting in categories, which evolved into themes.

Data reduction occurred after a general sense of the data was gained from reading through the combined data several times. From these readings, data were reduced into four initial categories; (a) assessment, (b) skill builder, (c) course supplement, and (d) curriculum. The single case data were again examined through the analytical lens of each category. Data were decontextualized by selecting only the data pertinent to the category under investigation and then through the process of recontextualizing (Tesch, 1990) a new document was created containing these categorical data. The process was repeated for each of the four categories. Assessment was the first category to be independently analyzed.

Assessment

Qualitative data revealed that EdReady was used to assess students' mathematical knowledge. Although not the placement test for students' first college math course, several instructors stated a desire to see EdReady used as the placement test. An EdReady administrator said it would be "ideal if we could get EdReady to be our placement test system. Because we have the same platform for the placement tests as well as the tutorials, I think it would be very helpful with the students." This administrator emphasized that EdReady should be used prior to taking math courses. Student participants described how helpful it was to use EdReady as an assessment of their current math skills.

EdReady assessments provided students with information about their strengths and weaknesses, which was then used to build upon current skill levels.

> I mean, the beauty of the EdReady program is they take an assessment test right at the beginning of it [the class], so it pinpoints the exact areas of need for each particular student and that's going to differ from student to student. (EdReady administrator)

Another administrator said, "We can assess exactly where students are at and what the needs are and then kind of tailor what exercises they're going through."

Skill Builder

EdReady was also used as skill builder: as a tutorial and/or refresher. Recognizing that math students need a strong foundation, one administrator pointed out that "students inevitably have gaps in their knowledge or perhaps they haven't used it for a while. EdReady is wonderful at filling in those gaps—let's just fill in this one piece and then you can move forward." Students reported using EdReady to enhance their skills in one or more ways. As a tutorial, students used EdReady to increase specific skills in preparation for their first college math course. These tutorials were described as being individualized based on the student's performance. The similarity of the tutorial and the platform of the test appeared to be a component of EdReady that students found helpful. Said one, "It was fun, it was easy to use and . . . there were several tutorials just on how to use each function if you needed one to enter a question." Instructors noted that the program is self-paced.

Students and instructors provided evidence that EdReady can also be used as a refresher. Students described using EdReady as a refresher for additional attempts on placement tests or preparing for an upcoming math course. An instructor saw the benefit of EdReady being used as a "brief refresher" where "the student could cover it [essential basic math skill] in a few weeks at the beginning of a course." As one student explained, "It helped me feel prepared for class. It was a lot of review from high school, even some middle school. It was a good starting point." Said another, "I think it is safe to say that I don't really enjoy math, but I do like EdReady a lot." EdReady was used as a tutorial/refresher by some students who wanted to improve their Assessment and Learning in Knowledge Spaces (ALEKS) math placement score.

Interviewees also described problems regarding EdReady. One instructor noted that 50% of the incoming freshman could do the problems and after the first 2 weeks of class using EdReady, they increased from 50% to 100% mastery. However,

> About one third of our students could not then do on paper what we were hoping they were able to do for those skills. Why wasn't the EdReady program effective for them in the way that then they could take what they learned and maybe put it on a piece of paper?

One student suggested that the final tests in EdReady be taken on paper rather than on the computer to allow more space to work out the problem and show one's work, adding that the computer version "doesn't specifically tell you the problem you got wrong. . . . It tells you to go back and review." An instructor also addressed this issue:

> For students with really weak evaluation skills, they can't figure that out [where there errors were]. They're not figuring that out even when they go back through their review. I don't know if it would work. I wouldn't be confident enough yet to say okay I want you guys to work on this. Work on this for a month and then come back and were going to test you to see if you get out of developmental [math].

Course Supplement

Instructors commented on the potential of EdReady as a supplement to math courses. One expressed pleasure that EdReady had "a giant set of resources and topics to study." Another said, "I like how I can basically map it to our existing classes here on campus." Some instructors encouraged students to use EdReady as a supplement to class lectures, demonstrating its ability to reinforce class content. As one instructor noted,

> I tried to use it with what we were covering in class, and so instead of sending them home with a bunch of problems to work on and come back, they're able to work in that EdReady environment. Whenever it's feasible for them, wherever it suits them, and they basically have to complete, for full credit, they have to get mastery of the unit, the current unit were working on.

Other instructors required EdReady for homework.

Students used EdReady tutorials as a resource for review when taking tests. One said, "I think it helped me feel comfortable with the minor things you just forget." An instructor described using EdReady as a supplement or "make-up" for a class session when a student was absent. Students who miss a day of class have access to the lesson material, with explanations that can be repeated as many times as needed. One instructor concluded, "EdReady is pretty versatile; you can use it anyway you want to."

One instructor viewed the most effective use of EdReady "as the whole component of a more conventionally structured classroom." Others described adjusting their course organization and teaching style to more closely align with EdReady. One said, "I align things much more closely with EdReady and I am requiring students to turn in screenshots that say they have completed their practice and review problems." Relying on the list of math topics covered in EdReady, some instructors were able to work EdReady into the developmental math curriculum.

Curriculum

Instructors struggled at first to grasp EdReady's scope and its relationship to the developmental math curriculum, eventually seeing it as a tool to standardize that curriculum. Said one, "We're all going to teach logarithms to this level and it's all going to be the same." This was viewed as a positive component of EdReady implementation.

EdReady can also be individualized to meet a particular student's needs. Instructors were positive about the program being self-paced. One liked the fact that students "are all working on different things at different times."

When integrating EdReady into a math course, an instructor needs to "not look at just the topic level [but also] look at the learning objectives." The objectives break topics down and enable a more precise integration of EdReady into the curriculum. Students know when the supplementary system is not meshing with what is being taught. As one instructor noted, "When

we decided what to include for EdReady, we didn't have access to the learning objectives. We just had the topic titles, so we had to make our best guess."

EdReady's greatest potential, according to one administrator, will be fulfilled when it becomes mandatory: "If EdReady is going to be used more on our campus, it would almost have to be a required part of the curriculum." She added, "I believe that our faculty, the faculty in the math department, are very open to doing anything we can to help our students."

Themes

Once the four categories of assessment, skill builder, course supplement, and curriculum were identified and analyzed, relationships among the categories became evident. These relationships led to the formulation of two general themes grounded in the data: EdReady as a tool and EdReady's impact on student success. The tool theme is related to assessment, skill builder, and course supplement. The impact theme is related to all four categories. These categories are not mutually exclusive, and through data decontextualization and recontextualization, relationships among them were revealed.

EdReady as a Tool

A primary use of EdReady has been as a tool to assess a student's current ability in math. Instructors were aware of EdReady's potential as a math placement tool even though institutional decision making was sometimes an obstacle. From the EdReady assessments, a student's strengths and weaknesses in math become evident. Using EdReady, tutorials can be personalized based on a student's performance. Because of the quality of EdReady feedback, instructors are able to individualize instruction, tailoring it to students' particular needs. EdReady thus is an effective skill builder through continued formative assessments. Instructors who learned EdReady's nuances used it as supplemental instruction to enhance understanding of lectures, homework, and review for exams, as well as a substitute for missed classes. Despite this potential, at least one instructor urged caution in using the program.

As instructors grew to understand the tools available and the specific learning objectives, their use of EdReady became more seamless, and students benefitted from being able to practice their lessons outside of class and review classroom instruction for better understanding of specific concepts. One instructor expressed a desire for more flexibility and "a little more control over the classroom," looking for ways to retain creativity and "allow students to think about the concepts." Another advised instructors to "learn the system and understand the system well." For another, "EdReady is pretty versatile; you can use it any way you want to." Another said that "even if it's presented differently than you might present in class, students aren't overwhelmed with really short presentations." An administrator said the hardest thing about EdReady, which was optional on their campus, was to get students to use it: "They don't want to do any more work than they have to."

Impact of EdReady on Student Success

Students reported that their experience with EdReady had a positive influence on their attitude toward math in general, improving confidence. Representative comments were as follows:

"It gave me a huge boost toward math."

"I am believing I can do math."

"My attitude toward math is better because I am understanding what is going on."

"It helped me understand math better."

"It impacted [me] for the best. I have been able to get A's on both math courses I took that used the program."

"It helped me get to the level [in math] I used to be at."

"It sped up my math classes so I could go on to the next."

"I continue to use EdReady, even though it is not a requirement in order for me to continue learning."

Experience

The use of EdReady as a tool and its impact on student success came together in the overarching theme of experience, which addressed the study's central qualitative research question: What were the experiences of students, professors, and administrators who experienced EdReady in the Fall of 2014? Participants' experiences with EdReady related to all four previously described categories: assessment, skill builder, course supplement, and curriculum.

Overall, respondents had positive experiences with EdReady. They described it as easy to follow and self-paced. One student said, "If I didn't understand what was taught in class, I could just go back and read more about it [later with EdReady]." In comparing EdReady to previous experiences with math, one student said the current course had the "same amount of work and I felt like they were good examples as far as what has been presented in the class I am taking now and other classes I have taken." Some EdReady students said using the program increased their ALEKS placement score, thus saving a semester's time and expense that would have been spent in a developmental math course. Some students expressed a preference for using EdReady as opposed to a textbook. One instructor described the program as "accessible, user-friendly, and "pretty easy to figure out as a teacher—what to and how to use it." Instructors also mentioned that one advantage of EdReady was that the program was free.

Several participants observed that EdReady had a rocky start. One cited "a lack of time to understand the program." Given a short timeframe and lacking access to learning objectives, instructors struggled at first to blend EdReady into daily classroom activities. Several observed that that more professional development is necessary to make the best use of EdReady.

Students reported a variety of difficulties with EdReady, including navigating the website and using the online program. One noted that "little things like that can inhibit your drive to use something like that." That student found using EdReady "mildly frustrating in general." Another said, "It took me longer sometimes to figure out how I was supposed to do what I was supposed to do." Students and instructors were displeased when the program occasionally included a problem unrelated to the topic at hand. Said one student, "It will throw [in] a problem that has nothing to do with the section we are on." Connectivity was also an issue for some students who lacked wireless access outside of class.

One limitation of EdReady was the lack of explanation for responses to quiz questions, which promoted a lack of understanding that EdReady was supposedly created to solve. One student said, "I ended up having to ask the teacher, because some of the things weren't very clear. I don't know how to do it. There are definitely some things that I still have questions on." Another noted that "not having the problems [indicated to us] that we were getting wrong was a challenge." An instructor said, "Show them the problems that they got wrong." One student described the ease of selecting an answer without understanding the mathematical process and concept: "You can get through a lot of it without having to actually know the material."

Instructors felt supported by the EdReady team. One suggested that teachers

> be wary of some of the misalignments. . . . Just because of the stage of development EdReady is in and don't be afraid to reach out to [the EdReady state coordinator] and team because they want to know what the issues are so they can be fixing it and making it better.

Both students and instructors questioned the number of items needed for mastery, such as "when it gives you one question and says you have mastered the subject." Instructors also expressed concerns about the grading function used in EdReady. They were unclear on how problems were weighted, particularly on assessments for multiple topics.

Students generally agreed that a teacher is still an important part of the learning process for developmental math. One said that a challenge with EdReady was "not having a live person to answer questions when necessary." Another suggested having "the opportunity to ask any questions to a real person." Another student said, "With no knowledge or strategies on how to do this math or learn the math, [without the teacher] it would be very difficult. Having someone who formulated the lessons towards EdReady helped a lot." One student commented on the EdReady delivery system: "Online classes are a bit harder for me. I like having the teacher there as well, just to help teach."

An administrator said, "I think it [EdReady] needs instructor management for them to get the most out of it." Another suggested that teachers "get familiar with the questions, how they are asked, and when the students do not understand the feedback, to clarify for them what the feedback means."

Conclusions from Qualitative Analysis

EdReady, an online math readiness program, affected the experiences of students, instructors, and administrators at four participating Montana postsecondary institutions. It also has the potential to influence assessment for placement in a student's first college math course and to affect higher education policy in Montana and beyond. Data collected and analyzed in this study provided insights into EdReady's success and potential.

Participating students used EdReady to establish their current level of math competency and as a refresher for math skills they once had. Some used EdReady as a self-paced tutorial to gain skills for a desired math course or math placement test. Students' use of EdReady was not limited to course preparation. EdReady was also used as a tutorial to support class lectures or to replace a missed class. Because of EdReady, some students have been able to reduce, or in some cases eliminate, their time in developmental math courses and thereby reduce the cost of their education.

EdReady administrators and math instructors across Montana have recognized the value of using EdReady as an integrated component of developmental math courses. Teachers have used EdReady as a class tutorial and/or a supplement to class content. Instructors described efforts to integrate EdReady into course designs, even adjusting teaching methods to more closely align with the EdReady format. Instructors had favorable comments about the EdReady support team. The potential of EdReady as a placement tool was noted.

Participants' feelings about EdReady were generally positive. Students described it as improving their confidence about and attitude toward math. Their main suggestions were to make the website more user-friendly through better organization and attention to content design. Administrators and instructors reported overcoming a rough start due to a quick adoption and implementation of EdReady. There is a need for ongoing professional development to assist educators as they continue to integrate EdReady into their courses.

Participants' assessments of using EdReady are summed up in the comment of one administrator: "EdReady created a study path for these students, so it's always appropriate for each particular person . . . for the students who actually take the time and work through it. I think it is quite an effective program. I think it is a fantastic tutorial."

Summary

EdReady has arrived on the scene in Montana and has been received with varying levels of support and understanding. It is clear from participants in this study that the program's success is related to instructors' time to prepare and their familiarity with the tool. It is clearly viewed as a viable supplement to standard developmental math courses.

Students who used EdReady outside a developmental math course performed well on their first college math course. Quantitative data show that EdReady students improved their math skills to a degree that exceeded their fellow students who spent time and money taking

developmental math courses. Qualitative data demonstrate a transition from students and instructors as new users to those who were comfortable with a new tool and found innovative ways to use it. When results from Phase II are combined with the data from Phase I of this study, it is clear that in Montana a relationship exists between enrollment in EdReady and success in college level math.

Future Research

As with any new tool, users gradually discover new ways to use it. Given the number of specific use cases being employed across Montana, future research on EdReady should focus on the effectiveness of those implementations and catalog the variety of uses to which EdReady has been put. Additional studies might address EdReady use at in secondary schools. This is a new application of EdReady that presents opportunities for both action research and longitudinal studies.

For college students who have used EdReady, either as a supplement to or replacement for developmental math, research should address the program's impact on graduation rates and time-to-college-completion. One component of such research would be the fiscal implications of adopting EdReady: its costs and any savings resulting from developmental course reductions.

Additional research opportunities also exist regarding the nature of online, self-initiated learning. For example, how do online skills transfer to paper-and-pencil work in mathematics? Through studying the lived experience of students, instructors, and administrators, many questions will arise, and the state of Montana is an excellent venue for ongoing research due to the diversity of existing implementation strategies and the cooperative attitude of personnel in the state's institutions of higher learning.

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Appendix A: EdReady Phase II Interview Protocol

Date: _____ Time: _____ Male: _____ Female: _____

Student EdReady-Dev Math EdReady-College Math EdReady-No College Math

Instructor Administrator Subject Code: _____

Thank you for agreeing to take time from your busy schedule to participate in this research study regarding mathematics education.

- I will be asking you some general questions and writing notes as we proceed regarding your experience with EdReady, the online math readiness system.
- This interview will be tape recorded. Once the interview has been transcribed, the audio tapes will be destroyed.
- All information from this interview will be kept confidential. You will not be identified by name in any reports from this study. The confidentiality of your identity is also under the purview of the Institutional Review Board at the University of Montana.
- A confidential subject code will be used to identify you for any follow up questions and during this research process.
- Your identity will only be known by the Research Team.
- You may stop this interview at any time without any negative consequences.
- You may hear the term "EdReady" during the interview. If I use this term, I am referring to your experience using the EdReady online math program.
- Please be assured that there are no correct answers to the questions asked during this interview. What is important, are your thoughts, feelings, and experiences regarding your experiences with mathematics education.

****Hand out consent form and give time to read.*

Before we begin this interview, do you have any questions about the study?

If you have no more questions, do you voluntarily agree to take part in this study? YES NO

Appendix B: Qualitative Questions — EdReady Phase II Study

Students

1. What led you to try EdReady?

2. How would you describe your experience with EdReady?

3. How did your effort in EdReady compare to other math learning experiences?

4. How has your EdReady experience impacted your attitude toward mathematics?

5. How has your EdReady experience impacted your college plans?

6. Tell me about the most challenging aspects of EdReady?

7. If you were able, how would you improve the EdReady experience for future students

8. Is there anything additional you would like to share?

Appendix C: Qualitative Questions — EdReady Phase II Study

Instructors

1. What role did you play in the decision to use EdReady?

2. How do you utilize EdReady in the mathematics program?

3. How do you utilize EdReady in your mathematics instruction?

4. What is your general impression of EdReady?

5. In your opinion, what is the most effective use of EdReady?

6. How has EdReady impacted college level math on your campus?

7. What advice would you have for other professors considering the use of EdReady?

8. Is there anything additional you would like to share?

Appendix D: Qualitative Questions: EdReady Phase II Study

Administrators

1. What role did you play in the decision to use EdReady?

2. What is your general impression of EdReady?

3. In your opinion, what is the most effective use of EdReady?

4. How has EdReady impacted college level math on your campus?

5. What advice would you have for other administrators considering the use of EdReady?

6. Is there anything additional you would like to share?

Appendix E: Informed Consent

SUBJECT INFORMATION AND INFORMED CONSENT

Study Title: EdReady Phase II Study

Investigator(s):

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Special Instructions:

This consent form may contain words that are new to you. If you read any words that are not clear to you, please ask the person who gave you this form to explain them to you. There are no correct answers to the questions that you are asked. The researchers are seeking your attitudes and perceptions. Once you begin this interview, you will be entered into a drawing to win an i-Pad Air unless you choose not to be entered in the drawing. If you want to be excluded from the drawing, please let the person conducting the interview know of your wishes. You do not have to complete the interview to be eligible for the drawing.

Purpose:

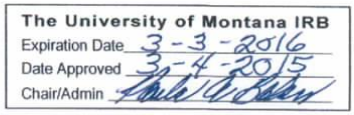
You have been invited to participate because of your experience with EdReady the online math readiness system using an individualized path tool designed to assist students considering attending a post-secondary institution. You must be 18 or older to participate in this research.

Procedures:

If you agree to take part in this research study, you will be asked a series of interview questions regarding your experiences with EdReady. The study will take place in an office provided by the institution or by electronic means (phone, Skype, Face Time, GoToMeeting, etc). It will take approximately 30-45 minutes to complete the interview. The interview will be audiotaped. The audio tape will be transcribed without any information that could identify you. The tape will then be erased.

Risks/Discomforts:

There is no anticipated discomfort for those contributing to this study, so risk to participants is minimal. There is a chance that answering the questions may cause you to think about feelings that make you sad or upset.



Benefits:

There is no promise that you will receive any benefit from taking part in this study.

Confidentiality:

Your records will be kept confidential and will not be released without your consent except as required by law. If the results of this study are written in a scientific journal or presented at a scientific meeting, your name will not be used. Your signed consent form will be stored in a cabinet separate from the data.

Voluntary Participation/Withdrawal:

You may refuse to take part in or you may withdraw from the study at any time without penalty or loss of benefits to which you are normally entitled.

You may be asked to leave the study for any of the following reasons:

1. Failure to follow the Project Director's instructions;
2. A serious adverse reaction which may require evaluation;
3. The Project Director thinks it is in the best interest of your health and welfare; or
4. The study is terminated.

Statement of Interview Recording:

This interview will be tape recorded. Once the interview has been transcribed, the audio tapes will be destroyed. No identifying information will be included in the transcription.

Questions:

If you have any questions about the research now or during the study contact:

Dr. John Matt
University of Montana
Phyllis J. Washington College of Education and Human Sciences
406-243-5610 john.matt@mso.umt.edu

If you have any questions regarding your rights as a research subject, you may contact the UM Institutional Review Board (IRB) at (406) 243-6672.

Statement of Your Consent:

This Consent Form describes the research study and informs you of the risks and benefits involved. At the time of your interview, the researcher will ask if you have any questions and if you voluntarily agree to take part in this study.