COOPERATIVE LEARNING AND ONLINE ASSESSMENTS

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Abstract
In the fall of 2017, Delta State University (DSU) implemented new general education mathematics pathways. As part of the new approach to mathematics pathways, Intermediate Algebra was no longer offered at DSU. Instead of a separate pre-requisite remedial course, all general education mathematics courses were assigned co-requisite labs. In this paper, we will discuss how DSU mathematics professors paired online assessments with cooperative learning techniques to enhance remediation efforts in College Algebra co-requisite labs.

The lab assignments discussed in this presentation were specifically chosen to facilitate just-in-time teaching (JiTT). JiTT is an instructional technique that effectively exploits the shortened feedback loop between learning management system (LMS) assignments and classroom activities. The lab lessons serve a dual purpose in that they inform the instructor of any preexisting gaps in student knowledge, and they allow students to adjust their approach to the material as well as to the LMS platform prior to a summative assessment. The instructional approach was specifically designed to encourage students to view the LMS as an approachable and valuable tool in the student's learning process rather than another obstacle to overcome.

We will discuss the instructional framework of the co-requisite labs regarding the establishment of cooperative learning groups as well as the purposeful correlation to active learning techniques within regularly scheduled class-time.

Introduction
Delta State University (DSU) is a regional public university situated in the heart of the Mississippi delta which is located in the southeastern region of the United States. The institutional demographic data provides an accurate picture of the students enrolled in College Algebra. In Fall 2018, 3,715 students attended DSU. Of these students, 59% are female and 41% are male. Although the average class size/teacher to student ratio at the institution is 12:1, the College Algebra classes typically have an enrollment of 30 – 40 students.

As seen in Table 1, from Fall 2012 to 2018, of the incoming students who provide ACT scores (at DSU, transfer students are exempt from this requirement), 58% earned less than a 21on the ACT (Institutional Research, 2019). The U.S. Department of Education (2018) has determined earning a 21 or higher on the ACT is an indicator of readiness for collegelevel mathematics. Therefore, only 42%, or significantly less than half, of the students in the College Algebra classes at Delta State University are considered ready to learn the subject matter at hand.

Table 1

Percent of incoming students earning a 21 or higher on the ACT

	Fall 2012	**Fall 2013**	**Fall 2014**	**Fall 2015**	**Fall 2016**	**Fall 2017**	**Fall 2018**
Percent of first-time *freshmen* who have an ACT composite score of 21 or above	41.4%	41.2%	47.6%	46.4%	55.5%	54.6%	53.8%

At Delta State University, students were designated as either traditional or remedial according to their ACT score. A traditional student is a student whose ACT mathematics sub-score was equal to/greater than a 20, whereas a remedial student is defined to be someone who scored below a 20 on the ACT mathematics sub-score.

Beginning in the 2017-2018 academic year, the Delta State University mathematics department initiated the co-requisite model in College Algebra. This model requires all College Algebra students to enroll in a co-requisite lab section paired with their class. The instructor of record, with the assistance of a supplemental student instructor, presides over the co-requisite lab. A student instructor is an undergraduate student who has successfully completed a College Algebra course with a grade of A or B. The purpose of implementing the co-requisite model is to increase gateway course completion, where gateway courses are defined to be any course necessary for a student to progress through the student's chosen major (Bondurant, Putnam, & Townsend, 2019).

Educational Framework

Cooperative learning, over the past few years, has gained distinction as a learning tool with positive results in college classes. But many college educators question how to implement cooperative learning alongside technology in their classes. The Delta State University mathematics professors continually focus on a single clear understanding of cooperative learning in order to align and integrate the online assessment to produce the positive results touted by previous researchers. Jones and Jones (2008) stated "Johnson, Johnson, and Smith (1991) define cooperative learning as the instructional use of small groups so that students work together to maximize their own and each other's learning." Beginning with this premise, the Delta State University mathematics professors researched for the best modalities for the integration of cooperative learning and online assessments.

The research is predicated with the belief that student "accountability ensures that students learn together, but perform alone" (Jones and Jones, 2008). According to Johnson, Johnson, & Roger (2015) there are three structures for cooperative learning in a university classroom: 1) formal cooperative learning, 2) informal cooperative learning, and 3) cooperative base groups. Delta State University professors chose to utilize the formal cooperative learning modality in the form of Peer-Assisted Learning (PALS).

Peer-Assisted Learning is typified by "students acquiring knowledge and skills through active helping among equal classmates" (Topping & Ehly, 1998). Using PALS promotes interaction through an ongoing dialogue process. This dialogue may be verbal or non-verbal. Students must be linked with each other in a way so that one cannot succeed unless others do (or vice versa), and other group members' work is mutually beneficial (Johnson, Johnson, & Roger, 2015). PALS is different from peer tutoring in that it is collaborative work produced through cooperation and not through competition. Once student dialogue and interdependence has been established, the next logical step in the learning process is for the student to show proof of the skill acquisition. Assessment as proof of skill acquisition is one method to show concrete evidence of mastery of subject content.

Delta State University professors chose to utilize a learning management system as student proof of skill mastery. This system assesses each student cooperatively as well as individually. DSU studies the student observational data (informal student dialogue, classroom questions, math lab practice assignments, and classroom exit quizzes) as well as cooperative and individual pass/fail ratios as indicators of the success of student learning and skill mastery acquired utilizing the cooperative learning model.

Model

We now introduce the implementation of cooperative learning groups in conjunction with paper-to-platform online assessments. Over the past several decades, collegiate mathematics courses have steadily expanded their use of learning management systems (LMS) for both formative and summative assessments. (Bondurant, Putnam, & Townsend, 2019). While the use of such LMS tools offer significant advantages, such as a shortened feedback loop and a wider availability of practice problems, many instructors have noted a considerable disconnect when transitioning students from their paper-based work to an online portal. The math professors observed a greater need for students to continue practicing proper organization and use of mathematical notation aside from their online assessments. Moreover, instructors have noted that our students have exhibited considerable anxiety when interacting with the software, and this often disguises, or skews, the instructor's ability to identify and track gaps in content knowledge. With that in mind, we implemented a procedure meant to train students for LMS interaction while maintaining the ability to track and address gaps in content knowledge.

Prior to lab procedures, students are placed in formal cooperative learning groups of size four with a heterogeneous structure. Heterogeneous grouping refers to the data-driven process of grouping individuals with varied levels of ability. In this case, we chose a threshold of 20 percentage points on student test average. For example, if one student had a test average of 80, no other student within the group could have a test average of less than 60. Groups are reassessed at the end of each unit. To ensure effective cooperative interaction, the paper-to-platform assignments includes periods of group dependency as well as individual accountability.

We now outline the model used in our co-requisite labs. Lab assignments are partitioned into three phases: 1) paper-based group work, 2) LMS-based group work, and 3) an individual assessment. In phase one, groups begin every lab by working on paper-based assignments generated by the LMS. During this time, students have access to all course notes, the instructor of record, and a supplemental instructor (SI). Course notes include models of correctly organized work for students to review. In order to complete this phase, each group member must have accurate work that is neat, organized, and uses accurate notation. Groups must have their work approved by either the instructor or the SI in order to proceed to the second phase.

In the second phase, groups are given a password to access the lab assignment in the LMS. This assignment is the online version of the paper-based work from phase one. Students work in groups to enter their solutions into the platform correctly. In order for the group to receive credit for their weekly lab assignment, every group member present must achieve an 80% or better within two attempts.

In the third and final phase of the lab model, students separate from their groups to take an individual, closed-notes exit quiz. The quiz is a computer-generated subset of the lab assignment with new values for each problem. In order to receive full credit for the quiz, students must also hand in their scratch work to show evidence of organization and proper notation. The instructor and the SI use the feedback from these quizzes to identify where any disconnect may have occurred within the content, while interacting with the platform, or some combination of the two.

Throughout the three lab phases, the instructor and the SI monitor the groups for emerging needs in content remediation or necessary reteaching. During this process, the instructor utilizes Just-in-Time Teaching (JiTT) methodologies. The intent is to develop a learning environment that is assessment-centered. Students are encouraged to view the exit quizzes as a valuable tool that allows them to adjust their thinking prior to a summative assessment (National Research Council, 2000). Thus, students are regularly reminded by the instructor and the SIs to view the group work in phases one and two as a time to review and prepare not only for the upcoming lab quiz, but also for future unit tests. In addition, every lab assignment includes at least one preparatory problem for the next set of course content. The additional preparatory problem feeds into the following class meeting as a warmup exercise. In this way, data from weekly lab quizzes is used to inform the next several lessons.

Results

Since the implementation of cooperative learning and online assessments in College Algebra at Delta State University, the student pass rate has risen from 52% to 68% (See

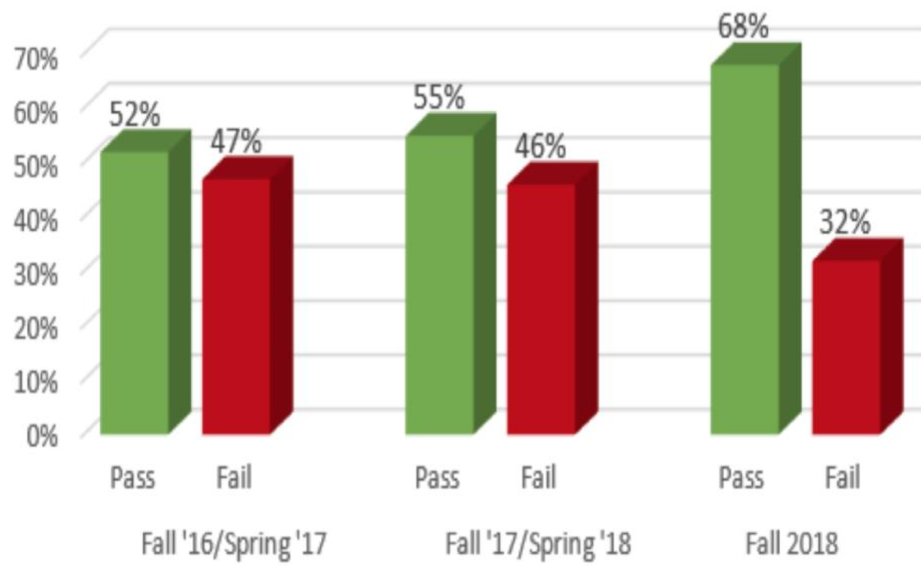
Table 2). The researchers are of the belief the increasing trend in the pass rate may be attributable to ongoing improvements in the instructor's cooperative learning pedagogy.

As seen in Table 2, where an A, B, or C final letter grade is defined as a passing grade, cooperative learning and online assessments have shown to effect positive gains on pass rates

Throughout each semester of full implementation of this lab model, the instructor observed an appreciable shift in student anxiety and self-efficacy. This shift occurred through the culture/climate shift within the student population. Student dialogue within the groups, as well as with the instructor, increased suggesting a drop in anxiety.

As the course progresses from unit to unit, students appear to be more confident in their ability to interact with the LMS as well as in their ability to succeed in the course overall. Students make fewer errors when transitioning from paper to platform in individual formative and summative assessments, allowing for the instructor to have a clearer understanding of student content knowledge. Additionally, the instructor and the SI experience less direct intervention with the groups during lab work as the students seem to become more comfortable with the cooperative learning structure.

Table 2
Yearly Pass/Fail Data in College Algebra



Conclusion
Data from the fall of 2017 through the fall of 2018 are indicative of the success of the implementation of the cooperative learning and online assessments initiative. While the data is still being sifted for the 2019/2020 school year due to ongoing changes in the

program, preliminary results are encouraging and will be included in the next research study to be written in the near future.

Given the observations over the last three semesters of implementation, the author plans to proceed as well with a qualitative study of any potential correlation between cooperative learning groups as outlined in this paper as well as student math anxiety and student self-efficacy.

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