

## **How Involving Secondary Students in the Assessment Process Transforms a Culture of Failure in Mathematics to a Culture of Accountability, Self-Efficacy and Success in Mathematics: *Student Action Plans, Assessment, and Cultural Shift***

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### **Abstract**

Learn how to realize a measurable increase in student engagement and achievement in mathematics through a guided, collaborative, and active process grounded in mathematics. Students and teachers collaboratively devise a data-driven plan of action that moves learning forward for all students and effectively supports at-risk secondary students in urban environments. Learn how teachers in the LMU Math and Science Teaching Program effectively implement assessments as motivations for student achievement and develop opportunities for students to demonstrate comprehension and retention of essential content over time. Students become active participants in the assessment process in an environment where learning is an individual progression and risk-taking is valued and encouraged. Find out how students, guided by teacher-provided descriptive feedback, make decisions in a process of self-reflection in which they critically analyze and compare their learning outcomes to expectations of content mastery. By comparing mastery to current performance, students utilize failure and engage in error analysis to deconstruct prior shortcomings and devise a plan of action that will move learning forward thereby overcoming failure.

### **Introduction**

The Loyola Marymount University (LMU) Math and Science Teaching (MAST) program inspires and supports cultural transformation through collaborative, innovative, research-based, and transformative practices that focus on students as the impetus for improving teaching and learning in mathematics and science and merge pedagogy with academic content. The MAST program serves as the link between the theories developed through educational action research specific to math and science education with practical applications designed to increase the number of students who are engaged and achieving proficiency in mathematics and science, and connect to the academic discipline of mathematics and science. The MAST program teaches how to analyze, organize, present, and assess information in innovative and active ways that stimulate students' critical thinking processes, embrace failure as part of the learning process, balance collaborative and independent learning, and instill the value of mathematical and scientific thinking as a solution for moving teaching and learning forward [1]. The goal is to transform classrooms so that they effectively implement and analyze assessments as motivations for student achievement, as well as develop opportunities for each student to demonstrate comprehension and retention of essential content over time [7]. Within this structure students become active participants in the learning process, influence the teaching process, and discover the joy and value of mathematical and scientific thinking.

### **Collaborative Learning Portfolios**

In order to involve students as active participants in the learning and assessment process, a framework that supports them in successfully interacting with the process and mathematics is required. An effective structure for engaging students in this process is the MAST Collaborative Learning Portfolio. This portfolio organizes data about what students know and need to know with supporting evidence and goal-setting structures. A key component of the Collaborative Learning Portfolio is the MAST Learning Target Logs. Through use of the log students self-monitor their progress toward academic learning targets by using a rubric to evaluate understanding of the content. The Learning Target Log groups learning targets with levels and shows a progression of these levels throughout the learning process [2]. The learning targets detail what students are expected to know, understand, and do in order to achieve mathematical literacy and competency. They provide a balance between conceptual knowledge and skills [8]. The levels assigned to these targets on the log are based on an

analysis of academic performance on assessments and understanding of the content aligned to learning targets.

Since Learning Target Logs are part of the Collaborative Learning Portfolio, these logs support students in making choices about their individual learning needs. With the logs, students assess and track their own progress in meeting their goals and meeting proficiency while also collaborating with the teacher in analyzing progress and next steps. When students receive returned assessments, scored by the teacher, or participate in an activity, which is self-assessed, the student identifies which learning target is being assessed, records the appropriate level of understanding based on the rubric, and then determines areas of strength and areas of growth. A primary vehicle for teaching students how to appropriately self-assess is the provision of descriptive feedback and communication about learning. Communication is a continuous process, in which teachers and students dialogue back and forth during active practice and individual communication about learning goals, progress, and questions [10]. This may be written, as feedback in the Collaborative Learning Portfolio, or verbal, shared in class or during a conference. The focus is supporting progress to achieve the end goal of mathematical literacy.

Feedback is given on a variety of assessments. Students can write questions which teachers answer, or teachers write questions for students. The modes of communication are exit slips, reflective slips, quick checks, quizzes, tests, and the collaborative learning portfolio. As the teacher and student consistently and effectively engage in this process, students internalize the appropriate and high-level usage of content-related and academic vocabulary and the ability to critically analyze their learning outcomes for errors [9]. Collaboration becomes the norm within the classroom and a transformative culture around learning emerges. While students need critical thinking in applying rubrics to learning target-aligned outcomes to record learning, the power behind the learning log lies not in the sorting of levels of understanding but in the analysis and action plans that result from this datum and other samples of outcomes.

### **Learning Target-Aligned Instruction and Assessment**

Having discussed the framework in which the students interact with assessments and various other learning outcomes and the interaction between students and teachers throughout the assessment process, the relationship between the assessment process and instruction is addressed. The goal of instruction is not to teach for short-term recall, but instead to support a depth of understanding and long-term retention. The MAST spiral cycle supports the internalization of learning through continued accountability and practice. This cycle is unlike the traditional focus on spiraling content that includes the continual re-teaching to students who remain unsuccessful in mastering the content at the initial time of instruction to support learning. The MAST spiral cycle supports continued, as opposed to initial, mastery of the content. It operates under the assumption that all students need to be able to maintain mastery of content throughout the duration of a course and into future courses. Spiraling aligns with the flow: students master a specific learning target, learning moves forward, and the previously mastered learning target is incorporated in teaching of future content to support long term retention and strengthening of learning through mathematical connections [12]. As the content is consistently incorporated and connected following the MAST spiral cycle, differentiation aids all students in accessing the content. In order to support retention, assessment is embedded within each component of daily instruction. A MAST-sequenced lesson includes a Hook to engage students at the beginning of a lesson, an Activity Before Concept (ABC) to transition from the hook to the delivery of new content, an Interactive Mini-Lecture to deliver new content and engage students in critically analyzing material as they learn, Active Practice to challenge students as they interact with the material in class, and an end of lesson assessment such as an exit slip [4]. Each of these lesson components facilitates multiple opportunities for assessment throughout the lesson [3]. The Hook is used to assess the students' level of interest in the topic to be delivered. The ABC measures student background knowledge connected to the concept; this information is used by the teacher to determine the amount of re-teaching and review that is necessary for a given lesson. The Interactive Mini-Lecture incorporates multiple components; such as brain

bubbles, think boxes, and think pair share; to evaluate comprehension of the content as it is delivered as well as students' ability to connect the new content to what they have already learned. The Active Practice component of a lesson measures students' ability to communicate understanding through written and spoken word. The aforementioned assessments measure understanding throughout the flow of the lesson but provide no deliverable for analysis. Throughout a unit of instruction, assessments that are marked or graded to support future learning include exit slips, quick checks for retention, spiraled summative assessments, and assessments that encourage content connections. Exit Slips are utilized to formally measure the learning of new content at the end of the lesson. Quick checks are used to formally assess retention of past content over extended periods of time. MAST spiraled assessments incorporate all learning targets from the course in the same assessment; these topics can be measured in isolation or can be combined to encourage content connections and provide a more challenging problem set that requires careful critical thinking. As students interact with these formal assessments they can engage in a process of intentional and purposeful reflection and error analysis [12].

### **Reflection and Error Analysis**

Learning is an interactive process by which learners try to make sense of new information and integrate it into what they already know. Students are always cognitively processing information and they are either challenging or reinforcing their thinking on a moment-by-moment basis [4]. Before teachers can plan for targeted teaching and before students can engage in practice and continued learning that is tailored to their individual learning needs all parties need to know about students' thinking and understanding for a given learning target. This knowledge goes beyond the simplicity of considering whether students have a question right or wrong, but instead connects to the constructs and patterns that students have internalized about the content. To effectively deconstruct patterns that are incorrect students need to critically analyze their learning outcomes to not only obtain the right answer, but to rectify their misunderstandings. To do this students engage in the MAST Assessment Protocol. In the framework of this protocol, students analyze their work, scores, and descriptive feedback to assess their own work and identify errors, complete an analysis of their errors - identifying the specific place where the error occurred and explaining what went wrong, and self-reflect. As students reflect they respond to questions that engage them in exploring what next steps are needed to achieve mathematical literacy and proficiency. Students analyze the learning targets for which they were ready to demonstrate mastery, targets for which they were not prepared, and the reasons for strengths and gaps in learning. Learning is enhanced when students are encouraged to think about their own learning, to review their experiences of learning, and to apply what they have learned to their future learning. Making these connections and then articulating next steps strengthens learning [5]. The teacher's role is to provide the structure and space to facilitate this process in connection to assessments and learning goals. After analyzing assessments, students analyze their progress of the learning targets and devise study plans based on their individual learning needs. As students engage in reflection they use the contents of their Collaborative Learning Portfolios to support the identification of learning targets that are strengths and those that require more review. Teachers must provide descriptive feedback in order to ensure a feedback loop for this process [11]. When students and teachers become comfortable with a continuous cycle of feedback and adjustment, learning becomes more efficient, students begin to internalize the process of standing outside their own learning and considering it against a range of criteria, rather than the teacher's judgment about quality or accuracy, and begin to take ownership of their learning. When combined with a focus analysis of assessment these activities reveal to the students their individual understanding of and gaps in the material. Using this analysis, and descriptive feedback from the teacher, students then set goals for and devise and implement a plan to support achievement of learning targets.

### **Goal Setting and Action Plans**

Connecting learning targets to academic expectations allows for written, reflective responses to meaningful questions posed about the learning process. It extends the meta-cognitive analysis of learning the content to include the creation of individual growth targets and the process of creating goals. Goals are not simply stated and revisited at some obscure future date, but instead aligned to a specific action plan that is generated in collaboration between the teacher and student and visited frequently [6]. The development of goals relies on accessing information from the Collaborative Learning Portfolio, including the Learning Target Log, that align to learning goals in order to align them with three categories: strengths, topics for review, and highest priority for studying. Review topics are connected to learning

goals for which a basic level of understanding has been demonstrated whereas the highest priority for studying are learning goals for which the lowest levels of understanding have been demonstrated.

Once learning targets have been separated into categories based on evidence, students can generate goals that include demonstrating an increase of the level of understanding for a selection of learning targets that are not currently categorized as strengths. These goals are then aligned to an action plan that is developed in collaboration with the teacher to ensure that the goals are measurable and that steps are taken to realize these goals. As students work toward their established goals in alignment with the action plan, they continue to engage in the process of reflection and error analysis. Students reflect continuously on their work and growth to determine what is supporting their understanding and what aspects of their action plan need to be modified to support their learning and proficiency in mastering the learning goals. Student responses and products throughout this process give an indication of the students' understanding of and gaps in the material as they reflect on learning, as mathematicians and scientists, and of their growth in meeting their goals. As they reflect the Collaborative Learning Portfolio and Learning Target Logs are updated to help students connect their efforts to growth in meeting the learning goals. Students continue to monitor their performance of these learning targets and change the plan as needed. This process empowers students as they take ownership of their learning and begin to view the teacher as a support and facilitator in the process of learning.

### **Cultural Shift**

As a result of implementing the Collaborative Learning Portfolios, Learning Logs, Learning Goal-Aligned Instruction and Assessment, Reflection, Error Analysis, Goal Setting, and Action Plans a shift of culture occurs for the student. In this framework students are able to take ownership of their learning and take intentional actions to realize measurable goals. Teachers become partners with students in the process of learning. Effectively implemented assessments motivate student achievement and develop opportunities for students to demonstrate comprehension and retention of essential content over time. Consequently classrooms in which this paradigm is implemented realize a measurable increase in student engagement and achievement.

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