Using TARGETTS to Create Learning Environments That Support Mathematical Understanding and Adaptive Motivation

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This article focuses on learning environments that support students' mathematical understanding and enhance their adaptive motivation. Drawing on our experiences as teachers and teacher educators, we first describe adaptive motivation. We then introduce TARGETTS, a lesson planning and analysis tool, and describe ways in which teachers can use this tool to highlight specific instructional strategies that support both adaptive motivation and mathematical understanding.

Adaptive Motivation

Adaptive motivation encompasses a number of constructs (e.g., perceived usefulness, interest in the

subject matter, self-confidence, and achievement goal orientation) that have extensive theoretical and empirical support in the affective literature. This literature well documents that students with adaptive motivation value mathematics (i.e., they feel mathematics is useful and interesting), are confident in their ability to learn mathematics, and approach mathematics class focused on learning and understanding the material (Anderman and Wolters 2006; Turner and Patrick 2004). These students tend to do well in mathematics, both in terms of their course and test performance and their ability to persist in the face of challenging work (Middleton and Spanias 1999; Wigfield and Eccles 2000). Further, they show a more meaningful understanding of mathematics (e.g., the ability to explain their reasoning) when compared to students with less adaptive motivation (Gilbert 2008; Stipek et al. 1998).

Learning environments in which teachers incorporate motivational considerations into their lesson planning and reflection can promote adaptive motivation. We now turn to specific examples of how this can be accomplished using TARGETTS.

TARGETTS

Classroom-based research has identified specific instructional practices that can support or hinder students' adaptive motivation (Patrick et al. 2003; Stipek et al. 1998). TARGETTS is a lesson planning and analysis tool that highlights key findings from this research regarding classroom practices that support students' adaptive motivation. The acronym TARGETTS focuses on the following eight dimensions of classroom practice:

Tasks
Autonomy or responsibility afforded students
Recognition of student achievement and learning
Grouping of students
Evaluation of student work
Time allocation in the classroom
Teacher expectations for student behavior and performance
Social interaction in the classroom

The Tasks dimension focuses on enhancing students' interest in learning mathematical tasks through, for example, real-world connections that illustrate the content's meaning or significance. The objective of the Autonomy or responsibility dimension is to provide opportunities for students to participate so they can take responsibility for their learning. The Recognition dimension refers to *why* students are rewarded and highlights the importance of finding a way to recognize all students, such as through honoring progress in goal attainment. The Grouping dimension recognizes the importance of mingling students in ways that emphasize conceptual understanding and deemphasize social comparison. The focus of the Evaluation dimension is on creating grading and reporting processes that spotlight students' personal growth. For example, we give students opportunities to improve their performance through repeat submissions and test corrections. The Time dimension highlights the importance of planning lessons strategically to address multiple objectives in fewer, richer tasks. The Teacher expectations dimension is more than a catchphrase; communicating clear, consistent expectations for *all* students is a key element to a learning environment that supports mathematical understanding. The Social interaction dimension is the basis of classroom community, and teachers can set the norms early on to facilitate *all* students' participation, especially when they are not sure they have a correct solution approach. **Table 1** provides mathematics classroom examples of each dimension.

TARGETTS and the NCTM Standards

The TARGETTS dimensions support the development and maintenance of mathematics classroom environments that are consistent with the recommendations of *Principles and Standards* (NCTM 2000). For instance, the Task dimension asks teachers to consider enhancing student interest through the use of authentic, open-ended problems. This approach to structuring classroom tasks not only supports adaptive motivation but also promotes development of a variety of appropriate solution strategies and reflection on the problem-solving process as encouraged in the Problem Solving Process Standard.

The TARGETTS dimensions are also relevant to establishing a classroom culture in which students work meaningfully with their peers as emphasized in the Communication Process Standard. For instance, creating appropriate groupings allows students to organize their ideas and learn from one another. Having students share solutions allows appropriate social interaction and helps develop mathematical language and expression, also emphasized in the Communication Process Standard. As these examples illustrate, the TARGETTS dimensions encompass classroom practices that assist students in gaining the proficiencies required by the NCTM Standards.

Table 1

Mathematics Classroom Examples for TARGETTS

Dimension	Examples
Task	• Write word problems that use current events, school data, or statistics. • Substitute students' names and their experiences within a problem. • Use manipulatives (e.g., base-ten blocks, pattern blocks) to provide hands-on and visual experience of content. • Connect lessons to real-life skills, such as percentages with shopping for sale items.
Autonomy or responsibility	• Empower students to choose from options (pick two out of five questions on a quiz; select your presentation style). • "Pair-Share" after a pretest; students explain to one another how to solve the problems. • Promote self-evaluation after an exam. • Model for students how to help others without doing it *for* them.
Recognition	• Use your students' extracurricular activities (e.g., athletic events, plays, concerts) as a source for class story problems. • Praise in-class progress outside of class (e.g., in the hallway, say, "Great job explaining on Friday's quiz.") • Rather than posting high test scores, highlight class progress by showing class mean improvement from pretest to end-of-unit test. • Help students develop and maintain individual progress graphs (e.g., to show progress with learning number families).
Grouping	• Ensure that everyone has a specific task during small-group work (e.g., when solving multistep problems, do a step, pass it on). • Allow group size to vary (e.g., pairs, trios, groups of four) based on the needs of the task. • Establish randomized partners (e.g., use an "appointment clock" where each student has a partner for each clock hour and say, "Work with your 3 o'clock partner today"). • Arrange tables and work stations to support individual, pair, and small-group work.
Evaluation	• Interview students to assess their understanding following a group project. • Use mistakes as teaching opportunities (e.g., "What can we learn from what went wrong here?"). • Provide feedback that highlights student progress (e.g., proficient with two-digit addition without regrouping but not yet with regrouping).
Time	• Encourage oral presentations of the subject matter. • Provide opportunities to integrate mathematics concepts and real-life experiences using outside-of-class projects. • Use classroom-based centers so students spend time on what is of interest to and needed for them. • Identify *key* ideas for units to keep up with the pacing chart.
Teacher expectations	• Spend ample time on expectations for students (e.g., "Start slow to go fast"). • Develop and share rubrics for long-term assignments and projects. • Monitor students' participation in and understanding of lessons and activities (e.g., whiteboards, popsicle sticks). • Ask students to demonstrate their solution approaches, not just their answers.
Social interaction	• Establish ways to honor students' need to interact (e.g., cooperative groups, Think-Pair-Share). • Emphasize that peers are valuable resources (e.g., for other solution strategies or ways to explain concepts). • Explain acceptable *and* unacceptable behaviors (e.g., no put-downs, politely critique one another's explanations).

Using TARGETTS

How can teachers implement TARGETTS? Analyzing a recent lesson is a good introduction to implementing the TARGETTS framework in your mathematics classroom.

Analyzing a lesson

You can use **table 2** to analyze a lesson and brainstorm possible revisions for subsequent lessons. To illustrate how this might work, we have answered the questions in **table 2** on the basis of the following example:

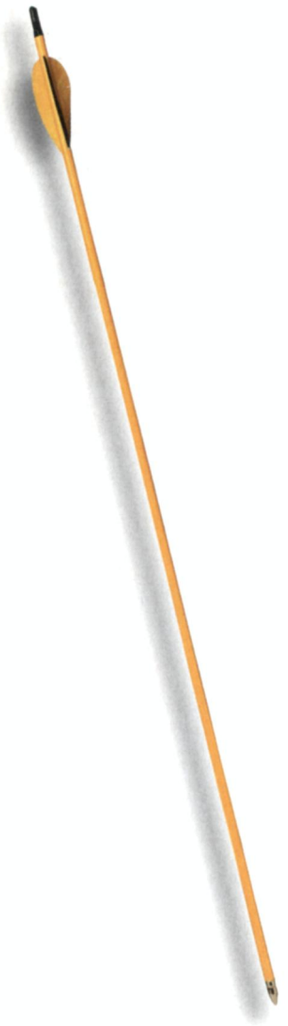
Imagine a lesson in which you are reviewing material for an upcoming chapter test. Your curriculum provides a two-page practice worksheet with both fill-in-the-blank and multiple-choice problems. You introduce the lesson by reminding students of the big mathematical ideas of the chapter and then ask students to work alone to complete the worksheet. The first two students to finish then compare their answers with the teacher's edition. When everyone is finished, these students read the correct answers aloud. You conclude the lesson by asking if there are any questions.

Table 2

TARGETTS as a Tool for Analyzing a Lesson

How was each TARGETTS dimension addressed in your lesson? What alternative strategies might you use to further support adaptive motivation?

TARGETTS Area	Focus	Teachers Should	Current Method	Alternative Strategies
Task	How learning tasks are structured—what the student is asked to do	Enhance student interest in learning tasks	Students complete a textbook worksheet, providing answers only	Modify worksheets so students explain answers; make problems open-ended: not $\frac{\_\_}{3} + \frac{\_\_}{2} = 5$ $\frac{\_\_}{3} + \frac{\_\_}{2} = \_\_$
Autonomy or responsibility	Student participation in learning/school decisions	Provide opportunities for student choice in learning activities	Teacher decides who reads the answers from the teacher's edition	Students choose the best way to represent the problem: in words, pictorially, etc.
Recognition	The nature and use of recognition and reward in the school setting	Find a way to appropriately recognize *all* students	Only students who finish first are recognized; they get to read answers	All students are recognized and participate in sharing answers
Grouping	How and for what purposes students are grouped	Create groups that emphasize conceptual understanding and deemphasize social comparison	There is no grouping; students work alone	Students spend time working alone, in pairs, and sharing with the whole class to help one another learn
Evaluation	The nature and use of evaluation and assessment procedures	Create grading and reporting practices that focus on personal growth	Students hear the correct answers and are graded on how many items are correct	Students share reasoning with a peer, then the whole class; are evaluated for problem-solving efforts more than answers
Time	The allocation of time to different classroom tasks and activities	Plan lessons that address multiple objectives in fewer, richer tasks	Students spend most of the class time working independently	Students share with peers and the whole class to reinforce understanding in preparation for the upcoming test
Teacher expectations	Beliefs and predictions about students' skills and abilities	Communicate clear, consistent expectations for all students	Teacher interacts only with students who have questions about the worksheet	Teacher monitors all students' progress and encourages all to share their thinking with the class
Social interaction	The nature of teacher-student and student-student relationships	Focus on creating a classroom community where all students will participate	Few students shared during the whole-class presentation	All students take turns sharing answers and solution approaches



Now use **table 2** to consider how the dimensions of TARGETTS could help you modify this lesson to support the mathematical goal while also enhancing students' adaptive motivation. Start by considering the task itself. Are there ways to modify the worksheet so that students' mathematical thinking is more transparent? Perhaps students could write a brief explanation for the multiple-choice items stating why the choice they selected is right and why each of the other choices is wrong. Moving to the Autonomy dimension, how might you incorporate student choice into the review of the worksheet? Instead of two students reading the answers, each student could choose how to present a problem to the class (e.g., pictorially, graphically, in words). This lesson modification addresses another dimension: Students who finish fastest are no longer privileged over their peers; instead, all students are recognized for their effort. Consider grouping students in pairs to review their answers and explanations after they have worked alone and before the whole-class discussion.

Are there ways to modify the original lesson to probe and evaluate students' understanding? Perhaps you could ask students to share their solutions and explanations with the class and give credit for effort, rather than correct solutions only. You could give students more time to work with peers to explain answers and help one another. This could be particularly beneficial in this lesson, given the goal of preparing students for a test. With your expectations in mind, did you demonstrate to all students that you were interested in how they solved the problems? Inviting student participation and seeking their answers and solution approaches could send this message more clearly. And finally, concerning their social interaction, were opportunities for students to interact with you and with one another limited in the original lesson? If so, consider ways to modify the lesson to have a more extensive whole-class discussion.

Planning a lesson

Similarly, the TARGETTS dimensions are useful when you are preparing to teach a lesson. We recently presented a teacher workshop that focused on how to support adaptive student motivation in the classroom. Many of these teachers had seen the TARGETTS dimensions in a workshop we had offered the previous year. While focusing on how reform practices can be used to support adaptive student motivation, a male teacher shared his experience of planning a lesson in the classroom using the TARGETTS dimensions.

His first step was to determine the task that students would be asked to perform. He decided to have them make posters to share their solutions to an open-ended problem, enhancing student interest by encouraging them to represent their solution in multiple ways. Students were grouped to help stimulate ideas for the thought-provoking problem, and each student was allowed to choose his or her role in the group (to promote autonomy). Students shared their final posters with the class in a brief presentation, which allowed for appropriate social interaction.

To evaluate his students' progress, the teacher employed an innovative technique that allowed him to recognize individual students' progress while also evaluating the group's work. After the group presentations, he interviewed students individually and found that although some of the final answers on the posters were incorrect, the students demonstrated a robust understanding of the underlying mathematical ideas. This approach saved instructional time because he realized he needed only to address calculation errors rather than conceptual gaps. Embedded throughout this lesson was the teacher expectation that each student could collaborate with peers and solve the problem.

This teacher's experience illustrates how

Celebrate National Metric Week

Break out your rulers; it is time to celebrate National Metric Week. NCTM started the tradition during the week of May 10, 1976, the year after the Metric Conversion Act of 1975 was enacted. Many states issued official proclamations in support, and the peak was in 1984 with 33 states. In 1983, NCTM moved National Metric Week to the week containing October 10—the tenth day of the tenth month. This year, October 6–10 is set aside to celebrate the importance and convenience of the measurement system based on tens.

Go to
www.nctm.org/metric-week.aspx
for metric-related Web sites.

TARGETTS supports the use of Standards-recommended practices to foster students' adaptive motivation. As a colleague of this teacher commented, "I like TARGETTS! It was good to see that [our reform-oriented, Standards-recommended] practices coincide with these goals."

Conclusion

TARGETTS provides mathematics teachers with a useful, research-based lesson planning and analysis tool consistent with the recommendations of NCTM Standards. The classroom examples provided throughout this article illustrate how to implement TARGETTS by first analyzing and then planning a lesson. Taken together, the Standards and TARGETTS offer teachers a framework and tool, respectively, for enhancing students' adaptive motivation and their mathematical understanding.

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