

Using Social and Emotional Learning to Develop Mathematically Proficient Students:

An instructional guide for use with MARS Task: “Printing Tickets”

This instructional guide focuses on the distinct areas of intersection between the Standards for Mathematical Practice (SMP) and the Social and Emotional Learning (SEL) competencies. The guide is built around one of a series of problem-solving tasks—developed by the Mathematics Assessment Resource Service (MARS)—that call for students to engage in the SMP. By making these competencies explicit, the guide supports your monitoring and encouraging the social and emotional learning competencies called for by the SMP. It also provides you with suggestions for facilitation that promotes students' social and emotional learning competencies and thus supports students' engagement in the SMP. The next page of this instructional guide provides a **template key** annotating the parts and purpose of each facilitation step in this guide.

The CCSS-SMP call for basic social and emotional skills necessary for students to successfully apply the mathematical practices. For example, the first mathematical practice standard, “*Make sense of problems and persevere in solving them,*” requires that students apply *self-management*, *self-awareness*, and *social awareness* skills as they engage with challenging problems (see the companion table “Connections between the CCSS-SMP and SEL competencies” for more details).

Common Core State Standards for Mathematical Practice*	Social and Emotional Learning Competencies ¹
<ol style="list-style-type: none"> 1. Make sense of problems and persevere in solving them. 2. Reason abstractly and computationally. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning. <p>*For additional detail, see the Common Core State Standards for Mathematical Practice, at http://www.corestandards.org/Math/Practice</p>	<p>Self-awareness: The ability to accurately recognize one’s emotions and thoughts and their influence on behavior. This includes accurately assessing one’s strengths and limitations and possessing a well-grounded sense of confidence and optimism.</p> <p>Self-management: The ability to regulate one’s emotions, thoughts, and behaviors effectively in different situations. This includes managing stress, controlling impulses, motivating oneself, and setting and working toward achieving personal and academic goals.</p> <p>Social awareness: The ability to take the perspective of and empathize with others from diverse backgrounds and cultures, to understand social and ethical norms for behavior, and to recognize family, school, and community resources and supports.</p> <p>Relationship skills: The ability to establish and maintain healthy and rewarding relationships with diverse individuals and groups. This includes communicating clearly, listening actively, cooperating, resisting inappropriate social pressure, negotiating conflict constructively, and seeking and offering help when needed.</p> <p>Responsible decision making: The ability to make constructive and respectful choices about personal behavior and social interactions based on consideration of ethical standards, safety concerns, social norms, the realistic evaluation of consequences of various actions, and the well-being of self and others.</p>

¹ Quoted from CASEL: Collaborative for Academic, Social, and Emotional Learning. Social and Emotional Learning Core Competencies. <http://www.casel.org/social-and-emotional-learning/core-competencies>

Template key: The parts and purpose of each facilitation step

Step #: [name of step]	
<p><i>[These instructional guides are built around a four-step lesson facilitation process.</i></p> <p><i>Step 1: Launch the task</i></p> <p><i>Step 2: Promote initial collaboration</i></p> <p><i>Step 3: Monitor progress</i></p> <p><i>Step 4: Share and discuss solutions and strategies</i></p> <p><i>Each step kicks off with an overview of the lesson facilitation for that step, including suggestions for cueing students to the relevant social and emotional learning competencies.]</i></p>	
<p><u>Connecting mathematical practices and social-emotional competencies</u></p> <p><i>[This section describes the relevant connections between the Common Core State Standards for Mathematical Practice and the social and emotional learning competencies.]</i></p>	
<p><u>Assessing social and emotional learning</u></p> <p><i>[This section briefly describes, for the social and emotional learning competencies addressed in this facilitation step, what teachers can look for and listen for to assess whether their students are demonstrating the relevant social and emotional learning competencies.]</i></p>	<p><u>Facilitation suggestions</u></p> <p><i>[This section describes suggestions to help teachers attend to and promote students' application of the Standards for Mathematical Practice or the social and emotional learning competencies as students engage with the mathematical task. These suggestions may include possible scaffolding or extension questions.]</i></p>

Instructional Guide: MARS Task “Printing Tickets”²

Step 1: Launch the task

Orient students to the task and clarify the expected work products. Let students know the task will be both interesting and challenging—and that it will be fun, because they can solve it any way they want, and they will work with a partner.

Explain to students that answering the questions on the task handout is only part of the challenge, and that you as their instructor will also be looking to see that students can describe and justify their own work and ideas as well as understand and explain the work and ideas of others.

Alerting students of these expectations ahead of time can help them see why they need to put effort into working with their partner.

Connect to prior learning by reminding students of experiences they have had as a class (for example, previous content experiences or challenging problems) that prepared them for success today.

Have students read all parts of the task on their own and prepare themselves to describe, in their own words, the set up of the problem and what is being asked for in each part. In this step, students need to read the task first and begin thinking about how they might approach the different parts of it. Allow enough time in this stage for students to also attempt to write the formula for the Best Print company.

Connecting mathematical practices and social-emotional competencies

- Students analyze the problem and explain to themselves the meaning of the quantities and other given information (**Make sense of problems and persevere in solving them**).
- Students may also consider ways in which the mathematics they know can apply to the situation (**Model with mathematics**).
- As students engage with these mathematical practices, they assess their own thoughts, strengths, and limitations (**self-awareness**) and regulate their emotions, thoughts, and behaviors (**self-management**).

Assessing social and emotional learning

When students apply **self-awareness** and **self-management**, they

- May be scanning the text for clues and/or listing questions to ask the teacher (**self-management**), and having confidence that they can work through their uncertainty (**self-awareness**).
- Are attentive and focused on their work (**self-management**).
- Manage stress and show minimal signs of frustration, such as head down, slouching, negative facial expressions, and/or distractibility (**self-management**).

Facilitation suggestions

- Encourage students to articulate their thoughts by restating the problem in their own words or by describing to you what they know about the scenario and the question(s) being asked.
- Acknowledge any student frustrations with the task and remind them that frustration is normal when working with a challenging task.
- Encourage students to consider what they’ve already learned, by asking them:
 - *How is this task like other scenarios you have investigated before? How is it different?*
 - *What questions do you have about the scenario?*
- Encourage students to persevere through challenges by asking them:
 - *What do you know about the ticket-printing scenario?*
 - *How does the Sure Print pricing formula relate to the verbal description of the pricing plan?*
 - *How is the Best Print pricing plan similar to and different from the Sure Print pricing plan? How might those similarities and differences affect the formula for Best Print?*

² Available at <http://www.insidemathematics.org/assets/common-core-math-tasks/printing-tickets.pdf>

Step 2: Promote initial collaboration

As you transition students to working in pairs, tell them that they will start by explaining to one another their initial ideas and approaches to the problem and that they should be prepared to restate the ideas of their partner. Remind them that you will be looking to see that they communicate their own ideas clearly and that they seek to understand the points of view of their classmates by asking clarifying questions.

You might hold students accountable to this approach by walking around and asking some students to restate their partner's idea or explain their partner's approach.

About the mathematics

Listen for students' descriptions of the similarities and differences among the representations (verbal, algebraic, and graphical) of the two ticket-printing pricing plans.

Connecting mathematical practices and social-emotional competencies

- As students seek to understand one another's approaches, they identify correspondences between different approaches, and they work together toward a solution (**Make sense of problems and persevere in solving them**). As pairs share their approaches to the task, they assist one another in making sense of quantities and their relationships in the problem (**Reason abstractly and quantitatively**).
- As students engage with these practices, they will apply **social awareness**, in taking the perspective of their partner, and key **relationship skills**, such as active listening and respectful rebuttals.

Assessing social and emotional learning

When students apply **relationship skills** and **social awareness**, they

- Communicate and listen actively by maintaining eye contact, nodding or showing understanding, and asking follow-up questions (**relationship skills**).
- Disagree respectfully by showing they understand others' perspectives (**social awareness**) and asking follow up questions.
- Show respect for their partners by allowing them to communicate without interruption (**relationship skills**).

Facilitation suggestions

- As students clarify their understandings with their partner, continue using the scaffolding questions from Step 1 as needed.
- Ask students to explain their partner's reasoning to you; frequent checking-in with students establishes "perspective taking" as the classroom norm.
- Model and encourage active listening by providing examples of good clarifying questions.
- Encourage students to begin a rebuttal with a restatement of their partner's viewpoint or argument. If needed, provided sample stems, such as "I understand your ideas are ____ and I think ____ because ____."
- Remind students that allowing others to complete their sharing without interruption communicates interest and respect.

Step 3: Monitor progress

Once pairs have had a chance to share their initial thinking with one another, let the class know that each student will continue working with his or her partner to answer all parts of the task and that you will continue to look and listen for high-quality collaboration and communication skills. Each partner should be able to describe the progress of their pair and how that pair is solving the problem. Continue to monitor students' progress by attending to the methods they use to solve the problem and the ways they interact with their partners. While students are working, select up to five different pairs to write up solutions to some or all of the parts of the task to be shared with the whole class. Select pairs with a variety of approaches.

About the mathematics

As students study the relationships between the number of tickets and the cost of printing them for the two companies, they may write their equations in a variety of ways. Some students may be able to graph the formula for Best Print directly from the equation; others may create a table of values first. In assessing where the cost is equal for both companies, students may solve the system algebraically in a variety of ways (e.g. substitution method, setting the expressions for cost equal to one another). Others may use the graph as a starting point and then verify through substitution into each of the formulas. Some students may construct a table or guess and check. It is possible for students to be unsuccessful with part 3, yet still generate in Part 4 an accurate or partially accurate explanation for which company Susie should choose.

Connecting mathematical practices and social-emotional competencies

- Students will need to work together to shift perspectives to discern a pattern or structure in the algebraic representations of the ticket-printing pricing plans, and solving the system of equations will require students to compose or decompose algebraic expressions. (**Look for and make use of structure**). They will also construct arguments supporting their answers and strategies (**Construct viable arguments and critique the reasoning of others**).
- As students engage with these practices, they will apply **self-management** as they continue to manage stress, maintain confidence, and monitor progress. As students engage together with these practices and work toward solutions, they cooperate, negotiate conflict constructively, and support and help one another through confusion and frustration (**relationship skills**).

Assessing social and emotional learning

When students apply **self-management**, they

- Seek help from peers or teachers as needed.
- Use organizational strategies as needed.
- Organize thoughts and information on paper, such as relevant rules from memory or clues found in the problem.

When students apply **relationship skills**, they

- Ask clarifying questions.
- Actively listen to their peers (maintain eye

Facilitation suggestions

- To enable students to practice self-management, acknowledge their emotions, but do not intervene too quickly in student work. Use these questions as needed if students are stuck:
This is a challenging task, so it is normal to feel frustrated, but let's think this through:
 - ... what are some strategies for graphing a function rule?
 - ... how can the graph help you determine when the cost is the same for both of the printers?
How can the equations help you?
 - ...if you know when the cost is the same for both companies, how can that help you determine when each is a better deal?
- Ask individual students to each summarize his or her progress so far.

<p>contact, nod to show understanding)</p> <ul style="list-style-type: none">• Communicate clearly and effectively.• Negotiate conflict appropriately.• Are comfortable seeking help when needed.	<ul style="list-style-type: none">• Remind students that each person will need to be able to summarize the solution and the strategies applied, as well as their partner's thinking.• As students prepare their arguments, encourage them to anticipate the feedback and questions they are likely to receive and to think about how they will respond.• If you observe conflict, support students' attempts to work through it with questions such as:<ul style="list-style-type: none">○ <i>Will each of you explain your perspective on why you think you and your partner are stuck?</i>○ <i>Has either of you asked for help? What help do you think you need as a team to solve this problem?</i>
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Step 4: Share and discuss solutions and strategies

Ask the student pairs you selected in step 3 to present and justify their solutions to the class. Make sure that the solutions presented include different approaches to the task.

Let students know that you will be calling on them to restate and compare one another's solution strategies, which will require careful listening and understanding the perspectives of others. Also, encourage students to generate clarifying questions.

It is not necessary that all five pairs you selected in step 3 be able to share their ideas with the whole class. What is important is that students engage with one another's ideas.

Connecting mathematical practices and social-emotional competencies

- As students listen effectively to the arguments of others and share logical progressions of their own thinking, they apply the mathematical practice of **Construct viable arguments and critique the reasoning of others**. As students compare and analyze the various ways of solving the system and assessing when each company is the better choice, students naturally discuss the ways in which they **use appropriate tools strategically**.
- As students engage with these practices and share their ideas with the class, they engage in **social awareness** and perspective taking. As students decide whether the arguments make sense and ask useful questions to respectfully critique one another's mathematical arguments, they engage in active listening, clear communication, and constructive negotiation of disagreements about answers or approaches to the task (**relationship skills**).

Assessing social and emotional learning

When students apply **social awareness** and **relationship skills**, they

- Understand and validate other positions and arguments (**social awareness**).
- Challenge peers in a respectful manner by constructing respectful rebuttals (**relationship skills**).
- Ask clarifying questions, actively listen to their peers, and negotiate conflict appropriately (**relationship skills**).
- Are comfortable seeking help when it is needed and accept feedback graciously (**relationship skills**).

Facilitation suggestions

- Remind students that all mistakes provide opportunities for learning for themselves and their peers.
- As students present justifications, reinforce their ability to reason abstractly and quantitatively by encouraging them to explain the connections among the formulas, the graph, and the written explanations.
- Encourage students' active listening by asking a volunteer to restate the presenter's strategy in the volunteer's own words. This practice helps establish or reinforce norms for classroom discourse while also setting the expectation that all students listen carefully to each other's ideas.
- Encourage students to ask clarifying questions and to challenge each other in a respectful manner, praising them when they do so appropriately.
- Ask for other approaches to finding the solution to question 8. This practice will expose students to different approaches, enhance relationship skills, and help them build flexibility in their thinking about different ways to solve problems.

About these resources

This document is one of five interrelated resources that articulate correlations and mutually reinforcing commonalities between the social and emotional learning competencies (as described by CASEL) and the Standards for Mathematical Practice (as described in the *Common Core State Standards for Mathematics*).

These resources consist of a whitepaper focused on **making the case** for integrating social and emotional learning with the Standards for Mathematical Practice; a vision **describing an ideal classroom** exemplifying such an integration; and three **instructional guides** for using selected MARS tasks, with special attention to the CCSS Standards for Mathematical Practice and the social and emotional learning competencies. (These MARS tasks can be found on the Inside Mathematics website at <http://www.insidemathematics.org/performance-assessment-tasks>.)

The resources are:

- Integrating Social and Emotional Learning and the Common Core State Standards for Mathematics: **Making the case**
- Integrating Social and Emotional Learning and the Common Core State Standards for Mathematics: **Describing an ideal classroom**
- Using Social and Emotional Learning to Develop Mathematically Proficient Students: An **instructional guide** for use with **MARS Task: “Conference Tables”**
- Using Social and Emotional Learning to Develop Mathematically Proficient Students: An **instructional guide** for use with **MARS Task: “Printing Tickets”**
- Using Social and Emotional Learning to Develop Mathematically Proficient Students: An **instructional guide** for use with **MARS Task: “Swimming Pool”**

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While the Noyce Foundation concluded its operations in 2015, its mission—to help young people become curious, thoughtful, and engaged learners—continues through the work of this project and others like it, including the Inside Mathematics website (<http://www.insidemathematics.org>), which has joined the Dana Center’s portfolio of services.

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About CASEL

Collaborative for Academic, Social, and Emotional Learning (CASEL) is the nation’s leading organization advancing social and emotional learning (SEL). Our mission is to make social and emotional learning an integral part of education from preschool through high school. Through research, practice, and policy, CASEL collaborates to ensure all students become knowledgeable, responsible, caring, and contributing members of society.

Learn more about our work at www.casel.org.

The Dana Center develops and scales math and science education innovations to support educators, administrators, and policy makers in creating seamless transitions throughout the K–14 system for all students, especially those who have historically been underserved.

We focus in particular on strategies for improving student engagement, motivation, persistence, and achievement.

The Center was founded in 1991 at The University of Texas at Austin. Our staff members have expertise in leadership, literacy, research, program evaluation, mathematics and science education, policy and systemic reform, and services to high-need populations.

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