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Getting Started and Establishing Norms

In the following vignettes, these teachers choose to enhance how they use formative assessment data to differentiate instruction in alternative ways. They all begin in different places and pursue individualised goals.

Ms Box decided to enhance how she used formative assessment to differentiate instruction after first identifying practices she already used, such as giving differentiated homework assignments and tests. She decided her next step would be giving diagnostic pre-assessments before units. Though she usually knew where her students were, a colleague reminded her that pre-assessments also benefit the students when they self-correct them and get an idea of what they need to work on. As an example, on a trial pre-assessment, one typically high-achieving student only scored 12/15, which surprised Ms Box. She had assumed that he had already mastered these skills and was planning to give him and several others an enrichment investigation task. Instead, she now chose to wait and shore up the skills he had missed. She was thrilled to hear him explain, "I missed the questions on volume of prisms and cylinders. It must have been due to calculation errors because I know the formulas. I found several model problems in a supplementary text. I'm going to practise these two types again and see if I can get the calculations right." In addition to her now knowing where to focus her teaching, the student also now knew exactly where he needed to focus his learning.

In contrast, Mr Martin decided to begin with smaller formative assessment check-ins. He chose to begin with check-ins so that he could monitor how students were going throughout the unit. After reviewing the class's homework and finding two minor error patterns, he designed a quick check-in task during a unit on solving linear equations. He had students solve two linear equations and substitute the

solution back into the original equations as a way of teaching his students how to self-check their work. He then reviewed the activity with the class, pointed out all they seemed to understand well, and then helped his students use the check-in to identify which of the two different types of errors they were making. He reviewed each type, then had them select which further practice to do based on which type of error they had made.

Ms Murray had been giving pre-assessments for some time and wanted to enhance how she handled the subsequent forming of groups. In the past, she had often created three groups based on those who knew most of the material, some or had no prior learning of it. Instead, she wanted to do a deeper error analysis and group students according to their specific inclinations and conceptual misunderstandings. She also wanted to move beyond just grouping by readiness levels so that she could strengthen the class norm that "we all learn differently" and move away from students regularly comparing each other hierarchically. To do this, she redesigned her pre-assessment to better capture these different conceptual understandings and to include a more substantial self-reflective evaluation for students to complete. They were able to more closely analyse their strengths as well as the kinds of conceptual errors they made and understand why they may have made them. The students proved adept and thoughtful in their analyses of their pre-assessments. Ms Murray then used this more complex, detailed information to form more nuanced groupings. She found four different tasks that allowed them to begin practising strategies for addressing the specific conceptual understandings, ranging from those who inverted the first fraction when dividing to those who needed to refine how precisely they could explain why the second is inverted.

GETTING STARTED

These three teachers understand that achieving a comprehensive vision of using formative assessment to differentiate instruction is achieved slowly over time, and each teacher's path to doing so is unique. Identifying where you already are can prove helpful toward deciding how to enhance your use of formative assessment to differentiate maths instruction. This process can begin with completing the self-assessment shown in Figure 1.1. You can then see what you already do and choose next steps to take.

Formative assessment has been defined as teachers or students using data as a basis for decisions about next steps to take toward achieving learning goals, and to then make instructional decisions that are better than those that would have been made without this data (Wiliam, 2010). When using formative assessment, differentiation is the natural next step. Carol Ann Tomlinson (1999) has defined differentiating instruction as an organised, flexible and proactive approach to adjusting instruction so that it best meets the needs of all learners and promotes maximum growth for all. Aiming to achieve this goal is a core of *equity,* which is an important principle of the high-quality mathematics education we should all strive to provide for students in the twenty-first century.

In a comprehensive approach to using formative assessment to differentiate maths instruction, teachers would work toward regularly using the following seven practices. I developed this group of practices to help guide the teachers that I have worked with

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Figure 1.1

Teacher Self-Assessment

Differentiating Maths Practices Rubric

We all begin in different places and pursue different goals as we grow as teachers. This self-assessment provides an overview of practices that can enhance your skills at using formative assessment to differentiate instruction, rather than a required to-do list.

Convey Norms and Targets

Assessment

Co-plan Next Steps

Grouping and Tiering

Challenge and Support

Homework and Marked Assessments

Figure 2.13

Justification Rubric

Score: (Categories listed below)	4 Outstanding	3 Proficient	2 Nearing Proficient	1 Not Yet Proficient
Complete and Accurate Maths	Fully Complete and Accurate	Maths is Complete and Accurate, but for a Small Simple Error That Is Reasonable	Maths Is Complete and Accurate, but for a Few Small Simple Errors That Are Reasonable	Maths Is Incomplete and Inaccurate
Key Point or Inference Identified	Overtly States the Key Point or Clearly Identifies the Inference	A Piece of Evidence Is Provided	Hints at Evidence	No Evidence
Clear Opinion	Clear Opinion Stated	Opinion Is Clear, but Not Fully Stated	Opinion Unclear	Opinion Not Stated
Solid Evidence to Support Opinion	Exceptionally Strong or Multiple Pieces of Supportive Evidence Are Given to Back Up Opinion	A Piece of Evidence Is Stated	Hints at Evidence	No Evidence
Evaluates Reasonableness of Opinion	Gives a Compelling, Direct Statement of Why the Opinion Is Reasonable	Suggests Why Opinion Is Reasonable	Reasonableness Is Unclear	Opinion Seems to Have No Reasonable Basis

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DIFFERENTIATING FOR CONCEPTUAL UNDERSTANDING

> *Elizabeth shrank back when she heard that the next unit would be on geometry. She knows her learning style well, and she knows that she has difficulty interpreting visual images. When her teacher had recently tried to explain fractions through visual images, she noticed that Elizabeth actually looked away. Elizabeth is a cooperative student and eager to learn, but it was an epiphany for them both when they realised that she did this because she just cannot make sense of images. Elizabeth has a mild nonverbal learning disability, which often means that she struggles with making sense of nonverbal images, and she prefers to learn through words.*
>
> *Eddie usually performs well on maths tasks, though not extraordinarily well. However, on a recent probability task, he had real difficulty understanding the idea of independent events. His teacher drew a diagram for him, but he still did not seem to get the concept. Eddie has no diagnosed disability; he just often requires more time, exposures and practice to master certain conceptual understandings.*

Students who struggle with conceptual understanding can pose some of the toughest challenges for teachers. Often teachers feel most of the class is ready to move on but recognise some need more time. The following approaches are designed to be used as homework or tiers built into full class lessons so the whole class is not held up while a few students get extra help with a concept. It is recommended that teachers focus on developing and solidifying conceptual understandings before procedures, and don't teach procedures without fully addressing conceptual understanding as well. A continued emphasis on solidifying conceptual understandings is prominent in all current thinking about mathematics instruction.

Clarify a Concept and Assess It

Before attempting to use a more intensive strategy to help strengthen a student's grasp of a concept, teachers should ensure they themselves have a clear sense of the specifics of the concept that they would like to develop as well as precisely where the student falls on a continuum of understanding the concept. Teachers can ask themselves questions such as:

- What are the specifics of the concept I want the student to grasp?
- What is already grasped?
- What else can I try to develop it?

To determine what the student already does understand, the teacher can sit with the student and ask him or her to verbalise their thought processes or explain their thinking, with prompts such as, "Tell me all you do understand." However, teachers

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Heuristics – Specific Strategies for Remembering a Sequence of Steps

In addition to checklists, students can be helped to design and use strategies for remembering sequences of steps needed for procedures through heuristics. Recent research has found that among those strategies that significantly uplift achievement among students with learning disabilities in mathematics, those that apply heuristics are by far the most powerful (Gersten, Chard, Jayanthi, Baker, Morphy & Flojo, 2009). Students with some learning needs have difficulty with monitoring and directing their thinking while they engage in solving maths problems (Montague, 2007), particularly following procedural steps. The following strategies, which are examples of heuristics, can be offered to all students, to assist them with following procedural steps if checklists are not enough support.

Look-Ask-Pick

Look-Ask-Pick (LAP) is an example of a procedural strategy that is somewhat of a heuristic, in that it is used to teach students the specific steps for solving one type of maths problem. LAP was developed and validated by Test and Ellis (2005) to help students understand the necessary steps for adding and subtracting fractions.

LAP: Adding and Subtracting Fractions

Look at the denominators ($\frac{1}{2} + \frac{1}{3}$)

Ask yourself the questions: Are they the same/Will the smaller denominator divide into the larger denominator an even number of times? (No.)

Pick your fraction type. (They fit into sixths.)

The steps for teaching LAP include:

- ❒ Teacher modelling of the strategy.
- ❒ Guided practice of the steps with the teacher and students restating the steps.
- ❒ Individual practice of the strategy steps.
- ❒ Pair practice using games and flash cards to recall the strategy steps and types of fractions.

Source: Test & Ellis, 2005.

A strategy like this can be posted in the classroom or placed on small laminated cards and given to students to hold at their desks. After addressing any prerequisite skill gaps and gaining buy-in from students through discussing when and how it will be useful to them, the teacher can model the strategy with a think-aloud and ensure students learn it through activities such as reciting or writing each step before entering or leaving the classroom.

Figure 6.7

Weekly Homework Packets

Please hand in this week's homework on Friday. All homework should be self-corrected, with notes on what you learned from each error and steps you'll take to avoid it in the future.

Monday:
Problem set numbers ___–___ on p. _____.
Challenges #_____ in extension packet.

Tuesday:
Problem set numbers ___–___ on p. _____.
Challenges #_____ in extension packet.

Wednesday:
Problem set numbers ___–___ on p. _____.
Challenges #_____ in extension packet.

Thursday:
Problem set numbers ___–___ on p. _____.
Challenges #_____ in extension packet.

If your pre-assessment was nearly perfect, you must do the optional challenges. You are to select three of the most challenging problems in each standard problem set also. Of course, you are welcome to do the challenges even if you had difficulty with the pre-assessment.

in which they reflect on any problems/questions they had and how they addressed them. Doing this, we have found, actually gives us the most powerful sense of where they are at, and being written so concisely, is a quick read for the teacher. Other options certainly exist and can be equally helpful. The key is having students self score their work as this is both extremely well supported by the research and dramatically saves teacher time.

Encourage Student-Directed Differentiation

Students can also be encouraged to propose ways to compact or extend their homework, based on where they are in mastering the unit's listed targets.[4] This can be challenging for kids to do well, though it is an ideal way to foster self-directedness and save teacher planning time. As an example, in a unit on probability one child who'd scored 96% on the pre-assessments was stumped by one type of problem – identifying the difference between a permutation and a combination. His teacher often reminded her students that he has found students typically need to do about 24 practice problems with at least 80% accuracy to master a topic. Although this student had tested out of most of the homework because of his high pre-assessments score, he chose to do 24 practice problems that required him to determine whether the problem was a permutation or a combination in order to master this topic.

Differentiate Homework

If a teacher has assigned homework for the class and feels that several students have mastered the topic during the class lesson despite having not shown mastery of it on the pre-assessment, she or he can have them star just those challenge problems that they should do. If a student needs extra practice with certain skills such as multiplication, Internet sites can be recommended, and they can keep a log of time spent in extra practice as described in Chapter 2 (refer to Figure 2.4).

Involve Students in Correcting Homework

Tiered tasks with the same answer, but varied levels of support, such as embedded hints or more steps provided, are ideal for homework because the whole class can correct it together. Having students self-correct homework in advance while they are at home saves time that can then be used to review two sets of questions on different homework the next day in class. Students can use self-correcting tasks, such as riddles; or teachers can send home or post answers on a website. Students can also be given answer keys in class to correct their own homework.

On days when all the homework is not the same, students should not have to sit through corrections of homework that they did not do when it is below their instructional level. They can work ahead in challenge packets instead, while the teacher answers questions from the other group. Also students can discuss homework questions with peers first, as the teacher rotates between groups answering questions. Keep in mind that running more than two homework groups can be logistically challenging.

Differentiate Support for Students Who Don't Hand in Homework

If students don't hand in homework, they can be asked to complete a time-management form in which they list out how they spend their time as well as create a time-management strategy. If they don't understand it, they can fill out a checklist of efforts made so that they and their teacher can assess the problem and find an individualised solution (see Figure 6.8).

To further differentiate support, if students have general difficulty despite these efforts, a parent can be asked to send a weekly email or note in the study/homework book as to whether homework has been completed. One teacher with a student whose parents had organisational challenges and forget to send the email weekly found that this student's grandfather was better at doing this. Asking parents to initiate a weekly check-in is just realistic in a time-management sense, as teachers with 100-plus students cannot easily stay on top of initiating emails regularly for missing homework. Time spent finding how to get parents to check in (e.g. have the grandparent do it) will save teachers inordinate amounts of time down the road.

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