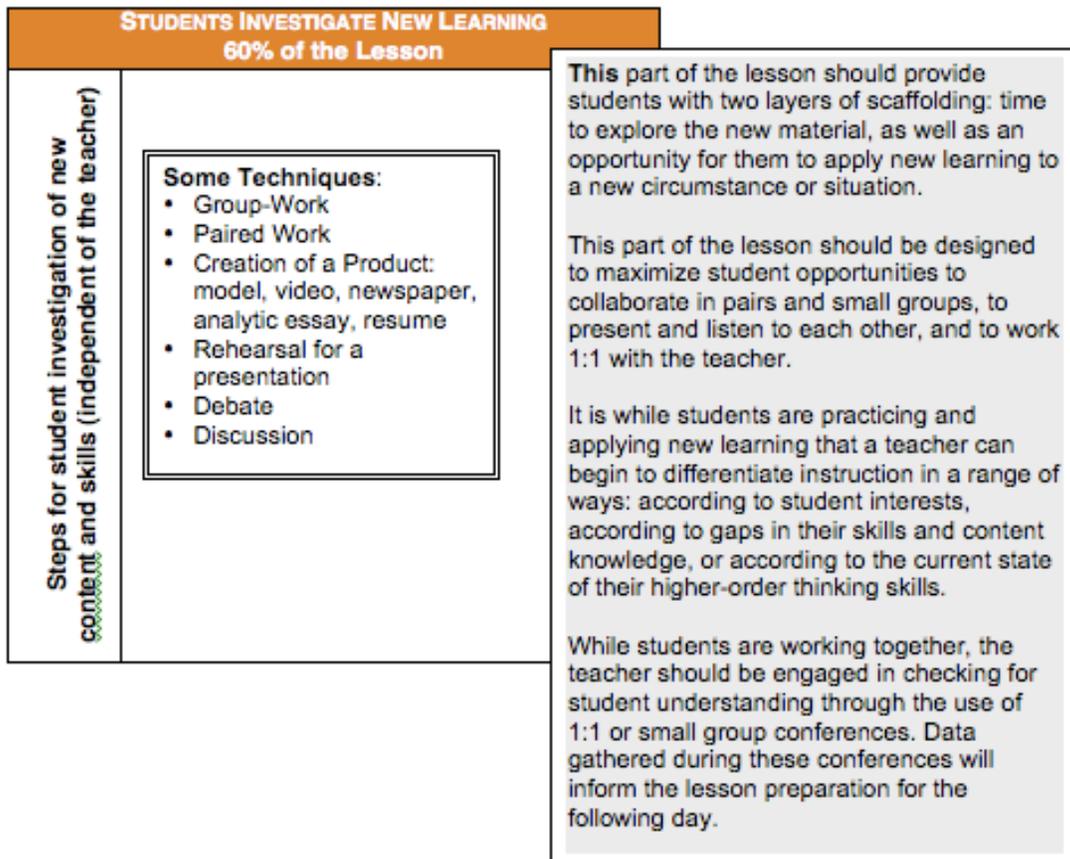


Investigation

When planning an FEI Lesson, teachers try to allocate as much of the learning time as possible to students' active exploration of ideas. The exploration typically includes opportunities for students to analyze and evaluate concepts, in addition to creating their own responses. Taking the place of a more traditional lecture-format, effective investigations place students at the center of their own meaning-making, as they work with their peers and the teacher to deepen their understanding of complex ideas (see inset).



Well-planned investigations might appear unstructured to an untrained observer, as students move from verbal collaboration into reading and writing activities, and back again, often at their own pace.¹ The key to the success of these classrooms is the array of familiar

¹ There is a wonderful video of a math classroom on youtube entitled "Differentiation in Action." Throughout the video, students are deeply engaged in an investigation of a math topic, while the teachers unobtrusively moves around the room, checking-in with students. The quality of the video is poor, but the viewer is left with a strong impression of what an exploratory classroom can look like, after students have mastered the routines, structures, and habits they need in order to successfully manage their own learning:
<http://www.youtube.com/watch?v=uU25gNc024I>.

routines, and rituals that have been put in place to support students' independent learning: materials are available, tasks are clear and available for students' reference at any time, habits of effective collaboration and independent work have been internalized, the learning strategies are actively used, and students have come to feel a certain level of efficacy. There are three additional features of the investigation period: First, students must have the opportunity to collaborate, mentor and share (interact) with one another in order to effectively consolidate their learning.² Second, teachers can use this period as an opportunity to differentiate instruction³ in a number of ways:

- by working with students on different levels of lower- and higher-order thinking,
- by providing different degrees of scaffolding for the learning strategies,
- by creating a menu of tasks for students to select,
- or by providing an array of texts for exploring the content.

And third, as students work with the new material, the teacher confers with them individually and in small groups, asking them to explain their learning process and decisions (their metacognitive narrative). These conferences provide the teacher with the opportunity to check and document student understanding of the material.⁴

A Math Investigation

- Pass out a scatter plot that shows the relationship between 2 variables related to gentrification in Brooklyn: for example, the number of banks or Starbucks, or check-cashing stores, in a neighborhood over the course of the past 20 years.
- Ask students to work in pairs to figure out what the story of this scatter plot is, and how they went about making this determination: what were the important clues (determining importance).
- Then, pass out a second scatter plot that plots the same variable in another neighborhood, and ask pairs to tell this story as well.
- Finally, students will compare the two scatter plots, and make some inferences about the neighborhoods with regard to gentrification.
- Pairs will share different aspects of their work with the full class: one or two will talk about the clues they found in the plots, one or two can talk about something they found challenging, one or two can share their inferences.

--Tegan Costanza's lesson on scatter plots

² Frey, Fisher and Everlove's text, *Productive Group Work* (ASCD, 2009), provide a wonderful exegesis on student collaboration. They have taken the time to really explore how students groups can become true learning centers, pushing beyond the need to keep students "busy" or "on-task" and into the realm of productivity and engagement.

³ Differentiation is currently one of the central issues in the field. We have identified two good primers that will be useful to teachers beginning to add this dimension to their practice: Spencer Waterman's text, *The Democratic Differentiated Classroom* (*Eye on Education*, 2007); and Tomlinson & McTighe's book *Integrating Differentiated Instruction and Understanding by Design* (ASCD, 2006).

⁴ While students are engaged in investigations, the teacher's role is that of a "a guide on the side." Central to her work during this time, is the facilitation of 1:1 and small group conferences with students. These conferences are used discuss and support what students are thinking and and wondering about, the strategies they are using, and what they believe they are learning. Some of the best work in this arena has been done by Carl Anderson, whose text *How's it Going* (Heineman, 2000) explores the ways in which conferences are critical individualized mentoring opportunities for students, providing another avenue for differentiation. Patrick Allen's 2009 text *Conferring* (Stenhouse) also provides powerful insight into the work of running meaningful conferences with students.

In one of Tegan's math investigations, students work in small groups to learn how to graph linear equations.⁵ In order to differentiate the intensity of scaffolding provided to students, each small group begins the investigation with five sealed envelopes, each holding a question designed to help students make new connections to potentially useful background knowledge and experience. Some groups explored the investigation without opening any envelopes, others opened them as needed. At first glance, the envelopes may appear to be a gimmick, designed to imbue the investigation with a game-like quality. While this is certainly one of the effects of this technique, its real power extends quite a bit further: First, it ensures that Tegan's students remain in control of the investigation, determining the level of support they need at any given moment. In the process, they develop a meta-awareness of the gaps in their content-knowledge and skills: they have to make a collective judgment that the strategies and background knowledge they possess is insufficient to the task. Later in the lesson, this will provide them the opportunity to reflect on the specific gaps in their knowledge, and explore potential ways to address these gaps. In Tegan's class, there is absolutely no shame attached to using the envelopes, but at the same time, they do act as an incentive for groups to try and perform without them—something that might not have happened if Tegan had merely moved amongst groups answering student questions as soon as they were posed. Ultimately, it is the scaffolding provided by the envelopes that makes it possible for all of the students to successfully engage at the higher-levels of thinking required by the task.

It takes time, sensitivity, and patience for teachers to successfully institute these kinds of learning conditions in their classrooms, as teachers and students reconstruct their beliefs about what should happen in a classroom. During the process, transfer school students may exhibit frustration and disengagement: active investigation is much more risky and demanding than the more passive stance that can be adopted during lectures, while taking ownership of one's learning is inherently fraught with numerous, new opportunities to fail in front of one's peers. As teachers begin to make time for investigation, they often find it useful to learn about some of the specific strategies they can use to effectively manage classroom routines and expectations while maintaining powerful learner-centered classrooms.⁶

⁵ See a video of this investigation at http://www____.vimeo.com.

⁶ Saphier & Gower's seminal text, *The Skillful Teacher* (Research for Better Teaching: 1997), devotes several chapters to "Classroom Management" as well as to "Student Motivation." The 10 chapters that make up these 2 sections provide rich opportunities to learn new ways to build a classroom infrastructure to support independent learn. Wong & Wong's text, *The First Days of School* (Wong Publications, 2009), also provides a series of chapters that explores these topics: Section B in their text explores the concept of "positive expectations," while section C describes an approach to classroom management. While the text is written for first year teachers approaching their first few days of school, there are many suggestions in these 15 short chapters that will support LAC

Metacognitive Guideposts for Investigation

1. What's the best way to give students an opportunity to practice their new learning?
2. What level of Bloom's is this activity?
3. How does this mesh with the level of the Objective: will this sort of practice help the students get to the Objective?
4. What will I be doing while students are practicing? Who will I be interacting with?
5. How will students be interacting?
6. How will I make sure students understand what they are practicing, in real time?

Frequently asked Questions about Investigation:

1. I have tried to set up activities and investigations for students, but so many of them just waste the time that I generally feel like I shouldn't bother.

In transfer schools this will frequently happen, and can be very disconcerting for teachers who have always been able to "hold a class" through the delivery of engaging lectures and charismatic relationship building. It can often take weeks before students develop both the confidence and skills required to operate effectively in an independent learning environment. Slowly scaffolding classroom management routines and practices can go a long way towards helping students feel comfortable in a changing classroom environment.

There are some schools that create "Learning to Learn" courses that specifically emphasize these habits, and whenever a student enrolls, she or he begins with these courses (usually a reading or writing workshop course, since these are so adaptable). In other schools, the full faculty has worked to agree on a set of learning protocols or practices that students will encounter in every class. Often, rubrics have been developed for these practices, such as one on collaboration or discussion, or one on investigation or peer review/feedback. Many teachers have also found the Learning Strategies rubric presented in the Introduction to be useful in supporting students to become more independent.

2. If most of the period is devoted to investigation, how can I ensure that students are really filling in the gaps in their content knowledge?

In some respects you can't be entirely sure. On the other hand, it is better than the alternative, since research has clearly shown that students aren't able to fill-in these gaps during a lecture. Within the FEI, gaps are addressed through lessons that provide scaffolded access to independent learning through

- A rich array of resources;
- Strategic emphasis on the most critical content gaps;
- Targeted practice with the learning strategies.

3. I don't really see how you can do a true investigation in math. Students need to learn the formulas before they do anything creative with them.

In Math, the ability to "apply" one's background knowledge to a new situation is a higher-level skill. Tegan's math courses provide a strong example of one way to create engaging investigations: by applying mathematical procedures to real-life situations, in order to

Teachers in their initial efforts to shift their classrooms into student-centered environments. Finally, Nancie Atwell's groundbreaking book, *In the Middle* (first published in 1998), details the practices that are central to creating a reading and writing workshop environment.

understand both math and social justice issues. In this way, students are using math to deepen their overall capacity to think about issues.

A second way to construct mathematical investigations is to present students with interesting and instructive problems, and have them figure out which mathematical principles to apply in order to solve the problems. In this case, students are learning to think like mathematicians. This approach is widely used in Japan and Singapore, and has proven very effective in developing students' ability to understand math as a way of thinking, rather than as a set of procedures to be memorized.