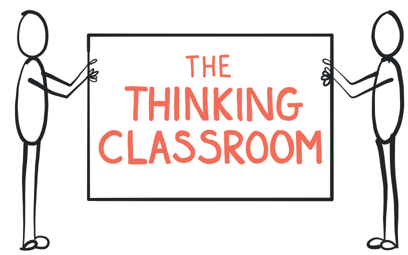
# WHAT IS BUILDING THINKING CLASSROOMS?

## An Executive Summary of 15 Years of Research

**By Peter Liljedahl**

Student difficulty with mathematics has been a pervasive and systemic problem since the advent of public education—not because students can't learn mathematics, but because, by and large, students can't learn it by being told how to do it. Since the publication of the NCTM Principles and Standards (1998), there has been a concerted effort to change this reality by transitioning to more progressive and student-centered pedagogies. And progress has been made. Yet, something is still missing. Systemically, we are still struggling with high failure rates, low self-efficacy, and massive student disengagement.




## WHAT'S MISSING?

Over 15 years ago I reached out to my connections in the teaching community and asked them to recommend to me teachers that they had heard were good mathematics teachers—teachers who were respected within their schools and within the school division and were known to have students who performed well in mathematics. Based on these recommendations, I visited 40 classrooms in 40 different schools. I visited classrooms of every grade from kindergarten to Grade 12. I was in low socioeconomic settings and high socioeconomic settings, English-speaking classrooms and French-speaking classrooms, and I was in public schools and private schools. And in every classroom I visited, I saw the same thing—*students not thinking* in ways that went beyond mimicking the teacher. Closer investigations revealed that within a 60-minute lesson, 20% of students spent 8–12 minutes thinking, while 80% spent zero minutes thinking. This is a problem. This is what has been missing. Thinking is a necessary precursor to learning, and if students are not thinking, they are not learning.

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The teachers I was observing were caring, devoted teachers who worked hard at delivering content and ensuring that no students were falling through the cracks. Yet, in every class I visited, I saw *teachers planning their teaching on the assumption that students either couldn't or wouldn't think*—they weren't requiring their students to think. Not because the students didn't want to, but because they couldn't. They had students who either couldn't or wouldn't think, and they had content to get through and time pressure to do so. So, they used activities from their resources and textbooks that allowed them to move through content but didn't require students to think, which then made it more difficult to get students to think, and so on. This is a systemic problem.

On my journey through these schools and classrooms, other patterns also emerged. Everywhere I went, irrespective of grade or demographic, classrooms looked more alike than they looked different. And what happened in those classrooms looked more alike than it looked different. Desks or tables were usually oriented toward a discernible front of the classroom. Toward this front was a teacher desk, some sort of vertical writing space for the teacher, and some sort of a vertical projection space. Students sat, while the teacher stood. Students wrote on horizontal surfaces, while the teacher wrote on vertical ones. And the lessons mostly followed the same rhythm of lecture, note taking, student activity, and homework.

These normative structures that permeate classrooms in North America, and around the world, are so entrenched that they transcend the idea of classroom norms (Cobb et al., 1991; Yackel & Cobb, 1996) and can only be described as *institutional norms* (Liu & Liljedahl, 2012)—norms that have extended beyond the classroom, even the school building, and have become ensconced in the very institution of *school*. Much of how classrooms look and much of what happens in them today is guided by these institutional norms—norms that have not changed since the inception of an industrial-age model of public education. Yes, desks look different now, and we have gone from blackboards to greenboards to whiteboards to smartboards, but students are still sitting, and teachers are still standing. Although there have been a lot of innovations in assessment, technology, and pedagogy, much of the foundational structure of *school* remains the same.

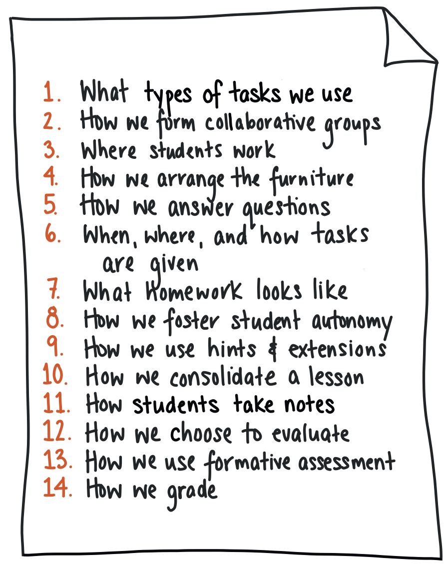
Could the very institutional norms that permeate all schools and all classrooms actually be perpetuating the non-thinking behaviors I was observing?

Everywhere I went, I saw students not thinking, leaving teachers to have to plan their teaching on the assumption that students either can't or won't think. And everywhere I went, I saw entrenched and systemic institutional norms. Are these issues connected? Could the very institutional norms that permeate all schools and all classrooms actually be perpetuating the non-thinking behaviors I was observing? If this were true, that meant we would need to fundamentally alter the institutional norms to get students to think.

## HOW DO WE GET STUDENTS TO THINK?

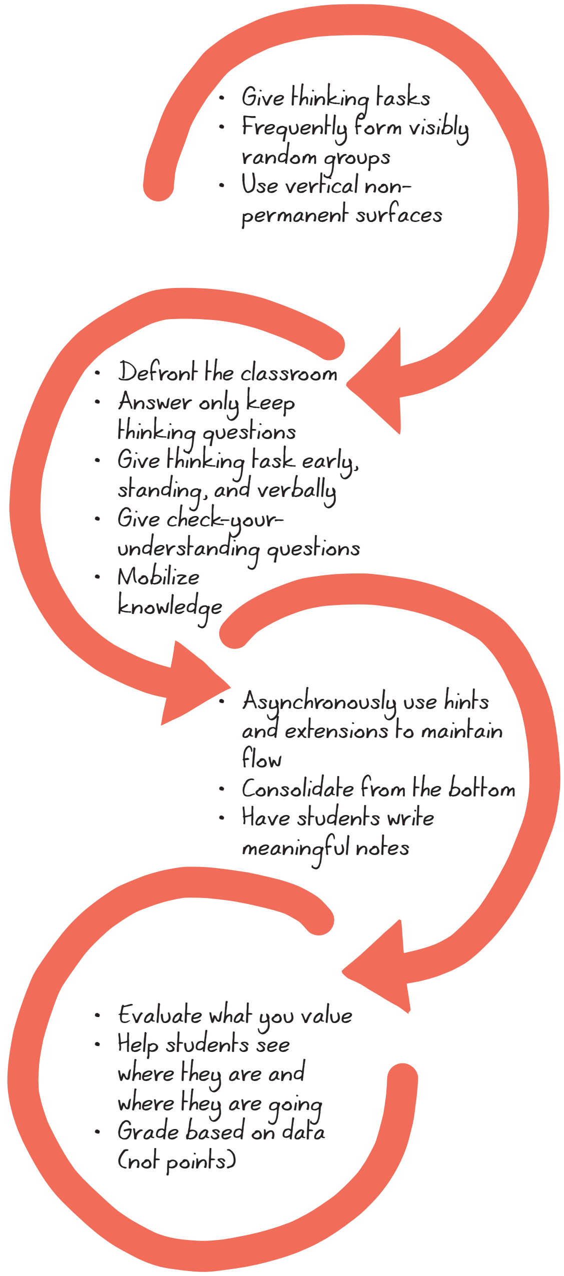
The goal was simple—try to increase the number of students thinking and try to increase the number of minutes during which students were thinking.

This assumption became the basis of my research, and for the next 15 years I worked with over 400 K–12 teachers to try to break through any and all institutional norms and get students to think. The goal was simple—try to increase the number of students thinking and try to increase the number of minutes during which students were thinking. Our work, in this regard was organized around the 14 factors that make up the core of every teacher's practice.




This list is comprehensive. Everything we, as teachers, do in the classroom is an enactment of one of these factors, and how we enact each of these factors is what forms our teaching practice—our unique teaching practice. These factors became the variables we systematically experimented with in our efforts to increase thinking in the classroom. What we were looking for were practices, for each factor, that generated more thinking than the institutionally normative practices I had observed. And of these practices, we were looking for the practices that generated the most thinking—what we eventually came to call the *optimal practice for thinking*. And we found them. Slowly at first. But over the next 15 years they all emerged along with an optimal sequence for introducing each of these optimal practices into the classroom—what we came to call the *Building Thinking Classrooms Framework* (see Figure 1).

**Figure 1** The Building Thinking Classrooms Framework.



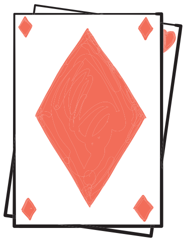

## HOW DO WE BUILD A THINKING CLASSROOM IN MATHEMATICS?

In the book *Building Thinking Classrooms in Mathematics,* each chapter explores one of the 14 optimal practices, beginning with a deep dive into what are the institutionally normative practices that permeate many classrooms around the world. It reveals how each of these practices is working against our efforts to get students to think, and then it offers a clear presentation of what the research revealed to be the optimal practice for each variable, unpacking it into macro- and micro-practices. These descriptions are punctuated by excerpts from the data, anecdotes from teachers, photographs from real K–12 classrooms, and responses to frequently asked questions (FAQ). Each chapter concludes with questions for educators to consider on their own or within a professional learning community as well as "try this" tasks or activities teachers can implement in their classrooms.

## What Types of Tasks We Use in a Thinking Classroom


If we want our students to think, we need to give them something to think about—something that will not only require thinking but also encourage thinking. In mathematics, this comes in the form of a task, and having the right task is important. The research revealed that ***we have to give thinking tasks.*** When first starting to build a thinking classroom, it is important that these tasks are highly engaging non-curricular tasks. As the culture of thinking begins to develop, we transition to using curriculum tasks. The goal of this book is not to get students to think about engaging with non-curricular tasks day in and day out—that turns out to be rather easy. Rather, the goal is to get more of your students thinking, and thinking for longer periods of time, within the context of curriculum, which leads to longer and deeper learning.

## How We Form Collaborative Groups in a Thinking Classroom



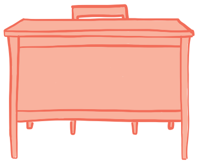
We know from research that student collaboration is an important aspect of classroom practice, because when it functions as intended, it has a powerful impact on learning (Edwards & Jones, 2003; Hattie, 2009; Slavin, 1996). How we have traditionally been forming groups, however, makes it very difficult to achieve the powerful learning we know is possible. Whether we grouped students strategically (Dweck & Leggett, 1988; Hatano, 1988; Jansen, 2006) or we let students form their own groups (Urdan & Maehr, 1995), we found that 80% of students entered these groups with the mindset that, within this group, their job is not to think. However, when we frequently formed ***visibly random groups***, within six weeks, 100% of students entered their groups with the mindset that they were not only going to think, but that they were going to contribute. In addition, the use of frequent and visibly random groupings was shown to break down social barriers within the room, increase knowledge mobility, reduce stress, and increase enthusiasm for mathematics.

## Where Students Work in a Thinking Classroom


One of the most enduring institutional norms that exists in mathematics classrooms is students sitting at their desks (or tables) and writing in their notebooks. This turned out to be the workspace least conducive to thinking. What emerged as optimal was to have the students standing and working on ***vertical non-permanent surfaces (VNPSs)*** such as whiteboards, blackboards, or windows. It did not matter what the surface was, as long as it was vertical and erasable (non-permanent). The fact that it was non-permanent promoted more risk taking, and the fact that it was vertical prevented students from disengaging. Taken together, having students work, in their random groups, on VNPSs had a massive impact on transforming previously passive learning spaces into active thinking spaces where students think, and keep thinking, for upwards of 60 minutes.


Source: Photo courtesy of Jennifer Hill. Used with permission.

## How We Arrange the Furniture in a Thinking Classroom



At its core, a classroom is just a room with furniture. Absent the students and the teacher, a classroom is an inert space waiting to be inhabited, waiting to be used, waiting for thinking to happen. This is not to say that the classroom, in its inert form, has no role in what happens in it—it actually has a huge role in determining what kind of learning can take place in it. The research showed that rectilinear and fronted classrooms promote passive learning. On the other hand, ***a defronted classroom***—a classroom where students sit facing every which way—was shown to be the single most effective way to organize the furniture in the room to induce student thinking.

## How We Answer Questions in a Thinking Classroom

A typical teacher will answer between 200 and 400 questions in a day, all of which fall into one of three categories: (1) *proximity questions*—the questions students ask because you happen to be close by, (2) *stop-thinking questions*—the questions students ask so they can reduce their effort, the most common of which is, "Is this right?" and (3) *keep-thinking questions*—the questions students ask so they can keep working, keep trying, and keep thinking. The research showed that 90% of the questions that students ask are either proximity questions or stop-thinking questions and that answering these is antithetical to building a culture of thinking and a culture of learning. To build a thinking classroom, we need to ***answer only keep-thinking questions***.

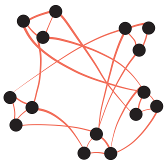
## When, Where, and How Tasks Are Given in a Thinking Classroom

In typical classrooms, tasks are given to students textually—from a workbook or textbook, written on the board, or projected on a screen. Interestingly, asking students to do a task from a workbook or textbook produced less thinking than if the same task were written on the board. It matters how we give the task. It turns out to also matter when in the lesson we give the task and where the students are when the task is given. The research showed that a task given in ***the first five minutes of a lesson*** produces significantly more thinking than the same task given later in the lesson. Likewise, students thought more when the task was given to them while they were ***standing in loose formation around the teacher*** than when it was given while they were sitting at their desks. Incidentally, the research also showed that, although giving a task by writing it on the board produced more thinking than assigning it from a workbook or textbook, ***giving a task verbally*** produced significantly more, and different types of, thinking.

## What Homework Looks Like in a Thinking Classroom

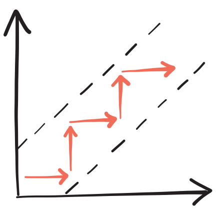
Homework, in its current institutionalized normative form as daily iterative practice to be done at home, doesn't work. Almost every teacher I have interviewed says the same thing—the students who need to do their homework don't, and the ones who do their homework are the ones who don't really need to do it. The research confirmed this. The problem, it turns out, has to do with who students perceive homework is for (the teacher) and what it is for (grades) and how this differs from the intentions of the teacher in assigning homework (for the students to check their understanding). By rebranding homework as ***check-your-understanding questions*** and positioning it as an opportunity rather than a requirement, we saw significant changes in how students engaged with the practice and how they now approached it with purpose and thought.

## How We Foster Student Autonomy in a Thinking Classroom



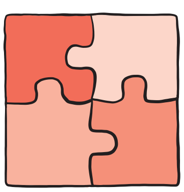
A thinking classroom looks very different from a typical classroom. Students are working in groups rather than individually, they are standing rather than sitting, and the furniture is arranged so as to *defront* the room. Closer inspection will reveal that the teacher is giving instructions verbally, is answering fewer questions, and has drastically altered the way they give "homework." All of these changes require a greater independence on the part of the students, and for thinking classrooms to function well, this independence needs to be fostered. But not just independence in general. To really access the potential of a thinking classroom, students need to learn to look at the work of their peers—to make use of the knowledge that exists in the room and to ***mobilize that knowledge*** to keep themselves thinking when they are stuck and need a push or when they are done and need a new task.

## How We Use Hints and Extensions in a Thinking Classroom



Mathematics teaching, since the inception of public education, has largely be been built on the idea of synchronous activity—students write the same notes at the same time, they do the same questions at the same time, et cetera. From a teacher's perspective, this is an efficient strategy that, on the surface, allows us to transmit large amounts of content to groups of 20 to 30 students at the same time. If we go under the surface, however, we realize that students' abilities are more different than they are alike, and the idea that they can all receive, and process, the same information at the same time is outlandish. Decades of work on differentiation is built on the realization that students learn differently, at different speeds, and have different mental constructs of the same content. What this work is telling us is that students need teaching built on the idea of asynchronous activity—activities that *meet the learner where they are* and are customized for their particular pace of learning. The research showed that, in order to foster and maintain thinking, we need to asynchronously give groups ***hints and extensions to keep them in flow***—"a state in which people are so involved in an activity that nothing else seems to matter; the experience is so enjoyable that people will continue to do it even at great cost, for the sheer sake of doing it" (Csíkszentmihályi, 1990, p. 4).

## How We Consolidate a Lesson in a Thinking Classroom



In a thinking classroom, consolidation is of the utmost importance in every lesson. Through consolidation we are able to bring together the disparate parts of a task or an activity and help students to solidify their experiences into a cohesive conceptual whole. For over 100 years, this has involved teachers showing, telling, or explaining the learning that the teachers desired for the students to have achieved (Schoenfeld, 1985). The problem is that it doesn't work. As mentioned, students, by and large, don't learn by being told how to do it. In a thinking classroom, consolidation takes an opposite approach—***working upwards from the basic foundation of a concept and drawing on student work produced during their thinking on a common set of tasks.***

Students, by and large, don't learn by being told how to do it.

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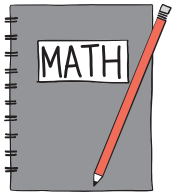
## How Students Take Notes in a Thinking Classroom




Having students take notes is another enduring institutional norm that permeate mathematics classrooms all over the world. Teachers engage in this activity for two reasons: (1) It creates a record for students to look back at in the future, and (2) it is a way for students to solidify their own learning. However, the research showed that less than 20% of students actually looked back at their notes, and, while they were writing the notes, the vast majority of students were so disengaged that there was no solidifying of learning happening. So, although done with noble intentions, having students write notes was a mindless activity. In a thinking classroom, on the other hand, notes are a mindful activity involving students deciding for themselves ***what notes their future selves will need***. The research showed that this way of taking notes kept students thinking while they wrote the notes and that the majority of students referred back to these self-created notes in both the near and far future.

## What We Choose to Evaluate in a Thinking Classroom

When asked what competencies they value most among their students, and which competencies they believe are most beneficial to students, teachers will give some subset of perseverance, willingness to take risk, ability to collaborate, patience, curiosity, autonomy, self-responsibility, grit, positive views, self-efficacy, and so on. The question is, if these are the most valuable competencies for students to possess, how do we then develop and nurture these competencies in our students? It turns out that the answer to this question is to ***evaluate what we value***. This is not to say that we stop evaluating students' abilities to demonstrate individual attainment of curriculum outcomes. But, if we value perseverance, then we need to also find a way to evaluate it. If we value collaboration, then we need to also find a way to evaluate it. What we choose to evaluate tells students what we value, and, in turn, students begin to value it as well. But it turns out that *how* we choose to evaluate is just as important as *what* we choose to evaluate. And the optimal practice for evaluating these valuable competencies turns out to be a particular type of rubric that emerged out of the research.

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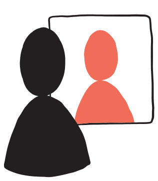
## How We Use Formative Assessment in a Thinking Classroom



Summative assessment has typically been defined as the gathering of information for the purpose of informing grading and was the dominant objective of assessment and evaluation for much of the *20th century*. On the other hand, formative assessment has been defined as the gathering of information for the purpose of informing teaching and has stood as the partner to summative assessment for much of the *21st century*. The problem is that, even within this more progressive paradigm, the needs of the learner have continued to be ignored. If we want our students to be active partners in their learning, we need to find ways to use formative assessment to inform both teaching (and teachers) and learning (and learners). The research into how best to do this revealed that when we ***find ways to help students understand both where they are (what they know) and where they are going (what they have yet to learn),*** not only do they become more active in their learning and thinking, but their performance on unit tests can improve upwards of 10%–15%.

## How We Grade in a Thinking Classroom

For the last 25 years, there has been a movement in assessment and evaluation to shift away from what is sometimes referred to as "events-based grading" and toward outcomes-based grading (also known as standards-based or evidence-based grading). The benefits of this shift are many—from increased student agency to increased student performance (O'Connor, 2009; Stiggins et al., 2006). What this looks like in a thinking classroom, it turns out, is closely linked to how we do formative assessment and involves not only the ***gathering of information on what students are capable of*** vis-à-vis specific outcomes or standards, but also a ***folding back of this information to the students*** to inform their learning.

When all 14 of these optimal practices are enacted in concert, a teacher will have a classroom that is not only conducive to thinking but also *requires* it. They will have a space that is inhabited by thinking individuals as well as individuals thinking collectively, learning together, and constructing knowledge and understanding through activity and discussion. ***They will have built a thinking classroom.***

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