Creative Teaching & Learning

Volume 8.4

Creativity
Intelligence
Arts-based Education
Cultures of Thinking
Assessment
Understanding

From Zero to Fifty

Celebrating Five Decades of Project Zero

Special Issue

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Reimagining potential

We are very pleased to present you with this special issue featuring some of the most cutting-edge thinking and research on education that exists today. Project Zero began more than five decades ago to address a gap in scholarship on arts-based education. Over the past fifty years, they have continued research on arts-based learning and expanded their work to ask questions about learning. If you have ever explored the literature relating to questions such as 'How do I know if my students are learning?' 'What do thinking and understanding look like?' or 'What learning will be most relevant for the lives my students will live?', then you have likely come across Project Zero's research.

I think for many of us, as educators, we are drawn to the profession because of its capacity to develop human potential. This includes the potential for achievement, the potential for education to develop citizens who participate in their society and create an environment that meets the needs of all its inhabitants. It also includes the potential for finding meaning in life and overcoming the obstacles many people face as a result of class, race and gender divides.

Because of the work of Project Zero researchers, we now have a strong understanding of how the brain works in many areas and we have concrete evidence about the complexity of learning and thinking that challenge many of the foundations of traditional understanding. For example, because of the work of PZ's Howard Gardner, we now know that intelligence is not a single entity that can be measured. Instead, it has multiple aspects, including the traditional Logical-Mathematical and Linguistic sides, but it also includes spatial, bodily-kinaesthetic, naturalist and musical aspects, as well as interpersonal and intrapersonal abilities. As Flossie Chua shows us in her article 'How are we smart?' (p. 24), not only do these various intelligences exist, but they work together and can be developed and strengthened in all individuals.

Similar to the major shift in thinking about intelligence, PZ researchers have transformed our understanding of creativity and what it means to be creative. Creativity no longer belongs to the realm of the eccentric genius or exceptionally talented person. Instead, as Edward Clapp outlines in 'Five Lessons Learned About Creativity' (p. 66), anyone has the capacity to be creative and that creativity is the result of ongoing development and mastery of a domain, rather than a specific 'thing' to be captured. Additionally, creativity is an ongoing process that has a strong social and participatory element, where diversity is crucial to creative success. No longer is creativity isolated solely within the purview of the arts – it is now a factor of success in all areas, including STEM fields.

The reach of PZ's research is wide and significant for educators. From developing a framework to leverage forces in the classroom to enable a culture of thinking (p. 42) and reimagining assessment (p. 58) to thinking about achieving depth of understanding (p. 33) and considering the parameters and potential of arts education (p. 14), their work is not only theoretical but practical, and is having a positive and profound effect on students' lives and the classrooms and schools where these ideas are embraced.

We wanted to highlight the great work of the PZ researchers in order to share with you the great options and potentials for educational practice. When we're faced with narrow curricula and constant testing, it can be very hard to focus on the bigger picture of creating an environment of enlightenment where there is deep respect for the learner, and remembering that there is virtue in not knowing something and being willing to ask the big questions anyway.

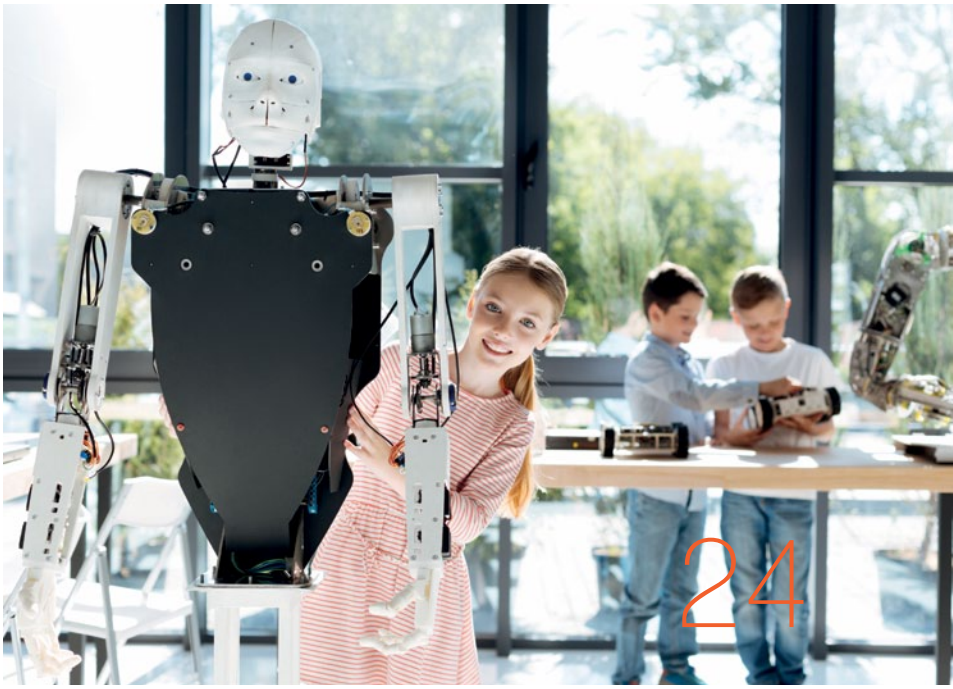
Jory Debenham

NOTES

1. See the video on PZ's website for more information on their work: http://www.pz.harvard.edu/who-we-are/about

Contents

Volume 8.4



01 Editorial | Reimagining Potential **05 News** | The latest in creative teaching

08 From Zero to Fifty: Marking a Half-Century of Project Zero's Impact in Education
From developing arts-based education to understanding the nature of creativity, intelligence, thinking and learning, Project Zero has changed what we know about human potential and educational practices. Director Daniel Gray Wilson highlights Project Zero's contributions.

14 Valuing Thinking in the Arts
Why study the arts? Can the arts help us think? Does arts education have value for other areas of the curriculum? Ellen Winner shows how Project Zero is finding real answers to these often elusive and problematic questions.

24 How Are We Smart?
What does it mean to be intelligent? We now know that intelligence, far from being singular, innate and fixed, is in fact multifaceted and learnable. Flossie Chua shows that it's much less important to measure intelligence than to understand how we can get it.

33 The Quest for Deeper Understanding

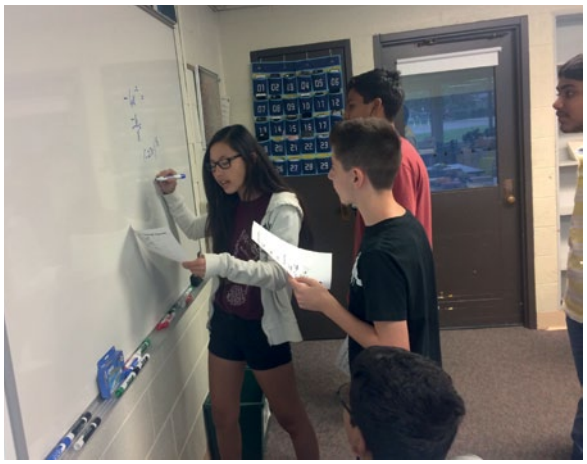
Education that focuses on factual recall leaves students without the skills they need to apply their knowledge. Tina Grotzer explains why depth of understanding is important and how it can be achieved.

42 Leveraging Culture with Ron Ritchhart

Reconsidering what schools are and what they aim to do has inspired the leader of Project Zero's 'Cultures of Thinking' project to truly examine and understand what it is that creates the optimal conditions for learning. In this interview we learn more about what drives him.

50 Transferring Ownership of Learning

An important way to leverage the cultural forces of the classroom for learning is to find opportunities for meaningful interactions. Teachers Jeff Watson and Roger Winn show how they're using the Cultures of Thinking framework to create community within the classroom.



58 Assessment Reimagined

What if there were an alternative to traditional notions of assessment and accountability that could change what 'counts' in the classroom? Mara Krechevsky and Tina Blythe show how Project Zero is rethinking assessment practices that foster deeper levels of learning and understanding.

66 Five Lessons Learned About Creativity

In the old days, creativity was an elusive concept that belonged only to a talented few. Now we know that it is not the work of a genius, but a distributed and participatory process that can be developed and learned. Edward Clapp shares what the research has taught us.

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Creative Teaching and Learning

Much more than a magazine…

If you want your staff to know how to develop thinking and creative skills, practice dialogic teaching and collaborative learning, lead project-based learning, use imaginative approaches to literacy, embed assessment for learning in all their teaching, as well as a host of other cutting-edge practices, then we have the answer.

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CTL/18

Children not Developing Necessary Tactile Skills

U.K. surgeon Roger Kneebone says the students he teaches each year don't have the same dexterity as their predecessors.

Young people's lack of experience of crafts such as sewing mean that young medical students lack the foundation for the practical skills they require for surgery, warns Roger Kneebone, professor of surgical education at Imperial College, London.

Whereas in the past you could make the assumption that students would leave school able to do certain practical things – cutting things out, making things – that is no longer the case. We have students who have very high exam grades, but lack tactile general knowledge so they struggle even to perform chemistry experiments," he says.

"An obvious example is of a surgeon needing some dexterity and skill in sewing or stitching. It can be traced back to the sweeping out of creative subjects from the curriculum; it is important and an increasingly urgent issue."

"It seems we can no longer rely on people having developed these ways of using their hands from early childhood, at home and at school," Dr. Roger Kneebone has said.

The professor of surgical education at London's Imperial College said colleagues in various branches of medicine have made the same observation.

"We're seeing increasing numbers of people who no longer have that sort of basic language using their hands, in the way that — only five or ten years ago — people used to," he said.

In secondary schools in the U.K., many of the activities that taught people how to be skilled with their hands — woodwork, cooking, painting, performance art — are now optional in the central curriculum, Kneebone explained.

Dr. Kneebone says his medical students are not comfortable cutting or tying string because they don't have the practical experience using these skills. The result is that basic skills like cutting and tying knots are not intuitive for most of Kneebone's medical students — yet it's an integral part of performing surgery.

It's not just dexterity, these skills inform an understanding of the world around us through the sense of touch.

In surgery for instance, he explained that surgeons always have to make judgments on the state of an organ or tissue, including whether they can be joined together or cut apart.

"It's not something that you learn once and apply it in the same way ever after — you're constantly having to make these judgements in the moment."

'Bucket List' Activities to Build Resilience and Character

Pupils will be urged to climb trees, build rockets and watch the sun rise under new measures to be introduced by the Department for Education to build character and resilience in children. In a marked departure from his predecessor Michael Gove's policies, Education Secretary Damian Hinds will publish a "bucket list" of life goals that school children will be encouraged to achieve every year before they leave primary school.

It comes as part of Mr Hinds's attempts to push schools and their pupils to view character and resilience as being just as important as exam results and qualifications.

Under the policy, schools will be given a list of milestones that children will be encouraged to tick off as they progress through primary school. Among the activities are outdoor pursuits such as learning to climb a tree, sleeping under a canvas and exploring a cave. Others include ideas such as putting on a performance, learning to knit and starting a vegetable patch. "Bluntly, it is about doing stuff that doesn't involve looking at a screen. It's about getting out and about. We put a lot effort into making sure we can share really good curriculum plans and teaching materials. This is an equivalent of that for stuff outside the curriculum in recognition of the fact that what you do academically is only part of the story." The idea is based on the National Trust's 50 things to do before you're 11¾.

The policy move could not be further from those introduced by Mr Gove, the former education secretary, who ushered in a regime of tougher exams and a more demanding curriculum. But Mr Hinds said building character and resilience is one of his key priorities as Education Secretary, which he views as being just as important as results. "Everybody can remember somebody who left school with no GCSEs or O levels, but went on to do something spectacular. "Qualifications are obviously not the only thing, and I tend to think the difference is everything you can't write on a certificate – drive, tenacity, sticking with the task at hand. And being able to bounce back from the knocks that inevitably come to all of us."

Disadvantages for Summer-Born Babies are Long-Lasting

The disadvantage of being the youngest in an academic year at primary school has been well documented and remains a serious cause for concern for parents, many of whom choose to delay their child's school start date.

This new research tracks the academic progress of summer-born babies in detail based on standardised termly tests within schools and shows a gradual closing of the gap with older peers as they progress through primary, but it never disappears.

According to this latest research, in reception year, when the gap is at its widest, four- and five-year-olds born in the summer achieve an average of 7.5 percentage points less in maths tests, compared with children who were not born in the summer.

By year 3, at the ages of seven and eight, the gap has narrowed to 5.5 percentage points; the following year it is 4.6 and then by year 6, the final year of primary school, it stands at 3.6 percentage points.

The findings by SchoolDash, an education data analytics company, are based on 1.5m individual pupil assessments in maths and reading, gathered by teachers between 2015 and 2018 in 2,000 state primary schools in England. All results have been anonymised.

Among the other intriguing findings is evidence that at the very start of primary school girls outperform boys in maths, with a "slightly higher" average performance than their male peers. By years 2 or 3, the boys overtake them and remain ahead until the end of primary school.

The analysis also explores gender differences in maths according to topic – boys excel in measures and number work, including counting, place value, rounding and negative numbers. Girls do relatively well in geometry and operations, which includes calculations such as addition, subtraction and multiplication.

Girls are also on average stronger than boys in reading at the start of primary school and they remain ahead until the age of 11.

The data looks at differences between types of school and finds that those with higher proportions of disadvantaged pupils show lower average performance in both maths and reading during the early years of primary education. The gap grows over time.

Creative Arts are a Necessity, not a Luxury

Creative arts should be compulsory at GCSE level to stop a decline "before it is too late", the artistic director of the Royal Albert Hall has said.

Lucy Noble says at least one creative subject – drama, art, music, design or dance – should be taken by every pupil until the age of 16 to help bolster the UK's creative industries.

In an open letter to Education Secretary Damian Hinds, Ms Noble is calling on the government to make the learning of a creative art subject compulsory for GCSE students in England and Wales.

The number of teenagers being entered for a creative art subject at GCSE has dropped by more than a quarter in the past five years, according to Ofqual.

The Royal Albert Hall in London is one of the most famous venues in the world, with everyone from The Beatles and Elton John to Adele and Jay-Z having performed there.

"The dramatic fall in the number of GCSE students choosing a creative art subject, and the government's apparent unwillingness to address this problem, is a matter of increasing concern for many involved in the creative industries," Ms Noble writes.

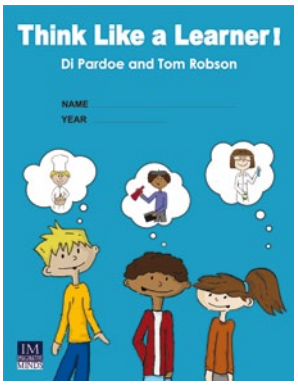
"Austerity measures and the continuing tendency for schools to focus on more academic subjects, risk having a negative and irreversible long-term impact on the field, for which Britain is respected all over the world.

"We are calling for at least one creative arts subject to be made compulsory for all pupils taking GCSEs in England and Wales, and for the proper investment in our future musicians, actors and artists before it is too late to reverse this most serious of declines."

Last year, a report by Labour highlighted a lack of support for subjects such as art and drama in schools, as well as costly audition fees and projects that pay performers "poverty wages", as major causes of what it described as a "class-shaped hole" in the industry.

MPs Tracy Brabin and Gloria De Piero, who put together the report, said "we'll all be poorer" if progress is not made and argued that performing arts were a "mirror to the nation".

THINK LIKE A LEARNER!



A new practical guidebook to help children acquire the language, skills and self-awareness of successful learners

This book asks children to involve themselves in key questions about learning and develops their self-awareness as self-critical thinkers and learners. It asks:

- **How do we think and talk about learning?**
- **What is 'bouncebackability' and how do you get it?**
- **How can we make sure our team learning is high quality?**
- **How does making choices help us to become more responsible for our own learning?**

Ofsted has observed how children 'really enjoyed learning' in a school using the guidebook.

Hundreds of schools and thousands of children have used the questions and ideas from the 'Think Like a Learner' approach and the authors, Diana Pardoe and Tom Robson have now turned them into a workbook for children aged 8-12.

Comments from children:

- *We now work harder*
- *It's good to be in the challenge zone and get out of the comfort zone*
- *We understand we need to co-operate and know how to do it*
- *We understand that learning is our responsibility and that we have got to take part*

Comments from teachers:

- *The children are becoming more divergent thinkers*
- *They are more in control of their learning. They recognise what makes them successful learners and THEY have the responsibility for learning.*
- *When faced with difficult tasks the children are more prepared to have a go and to take a risk*
- *Improved communication skills*
- *Raised self-esteem*

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Carol Dweck has shown how important children's self-concept as learners is to their performance, no matter what their ability and Bob Burden's Myself As a Learner Scale (MALS) suggests how children's self-concept as learners can grow when taking responsibility for assessing their own work. A child's ability to reflect on their own thinking is now recognised as critical to them becoming resilient and successful learners.

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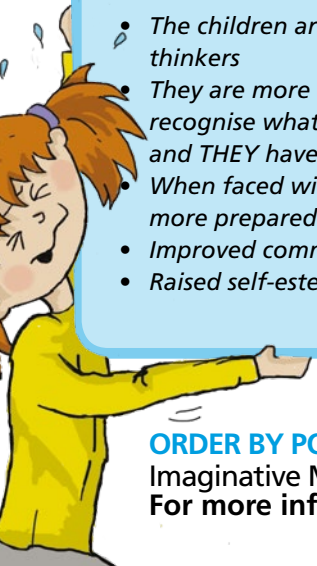
The more we understand about it the more exciting it gets

The better we get at thinking the more we enjoy taking on a challenge

The harder we try the prouder we feel



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IM IMAGINATIVE MINDS

From Zero to Fifty

Marking a half-century of Project Zero's impact in education

Harvard's Project Zero has been at the forefront of education research for more than five decades. Director **Daniel Wilson** highlights some of its contributions and current lines of research.

The fourth floor of the stately Longfellow Hall at the Harvard Graduate School of Education is home to Project Zero, one of the longest-running research centres at Harvard University and one of the most impactful in the field of education. Visitors entering its lobby are greeted with eye-catching exhibits of Project Zero's history, past publications and displays of its current research projects. Works of art and exhibitions of student work line the hallways. Quotes from former and current researchers dot the spaces between doorways. Offices and meeting rooms bustle with dozens of researchers analysing data, discussing findings, meeting with collaborators and writing up results. For five decades, the work of Project Zero's researchers has illuminated the nature of a variety of human potentials, such as the nature of creativity, intelligence, thinking, and learning. Today their research is thriving, continuing to shape policy, theory and pedagogical practice around the world.

Founded in 1967 by Harvard philosopher Nelson Goodman, Project Zero's initial aim was to explore and understand the nature of artistic development. Its name originates from Goodman's view at the time that 'The state of general, communicable knowledge about arts education is zero. So we are Project Zero.' That year he gathered together an interdisciplinary group of academics, including David Perkins and Howard Gardner who were completing their doctoral studies at MIT and Harvard, respectively. The group's early studies led to reports that outlined initial findings on the state of arts education and suggested directions for future research. When Goodman retired in 1972, Perkins and Gardner took the reigns of Project Zero, serving as its co-Directors for the next 28 years.

Under their leadership, the centre's research grew to explore a greater variety of human potentials beyond artistic development. Each new Project Zero Director—Steve Seidel in 2000 and Shari Tishman in 2008—oversaw an expansion of research that built upon previous insights and was fueled by a surging interest in education. Today, Project Zero is home to over sixty researchers working on twenty-five projects and research sites in nineteen countries. These projects range in size and foci – from understanding the nature of playful learning with educators in Denmark and South Africa, to examining the role of the artists in civic life in Australia, to studying how students develop cross-cultural perspective-taking in online learning environments. Each project continues to explore on the nature of human potentials and how they develop in different contemporary contexts.

The articles included in this special issue provide a window into the current and past work of researchers at Project Zero. They frame areas of study and offer tools that were often developed from close collaborations with teachers. To a reader unfamiliar with Project Zero's work, these articles may seem unrelated given the range of topics. However, below the surface, there are foundational connections. Fifty years of investigations have built the following cornerstone perspectives that bind Project Zero's past and current work together.

Intelligence as learnable and multiple: For almost a century, intelligence was seen as fixed, general and only measured by standardised linguistic and logical tests. Early Project Zero research revealed that intelligence is a learned ability to find and solve problems and to create products of value in a culture. Each person has a robust set of human intelligences that are developed and expressed within and across cultural contexts. Publications such as *Smart Schools*[1] and *Frames of Mind*,[2] the latter articulating the theory of multiple intelligences, contributed to the conceptual foundations for classroom practices of differentiated instruction, authentic assessment and project-based learning.

Creativity as socio-cultural and cognitive: Project Zero researchers extended their work on intelligence by rejecting long-standing traditions of evaluating single or trait-based conceptions of and tests for creativity. Their investigations exposed the myth of a single variety of creativity. Rather, creativity exists at the intersection of individuals, the domain knowledge and the field of practice. A student in any domain can develop the capacity to solve problems, craft products or define new questions in novel ways that may ultimately come to be accepted in a classroom or larger social setting. In this way, creativity isn't just the work of a genius, it is the work of anyone and everyone. It is a distributed

and participatory process, involving many actors in a given context. Publications such as The Mind's Best Work,[3] Creating Minds[4] and Participatory Creativity[5] illustrate the mental and collective properties of creativity.

Understanding as flexible performance: Research-based publications such as *Teaching for Understanding*[6] and *Teaching for Understanding Guide*[7] argue that understanding is not just the acquiring of the correct mental model or schema. Instead, understanding is a performance of acting flexibly with knowledge in novel situations. It includes students' capacity to transfer that knowledge to new settings, as well as the ability to restructure concepts rather than just acquire information. Understanding is revealed through performances, which are opportunities for students to extend their knowledge into new situations. The *Teaching for Understanding* project, which involved dozens of researchers and teachers around the world, examined the approaches and impact of pedagogies that foregrounded this performative view. Hundreds of schools around the globe have been inspired by this work and have reshaped curriculum and assessment practices to better develop understanding in their students.

Thinking as dispositional and visible: Project Zero research revealed that good thinking is a matter of disposition and that thinking can be seen. Developing students' dispositional motivations and skills are part of good thinking. However, findings from Project Zero research suggested the larger challenge is that students often lack the sensitivity to detect the opportunities to use their thinking skills. Developing students' dispositions to be sensitive to occasions for thinking is something that effective teachers do. Occasions for thinking invite students to make their thinking visible, through their language, drawings and other symbol systems. In contrast to long-held views that considered thinking to be solely

an invisible cognitive activity, thinking can be made visible through externalised representations. Project Zero projects and publications, such *The Thinking Classroom*,[8] *Making Thinking Visible*[9] and *Creating Cultures of Thinking*[10] have offered practices to educators that are based on insights from this research.

Artistry as cognitive and developmental: From its early pioneering work that examined how artists think and how children develop artistic skills, Project Zero has illuminated the cognitive dimensions of the arts and art-making. Artistic activity involves a variety of habits of mind that support skills such as looking and listening closely, reflection, and expression. Engaging in and with art, on its own merits, offers developmental opportunities for students that are uniquely different from those offered by other subjects. Projects and publications such as *Arts PROPEL*,[11] *Art Works for Schools*[12] and *Studio Thinking*[13] illustrate how students engage with and through the arts as vital pathways for developing and demonstrating thinking.

Assessment as an opportunity for learning: Evaluations and claims of learning are essential to any teaching and learning process. Without evidence, how are we to know that students are developing skills and knowledge? Moreover, the way learning is documented and assessed directly influences what gets taught. Over decades, Project Zero's research has shifted conceptions of assessment in the classroom in important ways. The focus of the assessment should include the learning process as well as outcomes and products. The role of students can be shifted to become participants in self and peer assessments. And the role of the teacher changes to become a documenter of learning, gathering various types of evidence in order to build theories that they can test with their students and their fellow teachers. Publications from projects such as T*eaching as Inquiry*,[14] *Looking Together at Student Work*[15] and *Visible Learners*[16] each depict educational practices that illuminate how assessments can be rich learning moments for students and teachers alike.

These foundational perspectives mark Project Zero's impact on the field of educational theory and practice. But what does the future hold? As researchers at Project Zero look ahead, issues of access and impact are foremost in their discussions. Increasingly, researchers are concerned with the cycle of how educators learn about research, adapt it into their practice and most importantly, how PZ researchers can learn from these educators. In the early days, access to PZ research was limited to its publications – scholarly journals and books were the only avenue to learn about the work.

Today, Project Zero convenes events around the United States and the world, bringing educators together to explore their practice in relation to new findings. Project Zero's international events, online courses and professional development workshops have become generative ways that teachers can engage with ideas while learning with and from other educators. In the past year, over a thousand educators participated in conferences and professional development workshops designed and led by Project Zero researchers. And over three thousand educators from around the world enrolled in online courses offered by the centre. In the coming years, Project Zero aims to advance offerings like these while continuing to raise funds to support the participation of many more educators who work in under-resourced settings.

In terms of Project Zero's future impact on the field of education, researchers are identifying contemporary challenges of developing human potentials. If you were to drop into meetings on the fourth floor of Longfellow Hall, you would hear researchers discussing questions such as: What does it mean to be globally competent in today's complex world and how do such competencies develop? How do young people navigate the various ethical dilemmas of digital life? What is the nature of civic engagement in today's society and how can civic dispositions be cultivated? These are just some of the questions that are shaping current discussions and future research at Project Zero.

Daniel Wilson is Director and Principal Investigator of Project Zero.

Notes

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Valuing Thinking in the Arts

The arts are often placed within a context of supporting other subjects and imbued with myths about how children's artistry is developed. **Ellen Winner** outlines some research-based approaches to thinking about arts education and assessment.

Project Zero was given its name in 1967 by its founder, philosopher Nelson Goodman, who quipped that there was little, if any, systematic knowledge about thinking in the arts – hence the name Zero. In this essay, I tell the story of arts research at Project Zero from the early 1970s until today, focusing on four strands of research: developmental studies of children's artistry; our move into arts education and assessment with Arts PROPEL; then a move into wider analyses of others' research, which led to the debunking of popular claims about the outcomes of arts education; and most recently our ethnographic study of the habits of mind that are actually taught (and we hope learned) in visual arts education, culminating in our Studio Thinking framework of visual arts education. We now have a considerable body of knowledge about thinking in the arts and a secure foundation from which to move forward to new initiatives.

Developmental Trajectories in the Arts

While most developmental psychologists (influenced by Piaget) have focused on the development of logical and scientific thinking, at Project Zero we have focused on the development of *artistic* thinking. We have studied the beginnings of metaphor, drawing, music, and pretend play (a precursor to metaphor and to acting). One of the most intriguing findings to come out of this research was that of the 'U-shaped curve' in artistic development.[1] Most capacities studied by developmental psychologists simply get bigger and better with age. But occasionally, one sees a decline or disappearance after the early years of childhood, followed by a reappearance (in some or all individuals) later on.

A 'U' had already been demonstrated by child language researchers who noted that, for example, children who utter an incorrect form of an irregular verb in the past tense (I *goed*) had actually been using the correct form (I *went*) a few months earlier.[2] Ultimately, of course, they revert to the correct irregular form. This sequence demonstrates rule learning: at first young children have memorised a small set of irregular verbs and thus utter them correctly. Later they master the 'add an –ed' rule and overgeneralise this to irregular verbs – and thus 'I goed' actually represents a cognitive advance, even though it seems on

Photo by Diane Jaquith. Reprinted by permission of Diane Jaquith.

the surface like a regression. When transitioning from *goed* to *went*, children have retained the –ed rule but now know when to apply it and when not.

We documented a U-curve in the arts, also explainable by the acquisition of the rules of the domain. Children's drawings at age 3–5 are wonderfully inventive and aesthetic, often reminding us of 20th-century paintings by artists such as Paul Klee or Joan Miro. At an early age, children do not care if they paint the sun green and the sky purple, and that is what so charms us (or at least those of us familiar with 20th-century Western art).

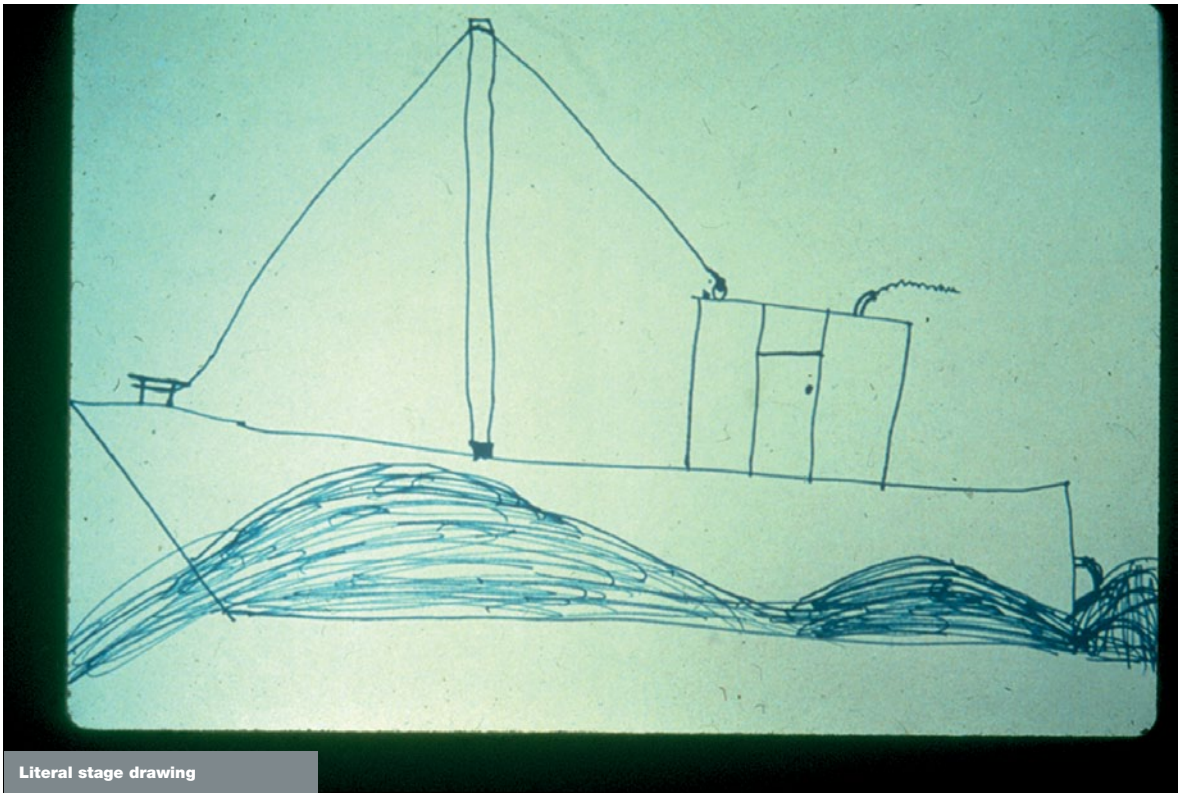
During the elementary school years, children enter what we dubbed the 'literal' stage. Children around 8, 9 or 10 become preoccupied with learning the rules of the drawing domain. They strive for realism and as a result, their drawings look conventional and far less interesting to us. Later, especially for those who go on to become artists, adolescents are willing to break these rules that they have established, drawing in a non-realistic, surrealistic or abstract style.

If we graph drawings by age in terms of aesthetic appeal (at least to Western, modernist eyes), we see a U-shaped curve, even though the decline is actually a sign of rule mastery. In short, young children's art is pre-conventional. In middle childhood children pass through a conventional stage, which only later are some able to override.

We documented the same kind of curve in the area of verbal metaphor. Whereas 3–5-year-olds make wonderful renamings (calling freckles *cornflakes* and skywriting a *scan*), a literal stage ensues in which children insist on using words the way they are supposed to be used.[3] This literal stage is not a bad thing, and it is likely that all children will pass through this, even those who will go on to become artists and poets. After all, one cannot break rules effectively and with intention until one has the rules to break.

Our conclusion: children pass from a pre-conventional to a conventional stage, and then, at least for those who go on to become amateur or professional artists, to a post-conventional stage. This results in a U-curve, though only some individuals actually reach the third stage of the U. The following pictures contrast a preschool painting and a literal stage drawing.

Preschool painting



Literal stage drawing

Assessment in the Arts

Due certainly to the influence of our founder, Nelson Goodman, we at Project Zero have always adopted a cognitive view of the arts. The arts involve thinking and serious learning and are not just an arena for feeling and self-expression (though they are that as well). And if the arts involve serious thinking and learning, then learning in the arts ought to be assessed.

In the 1980s, we were asked (and challenged) by the Rockefeller Foundation to develop forms of assessment in the arts that eschew standardised testing and capture the kinds of learnings that occur when children and adolescents study an art form. We accepted this challenge because we believed that assessing the arts signals the importance of learning in the arts.

To make matters more challenging, the Rockefeller Foundation asked us to work with the major multiple-choice test developers in the United States – the Educational Testing Service (ETS), and together to go beyond the use of standardised tests in this effort. We worked in three art forms: visual art, music and imaginative writing, which are documented in a series of handbooks.[4]

We coined our effort with the acronym PROPEL because of our belief in the centrality of making in arts education (production), the importance of looking closely at art (perceiving), and the role of thinking about one's process and evaluating one's learning (reflection). The name PROPEL is an acronym in which these three roles are embedded: PRO for production, which includes an R for reflection; PE for perception; and L for the learning that results.

The centrality of making was in contrast to another approach developed at the same time by Elliot Eisner and Stephen Dobbs at Stanford (funded by the Getty Trust) called Disciplinary Based Arts Education (DBAE), where making was only one of four equally important areas to be stressed, along with art history, art criticism, and art philosophy (aesthetics).[5]

Arts PROPEL introduced two concepts: *domain projects* and *processfolios*. Domain projects are projects that students work on over a long period of time, and that undergo many drafts and much reflection (both oral in conversation with the teacher and written in a journal). While DBAE argued for the teaching of art

history as a stand-alone part of art classes, even at the elementary school level, PROPEL sneaked in art history by helping students see connections between their work on a domain project and something professional artists had worked on.

For example, a student in visual arts who is struggling to create a portrait with dramatic lighting might study paintings by Rembrandt to see how he solved this problem; or a student trying to make a portrait in which the hands, rather than the face, are expressive might be motivated to study paintings by Rembrandt, Van Gogh or Picasso showing expressive hands.

In short, while PROPEL did not pretend to provide students with a systematic study of art history, it was founded on the belief that students are motivated to learn about art history in order to help them with their own work – which is why artists study the works of other artists. And as they worked, they should develop their skills of perception and reflection.

They would be asked to look closely at their work and at the work of artists, and they would be asked to reflect about their working process and to evaluate their drafts. These reflections could be oral or written, and all written reflections, including all drafts, would be saved, not in a *portfolio* (a collection of a student's best works), but in a *processfolio* (a collection that would reveal the students' process of thinking as she or he created works of art).

The PROPEL approach to assessment is formative and qualitative. Student work is to be continually assessed in terms of growth as the teacher, together with the student, reviews the learning that has taken place. And the evidentiary base of this assessment is not to be just the student's final works, but also the drafts along the way, and the written and oral reflection from the student about his or her process, goals and learning. Hence, the neologism *processfolio*.

Debunking False Claims About the Outcomes of Arts Education

Just as Arts PROPEL was an attempt to avoid objective tests in assessing arts learning, REAP (Reviewing Education in the Arts Project) was an attempt to rectify specious arguments about why we should have the arts in our schools.

We have always argued that the arts should be a core aspect of every child's education. But all too often schools focus so heavily on traditional academic subjects that arts education is offered minimally, if at all. In an attempt to prod school systems to give the arts a more prominent role, some arts advocates have argued that the arts are important because they result in improved standardised test scores and grades in core academic subjects, and lower high school drop-out rates.

Sign outside a guitar store in Tuscon, Arizona

As a result of such claims, many people believe that when schools infuse the arts into the curriculum, overall academic performance rises. Many people believe that music education raises children's IQ and improves their performance in maths and science. These views are popular in the media and held to particularly by individuals who lack first-hand experience in the arts.

Just what is the evidence for such claims? In 2000, we conducted a series of meta-analyses of studies (by other

researchers) to test these kinds of claims. We reviewed several hundred articles examining the relationship between arts education and academic achievement.[6]

First, we looked at the correlational evidence and it was positive. In an often cited paper, James Catterall showed that students who choose to take multiple arts classes in school score higher on standardised tests and have better grades in academic subjects, and this finding held across social class.[7] Many other correlational studies reported the same link: arts-involved students are academically strong.[8]

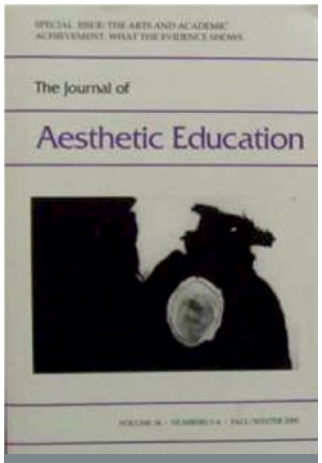
However, because the studies reporting this are correlational in design (simply assessing students in terms of arts involvement and academic performance), no causal conclusions can be reached. Does art study cause higher scores? Or do those with higher scores take more art? We can come up with numerous plausible non-causal explanations for such a link: e.g., academically strong students may be likely to come from families and/or schools that value the arts; academically strong students may be strongly motivated to learn in many areas; and academically weak students do not have time for the arts because they are guided into remedial classes or tutoring.

Unfortunately, however, studies reporting positive associations between arts involvement and academic performance have often been used to support the claim that studying the arts *causes* test scores to rise.

It is instructive to note that in the UK, where secondary school students choose to focus on only a few subjects, the opposite finding was reported: students who focused more on arts courses in secondary school tested lower than those who selected more on academic courses.[9]

No one would want to argue that choosing the arts courses causes test performance to decline! Rather, the explanation for this seems clear: academically strong students in the UK do not, by and large, choose to focus on the arts. In the US, students do not specialise in arts vs. more core academic courses; hence the findings in the UK do not mirror those in the US.

To allow a causal conclusion, an experimental or quasi-experimental design is called for. In such a design, a group of children getting a high dose of the arts



Volume of meta-analyses from the REAP study

Photo by Diane Jaquith. Reprinted by permission of Diane Jaquith.

must be compared to another similar group getting a low dose, and both groups must be assessed academically prior to and after receiving their dose of the arts.

When we looked at such studies, we found zero evidence that the arts group improved more than the non-arts group on any academic measure. It is important to stress here that this conclusion was based on a statistical synthesis of many studies. Thus, while some experimental studies might report a positive finding, overall, when the studies were combined in a meta-analysis in order to examine the strength of the overall effect, the results did not support a causal conclusion.

Despite our research to the contrary, the claim that the arts boost academic performance in the form of test scores and grades persists. This is unfortunate. These claims arise from good motivation – the attempt to secure a strong foothold for the arts in our schools. But those who live by such instrumental claims may die by them.

Once it becomes clear to the public that the arts do not boost academic performance, or even that they produce a modest effect but that direct instruction is far more effective, schools may in good conscience decide to drop the arts. Why teach the arts if all they are good for is boosting reading, writing, and maths, and they do not do this as well as teaching these subjects directly?

To avoid this trap, educators should not justify the arts in terms of what they can do for other subjects, but should rather stress the intrinsic importance of the arts (just as we believe in the intrinsic importance of maths and science). After all, no one ever demands that maths be justified for its effects on learning music or history. Demanding evidence of transfer of learning from the arts places an unfair burden on the arts, as psychologists have long shown that transfer is notoriously difficult to prove.[10]

The Studio Thinking Framework

After the negative conclusions from REAP, which were greeted with anger from many arts advocates (as potentially hurtful to the arts in our schools), we undertook a more positively motivated research effort – documenting what the arts actually teach (beginning with the visual arts). Of course, the arts teach the techniques of each art form. But we asked what broad habits of mind might be taught alongside the teaching of technique.

This kind of work, we believed, could also lead to the possibility of discovering transfer, because the search for transfer must begin with a full understanding of what is learned in the 'parent' domain of a particular art form. Only then does it make sense to ask whether what is learned might transfer to performance in another domain outside of the arts.

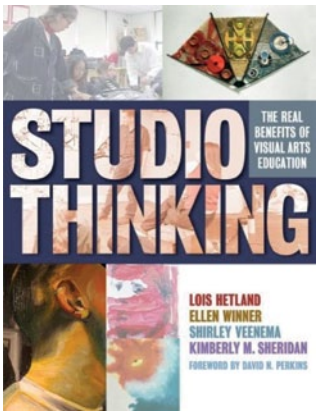
We undertook a qualitative, ethnographic study of visual arts classrooms. We elected to begin our study where we were most likely to find strong teaching in the arts, and hence we selected secondary schools (the Walnut Hill School for the Arts and the Boston Arts Academy) where students focus on an art form, spending at least three hours a day in art classes with teachers who are also practising artists. We studied visual arts teaching, but the same kind of study can and should be done in any art form in which one seeks to discover what is learned and what might transfer.

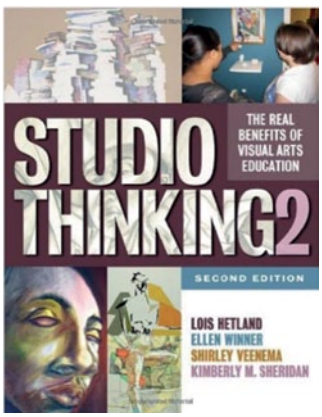
We videotaped classes over one year and interviewed teachers monthly. We then spent another year coding what we saw being taught. This led to the development of the Studio Thinking framework, where we documented the implicit and explicit teaching of eight broad, important and potentially generalisable habits of mind (or thinking dispositions) being taught.[11] One of these habits is the most obvious things students are taught – Develop Craft. We never saw this habit being taught in isolation. Rather, Develop Craft was always taught in tandem with one or more other habits. Each one of these habits of mind is potentially transferrable outside of the art studio – but transfer can never be assumed. It must be demonstrated. We called these *Studio Habits of Mind* and they are listed alphabeticallly in the following table.

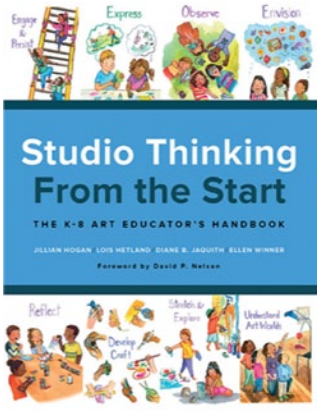
Studio Habits of Mind

Habit of Mind	Brief Definition	Sample Transfer Hypothesis
Develop Craft	Learn technique and care of materials.	Students understand that all areas of curriculum involve basic rules, and recognise importance of learning these.
Engage & Persist	Find problems that engage you, and stick with them.	Students are more likely to find engaging problems in any other area of the curriculum.
Envision	Imagine in images what you cannot observe directly.	Students are better able to envision molecular structures in chemistry.
Express	Convey meaning and personal vision.	Students develop a stronger personal voice in their non-fiction writing.
Observe	Open up your eyes and look more closely than you usually do.	Students' observational skills are strengthened in biology.
Reflect	Explain one's process (meta-cognition) and evaluate own and others' works.	When writing a history paper, students reflect on possible hypotheses and begin to evaluate strength of the evidence pro and con.
Stretch & Explore	Take risks and learn from mistakes.	Students are more likely to try out a new way of solving a maths problem.
Understand Art World	Recognise that artists learn from one another; recognise connections between own art and that in the professional art world.	Students begin to recognise links between work in a school subject area and work by professionals in the domain.

The Studio Thinking framework made explicit what many art teachers were already teaching. But we provided a framework which teachers have found very useful in their thinking and planning, as well as in their advocating for the importance of what they teach. And while the framework was developed with high school teachers, many teachers of grades K-8 have adapted this approach to their classrooms, as we documented in our most recent Studio Thinking book.[12]







Studio Thinking Volumes:

Studio Thinking book first edition, 2007

Studio Thinking book second edition, 2013

Studio Thinking from the Start, 2018

We stress that transfer cannot be assumed. These skills must first be clearly taught and learned in the visual arts. These skills may or may not be used by students outside of the context in which they were learned. If skills do transfer, they may only do so when teachers explicitly teach for transfer.[13] The study of transfer of learning from one domain to another has a long and vexed history, and one should never assume that a skill that 'sounds' general is in fact generalised. Only careful research can tease apart those skills which generalise from those which do not, and the circumstances under which transfer occurs.

Concluding Thoughts

I have highlighted some of the more unusual adventures we have had in our work in arts education at Project Zero: our study of the development in artistry in childhood that lead us to the surprising finding of a U-shaped curve; our work with the Pittsburgh public schools and the Educational Testing Service (known for its quantitative standardised summative assessment measures in academic areas) in the development of qualitative, non-standardised formative assessment measures in the arts; our debunking of the arts-academic transfer myth; and our attempt to conceptualise the real benefits of visual arts education – the Studio Habits of Mind.

I conclude by reflecting on what lies ahead. We need to document the kinds of habits of mind taught in other art forms, as there is no reason to expect that all of the arts teach the same kinds of thinking skills. And in fact, this is already beginning: my student Jillian Hogan has already conducted such a study in

high school music teaching, and my former student Thalia Goldstein is currently conducting such a study in theatre.[14] I also envision the development of measures of learning of each of the habits. I acknowledge that this is a daunting task, but without such measures we can make no transfer claims about the habits.

Finally, a few words about the relationship between arts education and moral, political and civic awareness. Any art form can be practised for the sake of art alone. The arts can also be (and have often been) practised to express values such as patriotism, nationalism or outrage at injustice. It is important for students to understand the uses (and abuses) to which the arts have and can be put, and to help students develop a meta-cognitive awareness of how they are using the arts – as a means to explore pattern, colour, beauty, emotion, language, etc., and/or as a means to express their own values, whatever these may be. Towards this end, arts educators would do well to introduce students to how the arts have been used – including contemporary art today, which is often used by marginalised groups to convey outrage at injustice.

Ellen Winner is Professor of Psychology at Boston College and Senior Research Associate at Project Zero, Harvard Graduate School of Education. She directs the *Arts and Mind Lab,* which focuses on cognition in the arts in typical and gifted children as well as adults.

Notes

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How are we smart?

What does it mean to be intelligent? How does intelligence develop and vary in humans? How much do thinking dispositions contribute to intelligent behaviour? Can intelligence be learned? **Flossie Chua** discusses what we know about these questions.

These questions around what intelligence is and what it means have intrigued and inspired researchers at Harvard's Project Zero for over 50 years, and our inquiry suggests that intelligence, far from being singular, innate and fixed, is in fact multifaceted and learnable. Rather than equating being smart with scoring the highest test scores, or being born with a fixed amount of 'smartness', we believe that being smart is having a profile of learnable intelligences that enables one to identify and solve problems, and to create products that are of value in contemporary society. In short, we propose that intelligence is *multiple, dispositional* and *learnable*.

Intelligence as Multiple

What do we mean when we say that intelligence is multiple? Our research suggests that intelligence is not a unitary ability; rather, it is best described as a complement or profile of distinct strengths – verbal, logical/mathematical, bodily-kinaesthetic, musical, spatial, interpersonal, intrapersonal and naturalistic.[1] This definition stands in opposition to conventional educational practices that treat each and every learner in exactly the same way. This lack of differentiation fails to recognise that, in practical terms, there is no such thing as an 'average' learner, and so designing instruction for the average student makes little sense.

While we possess all of the intelligences, *how* we have them varies. Each of us possesses a unique complement or profile of intelligences that differ in their relative strengths and weaknesses. Being more advanced in one intelligence is not predictive of development in another. Some of us may be good in thinking with visuals but are less adept at deductive reasoning, detecting patterns and logical thinking. Others may be excellent at interacting with a diverse range of people, but are less advanced in their fine and gross motor skills.

Our intelligences are best understood as potential that may or may not be developed to their fullest extent possible. The extent to which we do so rests on a triad of factors: the values of the culture we live in that either favours or diminishes particular intelligences; the opportunities that are available to us to develop particular intelligences; and the personal decisions made by individuals as to whether they want to focus efforts on developing particular intelligences. Our intelligences are developed and honed through the constant interaction of biological and environmental factors. They are not fixed at birth, and most certainly cannot simply be captured by a test score.

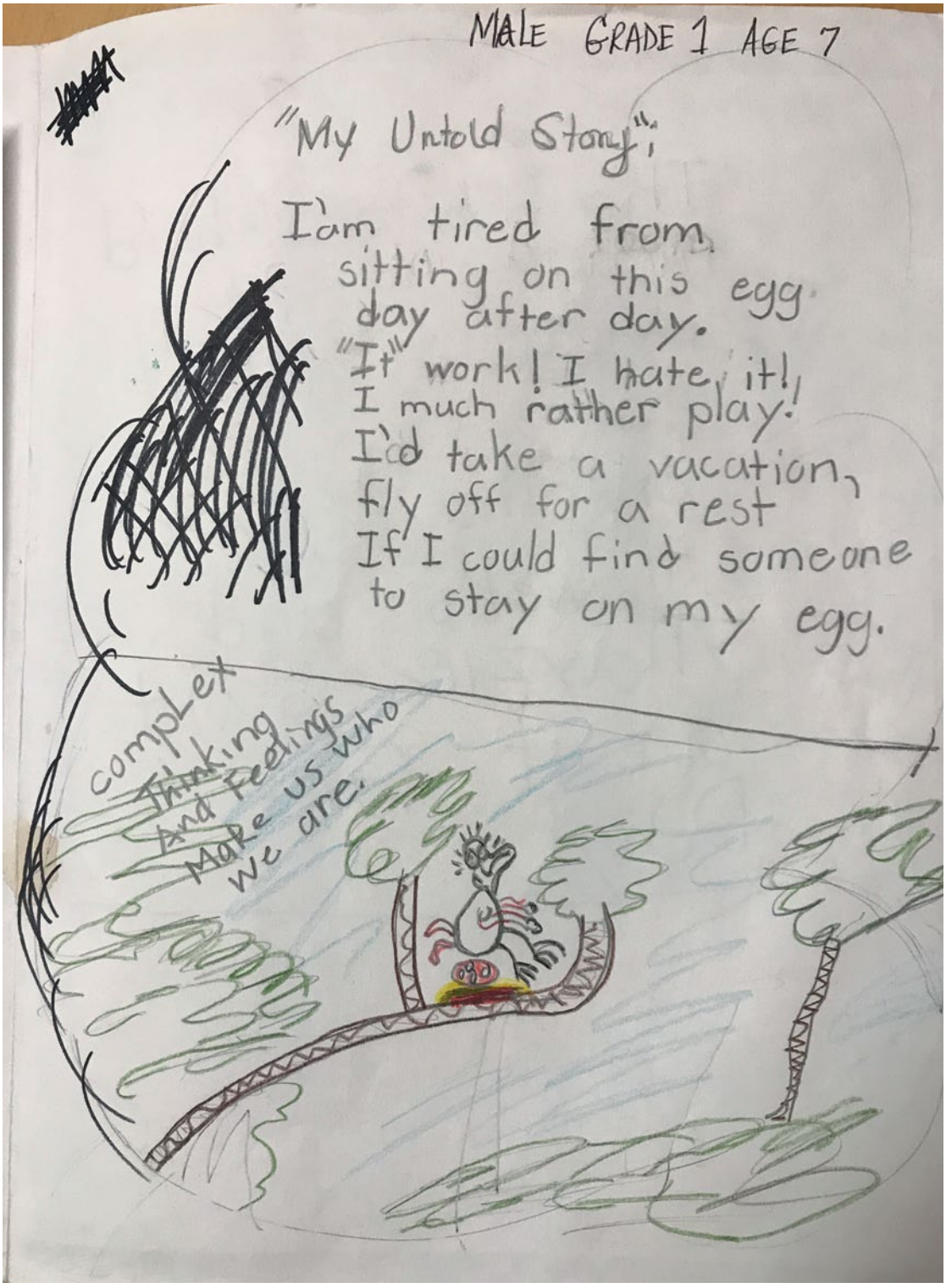
What are the implications of intelligence as multiple on the way we teach and learn? Our intelligences are expressed in the way we perform our understandings, whether it is synthesising ideas, communicating perspectives, creating products, solving problems, raising questions or offering explanations. Hence, evaluating intelligence means focusing on how learners visibly demonstrate their understanding in flexible ways across a range of novel contexts, rather than how much they know or have mastered and are able to reproduce on a test.

Keeping in mind that our learners are intelligent in multiple ways makes us more reflective in the way we design learning experiences for our learners. Two approaches to designing learning experiences are instructive here: *individualisation* and *pluralisation*.[2] Firstly, when we make a concerted effort to learn as much as we can about each learner, we begin to build a picture of their individual profiles of intelligences. With those in mind, we can design opportunities for them to learn and demonstrate their understanding in ways that are most comfortable for them. We are also more intentional when we design challenges that are not within their comfort zone but that are worthwhile capacities for them to develop.

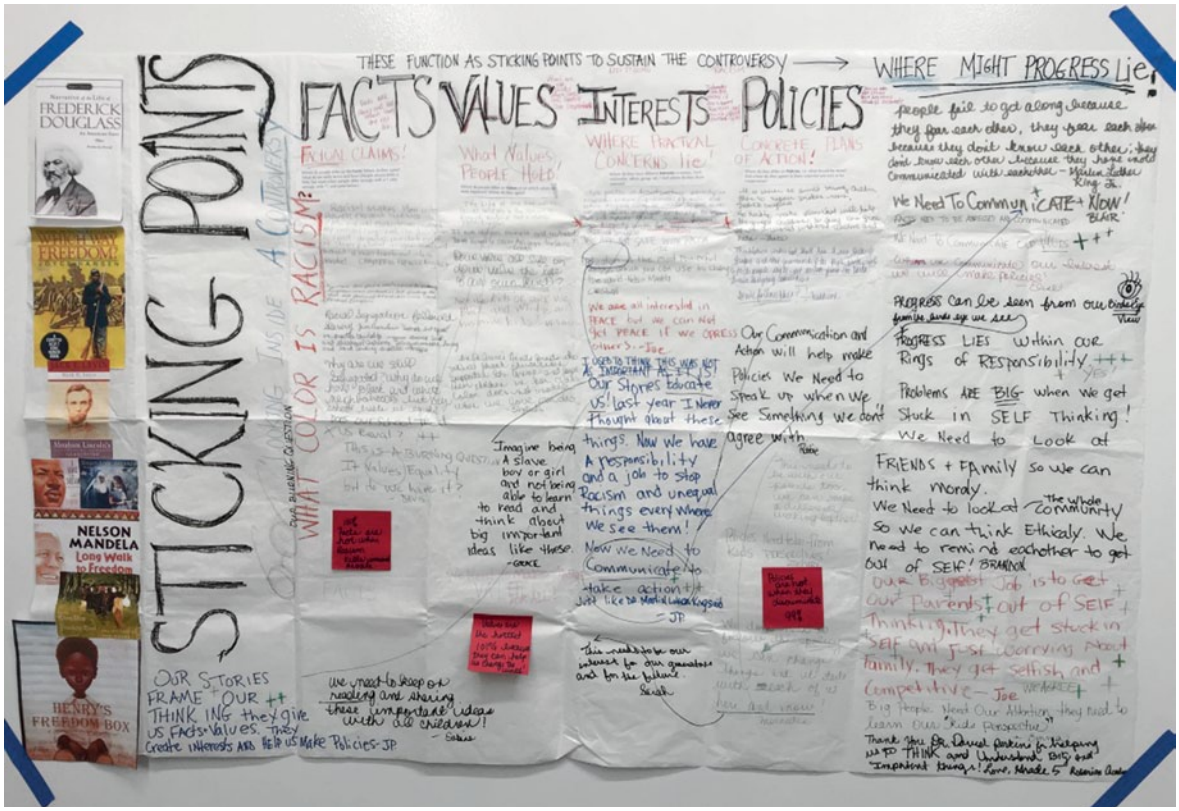
Secondly, bringing rich content into the lessons is not enough if we are not also providing opportunities for learners to engage with the content in multiple ways. In order for learners to demonstrate their understanding, we need to offer plural ways for learning. It is fruitful to ask: *are we providing various avenues for learners to gather and analyse information? Are there opportunities for them to perform their understandings in different ways? Have we designed tasks that challenge learners to build up intelligences that they may not be strong in?*

Intelligence as Dispositional and Learnable

What do we mean when we say that intelligence is dispositional and learnable? A long-standing line of work at Project Zero has explored ways that thinking dispositions model intelligent behaviour, and the promotive conditions and strategies that support such forms of thinking among learners. We asked, *what kinds of thinking dispositions are there? How much do thinking dispositions contribute to intelligent behaviour? How do dispositions relate to abilities? Can thinking dispositions be learned?*



Dispositions play a critical role in the way we express our intelligences, whether it is how we engage in problem finding and solving, or how we express our perspectives across diversity. In fact, the attitudes that learners display when they are working on complex matters strongly predict the extent to which they use cognitive reflective skills. It matters whether they take an expansive or narrow stance when they are working with people from diverse backgrounds, and it matters whether they are intellectually adventurous or careful in their thinking when analysing a range of solutions to a global issue.



So, what are thinking dispositions? We describe them as tendencies towards particular patterns of intellectual behaviour, such as making connections across different ideas, or probing and digging deeper into assumptions. In particular, we found that key to providing the best leverage for the kinds of thinking and learning that learners frequently encounter in our complex and dynamic world are seven critical thinking dispositions:[3]

1. The disposition to be broad and adventurous.
2. The disposition towards wondering, problem finding and investigating.
3. The disposition to build explanations and understandings.
4. The disposition to make plans and be strategic.
5. The disposition to be intellectually careful.
6. The disposition to seek and evaluate reasons.
7. The disposition to be metacognitive.

This robust set of thinking dispositions are learnable, and once integrated into one's everyday repertoire, they form the foundations of intelligent behaviour and a profile of multiple intelligences that are expressed within and across cultural contexts.

What are the implications of intelligence as dispositional and learnable on the way we teach and learn? When we embrace intelligence as dispositional and learnable, our goal in designing learning environments must be to support learners to build their intelligence by creating rich and ample opportunities for problem finding and solving experiences. Classrooms organised with this in mind effectively emphasise the cultivation of desirable dispositions and the teaching of skills that hone those dispositions.

A key construct in such learning designs is the metacognitive capacity for reflection. When learners develop the capacity for persisting in good thinking in the face of growing complexity and challenge, or the capacity for monitoring and learning from the way they approach learning challenges, or the capacity to imagine more broadly and expansively how current thinking matters in the

unknown future, they become more aware of their own cognitive processing abilities and styles, and are able to take stock of where and how they might improve the way they learn.

More recently, researchers at Project Zero developed new thinking routines for developing the dispositions to uncover and grapple with complexity, as well as to transfer and apply understandings far and wide in learners' lives. One such tool is the *Stories* thinking routine, which invites learners to explore how accounts of issues, events, people, society, etc. are presented; to tease apart and rethink the various angles, dimensions and scope of accounts; to consider what has been left out in the account; and to take a stand on the kind of account that they would want to hear:

STORIES

Uncovering Accounts of Complex Issues

Consider how accounts of issues, events, people, society, etc. are presented, what has been left out and how you might want to present the account.

What is the *story* that is presented?
What is the account that is told?

What is the *untold* story?
What is left out in the account?
What other angles are missing in the account?

What is *your* story?
What is the account that you think should be the one told?

Teachers can adapt the routine for different purposes and subject matter. For instance, they could move the thinking and discussion from a local to a global perspective – *'What is a bigger story that this story could be connected or related to?'* They could also invite learners to think about what an individual's account could be – *'What is a smaller story that this story could be connected or related to?'* Another adaptation could involve bringing in multiple disciplinary perspectives into the conversation: *'What is the scientific/historical/ literary/ etc. story?'* Teachers may also consider framing the prompt 'What is ***your*** story?' as *'What is his/her story? What is our story?'* to have learners explore multiple perspectives on an issue, event, people, society, etc., and begin to

craft a collective account. (For a more complete and detailed look at thinking routines exploring complexity, download the pdf at www.pz.harvard.edu/resources/exploring-complexity)

OUR IDENTITY AS THINKERS

A different thinking routine – *Our Identity as Thinkers* – fosters transfer of how we monitor our thinking and the cultivation of strong thinking practices. It functions as a quick reminder to learners about what to pay attention to, and encourages them to take to heart the idea of being a good thinker, to make the commitment to good thinking an integral part of who they are, and to apply good thinking far and wide in school and beyond.

As we think personally or in conversation, let's take a moment to remind ourselves...

— WE GIVE THINKING TIME —

We quiet our impulse to hurry, tapping energy to... • gather ideas and evidence first and then decide • think it through part by part • talk it over with friends or an advisor • think about it for a while, set it aside, come back to it later • sleep on it...

— WE MAKE OUR THINKING BROAD AND ADVENTUROUS —

We reach beyond the ordinary, finding the spirit to... • explore unusual points of view • brainstorm very different ideas • drop typical assumptions at least temporarily • think far away from the usual approach • ask 'what if not?' • exchange ideas with others • look for connections far and wide, in other topics and areas of life • listen to our intuitions without necessarily taking them as final • keep open and alert to the world of things and ideas and opportunities around us...

— WE MAKE OUR THINKING CLEAR AND DEEP —

We get beyond the surface, digging in to… • get clear about what things mean • look for parts and purposes, how things fit together, how they are designed • map the larger system around what we're looking at and investigate how things work underneath • look for evidence, look on both sides, think about the reliability of our sources • take different perspectives • test our ideas through conversations with others • express cautions with conclusions: how sure is it reasonable to be, does this really make sense? • think what further points to investigate...

— WE KEEP OUR THINKING ORGANISED —

We avoid muddling through, getting sharp to... • be clear about our goals: what are we trying to figure out? • use various thinking moves (like those above) and thinking routines • think on paper (or computer, etc.) to help ourselves keep track • think together with others, helping one another to move forward • pause and ask whether we're making good progress and, if not, try a different path...

(For more thinking routines and more details of **Our Identity as Thinkers**, download the pdf at http://www.pz.harvard.edu/resources/portable-knowledge)

Intelligence as an Educational Commitment

When we make a commitment to developing intelligence in our learners, we do so not solely because it's a way forward towards a good numerical score, but because intelligence that is multiple, dispositional and learnable is a critical capacity that will support learners to thrive in a complex world with many unknowns. Learners who see that their capacity to engage the world can be developed from strength to strength come to understand that intelligence is not a unitary construct, but one that involves varied strengths that they can continue to build. Instead of asking, *'how smart am I', they ask, 'how am I smart?'*

Flossie Chua is a Senior Research Manager at Project Zero. Her work focuses on understanding how we can nurture good thinking and practices that develop the capacity for informed and positive action.

Notes

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The Quest for Deeper Understanding

Achieving a deep understanding of something can be challenging for many students, however the benefits can be transformative. **Tina Grotzer** shares some approaches for developing adaptive expertise and helping children become deeper learners.

Learning is like a geode. Its hidden gems are revealed to those who invest the effort to get beneath the surface, to look deeper and to get to know the internal structures.

The nature of understanding and how it relates to the enterprise of education has long been a focus of Project Zero research and for good reason. Understanding is elusive; it requires considerable investment, but the pay-offs can be significant for learners.

Fortunately, research has helped us to learn a lot about the nature of deep understanding and

the challenges in developing it. In this article, I explain the main ideas behind what we have learned along the way and offer some implications for practice. First, I step back to consider the nature of understanding and to elaborate some principles that have guided Project Zero's work on understanding over the years.

Take a few minutes to think about something that you understand very deeply. What are the features of this understanding? In what ways does the understanding reveal itself? What is the emotional impact of having this type of understanding? Next, take a few minutes to contrast these features to something that you do not understand very well. What does the contrast illuminate about the nature of deep versus superficial understanding?

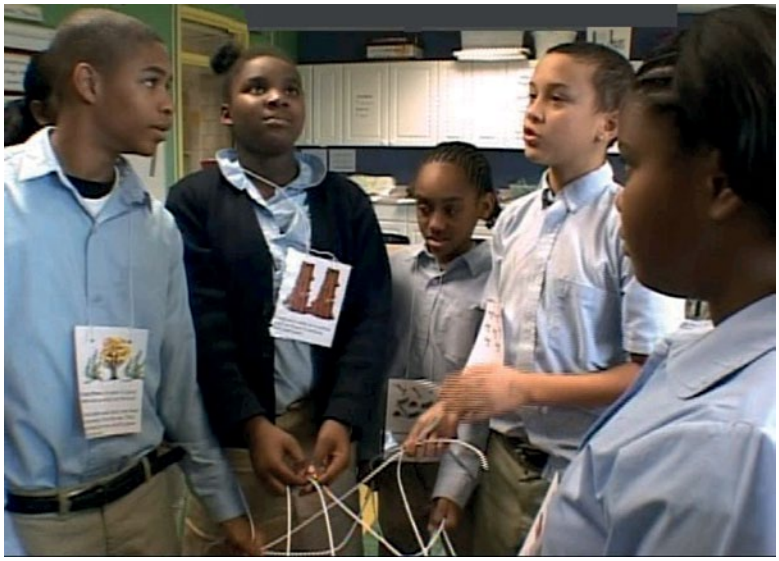
These are questions that my colleagues and I have long asked educators and other audiences. Their responses have highlighted how deep understanding is flexible, nuanced, empowering and often applicable in multiple contexts. It leads to a sense of confidence, engagement, and often, a greater sense of humility about what is and is not understood. Interestingly, it typically leads to new questions and a willingness to work at the edge of one's competence to pursue new knowledge in a form of progressive problem-solving. Expertise begets more expertise.

What are some broad guiding principles of Project Zero's work related to the nature of deep understanding?

1. Depth of understanding is more empowering than broad, superficial coverage.

David Perkins has written extensively about how fragile, superficial knowledge hurts. It betrays the very promise of education—that what one learns will serve them in the real world. Often students learn isolated facts, information with gaps that leave it inactionable, or ritualised knowledge that is rigid and inflexible. In an information age, when facts can be readily acquired at one's fingertips, educating primarily for factual recall instead of deep understanding makes little sense.

2. Understanding is revealed through performances as opposed to what we know in our heads.
The ability to act with what we know is what matters. A Jeopardy-like command of facts can be helpful in limited instances, such as test-taking, crossword puzzles and game shows, but in general, it doesn't help us to live better lives. Actionable understanding is enabling and should be the goal of education. We need to be able to think flexibly and apply knowledge to new contexts. This requires recognising contexts to which it might apply and figuring out how to map it. One of the ways to make sure that students have the opportunity to gain actionable understandings is to engage them in scaled down versions of more expert endeavours—what David Perkins has called 'playing the whole game at a junior level'.[1]



3. Assessment should be on-going, based on authentic performances and interspersed with further opportunities to learn.
If understanding is revealed through performance, assessment must follow suit. When performance is high stakes, we typically do assess it in authentic contexts or in ones that closely adhere to the authentic features. Further, we offer on-going learning support, assess understanding and then provide further support in taking the next steps. We don't give a book exam on swimming and then toss kids into the pool. A written test for new drivers signals the beginning of the actual important learning that takes place with guidance behind the wheel. And the surgeon holding a scalpel had better have lots of guided experience before taking on solo surgery! Certainly these are high risk endeavours, but if what we are teaching truly matters, then performance-based assessment interspersed with supported learning experiences is warranted.

4. The focus of learning should be on topics or themes that have the potential to be generative and to contribute to understanding beyond the contexts taught.
When teaching for deeper understanding, the impact of learning can be extended by focusing on topics that enable understanding beyond the specific content in which it is learned. For instance, certain topics in science, such as density and pressure, are viewed as fundamental concepts that open the door to concepts that build upon them. In the humanities, themes related to the nature of the common good, sources of conflict, and perspective-taking can be generative. Expansive framing refers to letting students know at the outset that what they are learning holds the potential to be widely helpful.[2] This does not mean that transfer happens automatically – one must still help students to extract the big ideas and to see how they can be powerful in other contexts.

What do we know about developing deep understanding? What do the research findings suggest?

Considerable research exists to inform the challenges and pedagogical implications of helping students to develop deeper understanding. This research spans cognitive science, neuroscience and the learning sciences. While there

are a lot of nuanced implications to be drawn from the research, some overarching findings are as follows.

1. Deeper understanding is a journey not a destination. It involves trading up for increasingly more powerful explanatory models.

Research shows that students' understanding goes through an evolutionary process whereby they gain models that have greater explanatory power and that are more connected to other understandings. They don't necessarily let go of their earlier models – similar to how we think about Newtonian physics, these models may be useful in certain contexts.

A significant body of research in science, maths, social and historical perspectives has established that we hold robust views about how the world works based on our experiences.[3] Often, these views are limited by factors such as the perceptual evidence available to us, the ways the brain filters information to prevent overstimulation, and our ability to perceive and remember the data that we have access to. These views must be addressed in order to help students gain deeper understanding. It is not enough to bracket them. Students have to see the ways in which the models have explanatory power and the ways in which they are limiting.

The process of helping students to evolve more powerful explanatory models can be supported by educators who understand the specific conceptual terrain (and what makes it hard) as well as the cognitive challenges that the mind has to grapple with in the new model. For instance, consider the challenges for students learning about the solar system. They need to imagine an earth in constant motion (though it certainly doesn't feel like it!), the location of the sun, the earth, the moon, etc., and put it all in dynamic relationship to one another. At the same time, they need to adopt the perspective of the scale of these astronomical bodies and their own relationship to it. A deep understanding of history involves holding a multitude of perspectives as different narratives are told, setting them in the context of the cultural milieu of the time, and trying to put oneself into a time scale that is typically many times the number of years that the students have been alive. Researchers have documented, particularly in science education,[4] the kinds of challenges involved and some typical paths that students' evolving understanding takes. This information can help teachers develop the provocations and supporting curriculum for students to navigate towards understanding.

However, a significant puzzle for education is that the evolving nature of deepening understanding is typically at odds with how schools structure units of learning. Units tend to have a finite endpoint and there are few opportunities to revisit concepts across and within school years. Teachers who attend carefully to students' current thinking as they begin a unit and shepherd them along the journey towards more powerful understandings of the world, may find that their efforts fall short in an unsupportive school structure.

2. Developing deeper understanding requires attention to structural knowledge. It involves restructuring tacit schemas that we hold and gaining a broader repertoire of schemas.

The journey towards deeper understanding requires careful attention to

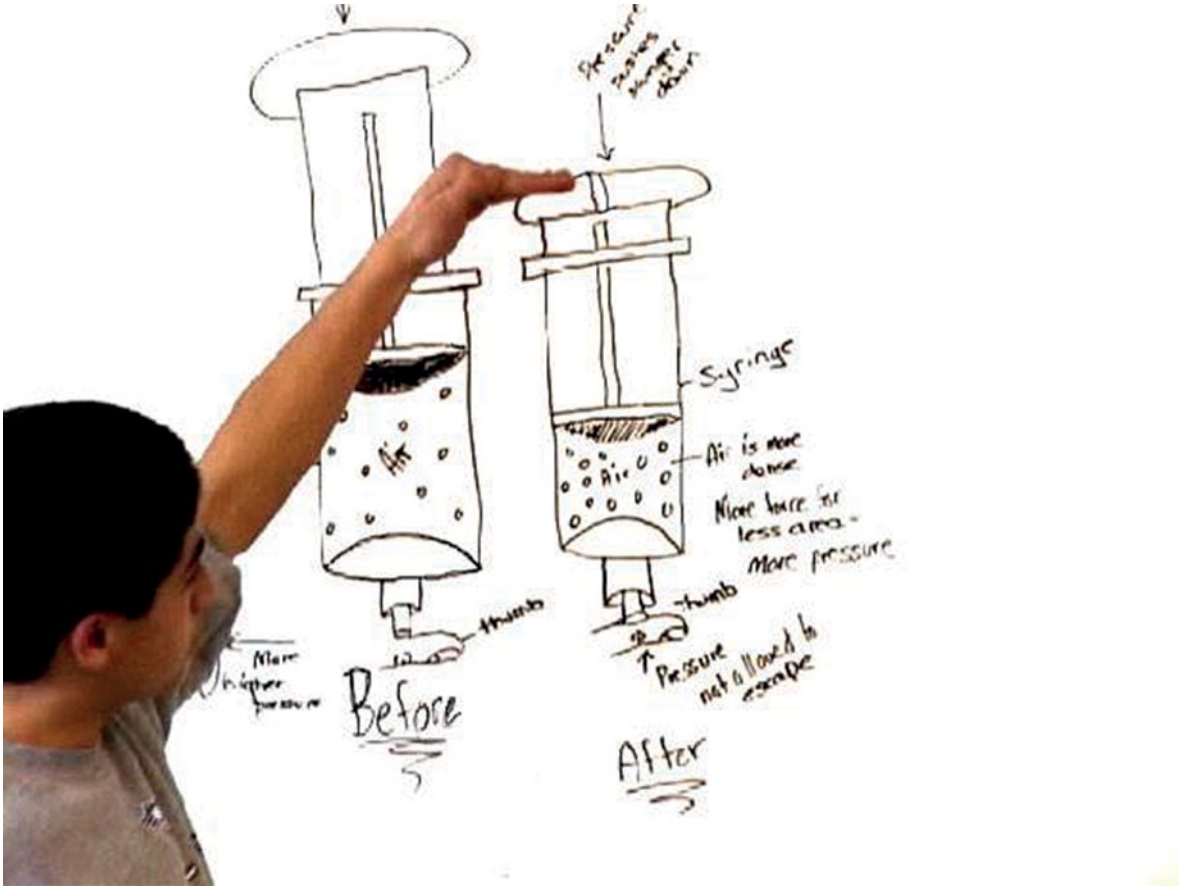
how students are structuring their models. Research shows that the implicit structures of our current understanding can limit and distort concepts. So, the process of achieving deeper understanding often requires deconstructing embedded structural assumptions that we are making. However, we may not even be aware that we are making them! For example, consider what happens when you drink from a straw. Students often think hold an agency-oriented, linear model that sounds something like, 'I suck hard on the straw and pull the liquid into my mouth'. However, a more sophisticated understanding of the fluid dynamics involves an implicit relational causality that sounds like, 'As I remove some liquid, I lower the air pressure in the straw and the higher ambient air pressure surrounding the liquid in the glass creates a differential so that the liquid moves up the straw'.[5]

My own work shows that most students adopt simple linear models such as these without knowing it. Researcher Michelene Chi has shown that students often adopt the wrong categories in their knowledge claims, for instance, they treat simply circuits as substance-like instead of process-like.[6] These structural assumptions are about the nature of the knowledge rather than the specific concepts.[7]

Building more powerful understandings requires rethinking these underlying structures and adopting schemas that lend greater insight. As educators, we often focus on what students know that they know or know that they don't know. Tacit structural knowledge is much more challenging because it focuses on what students don't know that they know and we as educators may not readily realise the powerful pull that these schemas have on their understanding.

So the quest for deeper understanding needs to attend to students' underlying structural knowledge, in addition to the conceptual and procedural knowledge that most classrooms focus on. What might this sound like in primary and secondary classrooms?

- In mathematics, students might discuss the assumptions of what it means to quantify. Or that base 10 is an invention—a design that has a history related to the number of digits we have on our hands but that one can use other bases and they may present advantages in some situations. Another example can be found in a video of a third grader named Sean grappling with the meaning of the terms odd and even in the University of Michigan Series.[8]
- In social studies, students might consider the perils of 20/20 hindsight and how hard it is to actually adopt the perspective of a given point in time as we look back to consider events from the perspective of those living in that time. Without realising the pull of 20/20 hindsight, we might believe that we are more intelligent than people from the past, that certain historical outcomes were inevitable and should have been obvious to the people of that time.
- In science, students might consider how climate change has many distributed causal agents and the emergent outcomes are unaligned with the intentions of those agents. They might discuss how the non-obvious greenhouse gases make it harder to think about inherent causal relationships.[9]



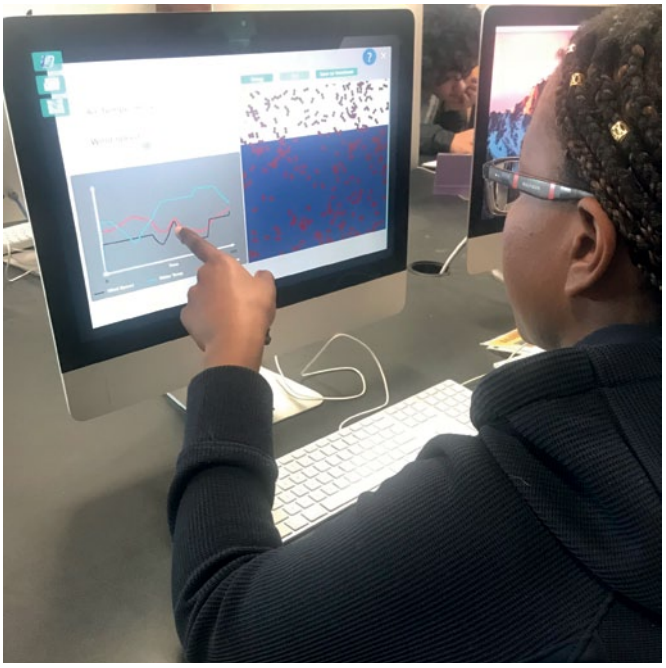
3. Our cognitive architecture presents challenges for developing deeper understanding. It requires reflective attention to the intersection between our cognitive tendencies, the conceptual terrain and the instructional approaches that navigate between them.

Research shows that a key way that humans develop understandings about how our world works is not through formal education but by summing across the wealth of our everyday experiences. We notice relationships and make connections between them in what has been referred to as a *Bayesian mindset*. We manage this process in a statistical rather than a deterministic manner. This means that if, most of the time, a certain outcome follows a certain impetus, we come to view them as related. This makes it possible for us to see patterns in our world.[10]

However, this process also means that we may miss critical, but uncommon distinctions that could drive our understanding towards deeper, more explanatory models. For instance, in the drinking through a straw example, most people have had the experience of drinking from a juice box and reaching a point at which they cannot get any more juice from the straw. However, we don't necessarily attend to this information and use it to drive towards more powerful models. There are many other examples like this in science. Further, once we think that we understand something, it actually becomes harder to see discrepant information. This is called confirmation bias. The neuroscience demonstrates that our brains react differently to information that confirms current beliefs than that which doesn't.[11] This work suggests that we bracket rather than attend to disconfirmatory information.

These tendencies make it difficult to see information that fits beyond our current understandings. We filter it away before we have a chance to reflectively consider it. This is the case in all learning—whether it is models in science, perspectives that we disagree with in our social and political world,

or the argument that one just had over what happened on the playground. It is, in my mind, the strongest case for supported opportunities in education to discover that which eludes us.



4. Students need to learn how to seek out deeper understanding. Learning how to learn new and challenging content—developing adaptive expertise—is necessary for helping students continue the journey beyond formal schooling.

One of the most important things that teachers can do to support the development of lifelong learners is to help students know how to seek out and develop understanding. Learning for understanding is a special set of skills. For example, students need to develop sensitivity to when they are unclear on concepts, what steps might help them to gain clarity, and different ways to gain understanding. At Parker Charter School in Devens, MA, students decide when to petition to transition between divisions. The question of 'Do I deeply understand this material?' is one that they regularly ask and reflect upon. Learners need to understand the value of flow states, the deep engagement that enables optimal learning and often, losing track of time, as the process becomes internally driven and motivated.[12]

In a Living Curriculum Pedagogy, schools take learning for understanding even further.[13] Understanding is an ongoing quest carried out by the learner. The curriculum is living in that it is about real world, authentic learning that is dynamic and changeable—responding to what is relevant at that time. Most importantly, it is developed with teacher support by the one living it. It focuses on having the ability to gain deeper understandings—on developing adaptive experts—more than on a particular set of understandings. Instead of viewing themselves as the ones who chart the journey towards understanding, teachers at Tremont School, a Living Curriculum School in Lexington, MA, help students in this role in a form of negotiated curriculum. Students learn things such as knowing how to operationalise their questions into inquiry paths, and considering what forms of resources and expertise they can build upon as they set and revise their learning paths. As the content to think with, students in Living Curriculum schools often learn as many facts as students elsewhere, yet they also emerge as better learners and innovators.

What are some implications for educators?

The research findings support that it is challenging to develop deeper understanding. However, we know a lot about why and how to help us get there. Here are some main take-away messages:

- Start with what learners know.
- Try to understand how learners are making sense and help them to see the tacit structures in their sense-making.
- Help learners experience where their current understandings work and where they fall down.
- Help learners to gain models of what more expert understanding looks like.
- Look for critical distinctions and disconfirmatory evidence that will drive learners towards more powerful conceptions.
- Position learning as a journey, not a destination.

Despite the challenges, the pay-off for the quest for understanding can result in deep and big understandings that David Perkins has called, 'lifeworthy learning'. The promise of education should offer no less!

Tina Grotzer is a member of the faculty of education at the Harvard Graduate School of Education and a Principal Research Scientist at Project Zero. Tina directs the Causal Learning in a Complex World Research Lab where her research identifies ways in which understandings about the nature of causality impact our ability to deal with complexity in our world.

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Knowledge Trails

1. **Fostering Deep Thinking In The Primary Classroom**
   Is it ever too early to teach children how to think? Researchers Russell Grigg and Helen Lewis say it's not. Here they report on the strategies uncovered during an action research project in South Wales to extend and deepen pupils' thinking – even from a very young age.
   https://library.teachingtimes.com/articles/fostering_deep_thinking_in_the_primary_classroom
2. **Learning In Depth: A Curriculum Innovation**
   Deep knowledge of one topic has the potential to transform the schooling experience of nearly all children, says Kieran Egan. https://library.teachingtimes.com/articles/learning-in-depth-cross-curriculum-projects
3. **Project Plan - Learning In Depth**
   A Cross Curriculum Project with a difference. The rationale is that learning about one topic for the whole of their school career will radically change students' understanding of the nature of knowledge.
   https://library.teachingtimes.com/articles/project-plan-learning-in-depth
4. **The Young Researchers**
   Ryan Hughes argues the case for Learning in Depth - a casual, yet effective, mode of teaching and learning.
   https://library.teachingtimes.com/articles/ctl6-4-the-young-researchers

Leveraging Culture with Ron Ritchhart

Ron Ritchhart, leader of PZ's 'Cultures of Thinking' project, has been a powerful advocate for educational practices that bring out the best in people, and creating places where thinking is valued, visible and actively promoted. We sat down with him to discuss his research and thoughts on the current state of education.

Since 1994, Ron Ritchhart has been involved with Project Zero, aiming to understand how to develop, nurture and sustain thoughtful learning environments for both students and teachers. His books *Making Thinking Visible* and *Creating Cultures of Thinking* have not only put out a call for action for schools to become inspirational environments that bring out the best in all learners, but they have also offered concrete strategies and approaches to make that happen.

His research has explored areas such as intellectual character, mindfulness, thinking dispositions, teaching for understanding, creativity in teaching and the development of communities of practice. From this, he has clarified a framework for leveraging the cultural forces that exist in classrooms and has developed a series of 'Thinking Routines' that help scaffold and support thinking and make the learning process visible as ideas are expressed, discussed and reflected upon.

Can you give us a brief overview of the 'Cultures of Thinking' and tell us a bit about the project and the key concepts?

Well, several years ago I became really interested in the idea of thinking dispositions. To cultivate those, one can't rely on direct

teaching. What we have to do is create a culture in which thinking is supported and where we enable students to develop deep understanding and also to develop those habits of mind. The framework that we use for understanding how culture exists comes from some early research that I did almost 20 years ago in which I looked at classrooms where teachers were really adept at getting students to think. I set out to try and understand how those teachers developed their students as thinkers and learners. And what I saw was that all of those teachers really leveraged the culture, and from that, we then identified what we call *cultural forces*. I've chosen that name quite deliberately because, just like the force of gravity, it is not something we choose. These forces already exist in classrooms, so they're not something we choose to implement, but they are something we can choose to use to shape the culture.

Those eight cultural forces are:

- the routines and structures that the group has in place
- how time is allocated
- the opportunities that are being created
- the interactions that teachers have with students and that students have with one another,
- the modelling that teachers offer of who they are as thinkers and learners,
- the physical environment,
- the language that gets used, particularly language of thinking
- the expectations that we have for our students that really guide us

So those eight forces really wind up being the centre of our work. There's a lot there. We've spent a lot of time researching each of those in more depth to provide teachers with tools to help them move forward.

Great. And who were your influences that got you interested in education and this line of research?

Well, what took me to Project Zero was the opportunity to work with David Perkins. I had read his book *Smart Schools*, and was really captivated by the notion that we can think about schools in a different way and think about education in terms of developing students as thinkers and learners with a focus on deep understanding. He shaped a lot of the teaching that I was doing in my own mathematics classroom at the time, and then I got the opportunity to come to to Harvard and work with him and with other people at Project Zero, including, of course, Howard Gardener as well as David Perkins. And so they've been very influential, as well as the colleagues that I've had over the years. Joseph Onosko, a professor at the University of New Hampshire, is someone else who has influenced me. He too was looking deeply into thinking. His research has also looked at classroom teachers and how they understand the role of thinking and how that connects to their agenda of teaching. Those have been very major influences.

One of the things you mentioned with the eight forces is that they are things that good teachers were already doing. Some people might say then that your research is a collation of good teaching practices and theories that are already out there and that these forces are simply a collection of research practices that have been out there for a long time. How would you respond to that perspective?

Well, I think what my research has added is the identification of these forces. Whenever research identifies something that exists, then what that research does is illuminate how those things work. That's what my research has focused on. And so, take something like language. Of course it's not surprising that

teachers use language, but it's *how* they use language and the *effect* of that language, as well as the role of what's known as conditional and absolute language, and how that plays out in the classroom, along with the role of language of identity. So the forces certainly connect to other researchers and to my own research, but their purpose is to illuminate how these things work.

And I think that this also represents a shift. One of the things that can sometimes be challenging in the world of education today is that we actually have gotten teachers accustomed to the idea that anything you hear about is something to implement. It's a new program, it's a new approach, it's something to implement.

And what the cultural forces offer is that they are something to examine or something to pay attention to. They involve paying attention to your own teaching and certainly there are actions to take to move that forward, but they're not something that you just merely implement. It's something that is an ongoing process. People should always be suspicious of anything new that comes along that doesn't connect to good teaching or doesn't connect the practices of what we know about engaging students deeply in learning. So we sometimes search for novelty in education today, rather than searching for refinement.

When a teacher wants to get started using the Cultures of Thinking, where do they start? And how do they know if what they're doing is correct?

Traditionally, a lot of time is spent in schools talking with teachers about curriculum, giving them curriculum. Sometimes teachers are engaged with the curriculum, but not nearly enough. A lot of times the curriculum comes from outside. A lot of attention is given to instruction and to giving teachers new instructional techniques. But there's a third leg of that stool, if you will, which is culture. We don't give teachers the tools or means to construct that culture. So again, since this isn't something to implement, a teacher can start anywhere. Where they do have to start is by examining their own teaching and culture. If you were to try to encapsulate what culture is, it is embedded in the messages we send and so, it's important to start by looking at the messages we're sending our students and how we send those messages through these eight cultural forces.

A teacher has to become reflective, observant and aware. When we work with schools, we often engage teachers in observations both through video in the classroom and through going into one another's classrooms. We really look at those eight cultural forces in action to see how they're actually playing out and how they are shaping the culture. That awareness then becomes a lever for how you might begin to do that practice in your own classroom.

We've also found that there's no order for these eight cultural forces. They all work together. Again, because it's never a matter of inserting or taking things out and since they're always present, a teacher could start anywhere. Some teachers become very engaged with thinking about the environment they're creating, and often once teachers become aware of the research on language and the many subtleties of language, they become very captivated by how they might use language more effectively.

We often start with thinking routines in schools and one reason for that is because they give teachers something very concrete to do and they help to put thinking on the agenda. This helps teachers become more aware of thinking in general and the thinking their students are able to do. What happens is, as teachers use routines, they become more aware of their language. They might also become more aware of the opportunities they're creating, of their allocation of time, of the role of modelling. So, all of the other cultural forces to begin to come into play. The routines are a very useful way to start.

So how can you assess what's going on? Is there evidence that this works better or differently from other methods? And assessment is always a big issue in education. How do we assess this?

Well, one of the things that makes Project Zero so impactful, so long standing, and such a rich place to work is that we don't produce programs that are aimed at improving test scores or even changing schools. All of our research focuses on learning. How do we understand learning? How do we support learning? How do we move that forward? So to the extent that schools are interested in learning, we do that.

We don't design programs that are meant to have teachers do something that will then automatically improve test scores. But we have seen that when schools and teachers focus on building the culture in their school, test scores go up. We have seen this happen all around the world whenever teachers put their focus there. And that's consistent with findings from anyone who works in the field of thinking—when you focus on thinking, when you focus on understanding, it does contribute to good test scores. So it's not a program that you evaluate, because evaluation is based on people's implementation of something. This isn't something you implement. This is a reflective tool. This is a process. This is a journey that people go through. We do absolutely see that in no way does this ever cause test scores to go down, and in fact we've seen some really dramatic inclines and gains.

One area that we have very deliberately assessed because it is a goal of ours, is whether students are developing as thinkers. When we were working at Bialik College in Australia as part of our research there, we did feel that as teachers work on building a culture of thinking, as they're using the thinking routines, as they're making thinking visible, that this should help develop students as thinkers. So that's what we assessed. We didn't assess grades, we assessed students' development as thinkers. Very specifically, we looked at one area of that: the development of students' metastrategic knowledge, which is a sub-component of metacognition. And what we found was that the students made about a two-and-a-half-year gain when they were in classrooms where teachers were actively working towards supporting thinking, of valuing thinking, of making that thinking visible. And, that's a research paper, "Uncovering Students' Thinking about Thinking," which is available on my website if people are interested in more

of that research. (http://www.ronritchhart.com/ronritchhart.com/Papers_files/UNCOVERING%20STUDENTS%20THINKING_Pub.pdf.)

What do you do with a sceptical administration or school leadership that are resistant to implementing things that take time and where they do not always see immediate tangible or measurable results. Can you convince people that this is a way to go or do they already have to have a sympathetic point of view?

Well, we don't do that because we're not an organisation that is selling anything. We have ideas about how people think and learn. People are often interested, as you said, in measures or outcomes. We are definitely interested in evidence and the evidence is what you see in your classroom. The evidence is when you use a thinking routine and it works with students and it leads to rich thinking. It leads to deeper learning.

So all of these things are evidence-based, and I think that schools really need to become more evidence-based, rather than data-driven. We often look at data because it's easy to collect. It's some superficial measure. But that's not an accurate focus on effectiveness. So realistically, because we aren't trying to sell a program, we tend to work in schools where there are sympathetic administrators.

Of course, not every teacher at any school is necessarily always at the same place or on board, but as their colleagues began to try out ideas, as excitement for teaching grows, as they see their students more engaged, as they see understanding develop, that's the evidence that propels them forward. So the people who take on this work are the people who are interested in not perpetuating the status quo, not thinking about schools as test prep factories, but who are interested in thinking about schools as an opportunity to develop human potential, as an opportunity to engage and empower students, an opportunity to look beyond traditional modes of schooling.

And fortunately, worldwide, there is an increasing push for us to rethink schools and rethink what we're doing with students to make sure that we are really providing a quality education for them. So those are the people who tend to be attracted to these ideas, not as a vehicle for raising test scores, but as a vehicle for creating engaged and empowered students.

I want to go back to something you just said a moment ago about how your research does not present a program that teachers are implementing, but rather that is is a bigger framework. What do you make of something like John Hattie's *Visible Learning,* which has been popularised and commodified. Is that helpful to your research in that there's more awareness, or does it create obstacles for you?

I wouldn't say his work has helped our research. In fact, it's created some confusion over whether we are talking about the same things. There is often a lot of confusion created around this because John Hattie titled his book *Visible Learning,* and so people think that there's a connection between that and my colleagues.[1] I think the title of his books is a bit incorrect because he has not made *learning* visible. He takes it as a given that learning consists of test scores, but test scores often obscure what real learning is. So what he has done is made *teaching practices* visible and the teaching practices he has made visible are the ones that lead to better test scores on traditional measures of tests. Hattie's research is about perpetuating the status quo of what schools are. And so, if you're looking at at test scores and you think that schools as they exist are exactly as they should be, then those practices fit in with the model.

And, while there is some overlap between our work and Hattie's, we're actually talking about different things. When we talk about making learning visible or

1. Steve Sydell, Mara Krechevsky and Ben Mardell wrote a book called Making Learning Visible, which is connected to the Reggio Emilia approach. Additionally, a 2011 book called Making Thinking Visible was authored by the PZ team of Ron Ritchhart, Mark Church and Karin Morrison.

making thinking visible, we really are talking about those processes, while Hattie is using test scores as a proxy for what learning is.

We're trying to go much deeper and we recognise that students can learn and think, separately from the agenda that any teacher might set for any particular lesson. And so we begin to recognise and see how the student is making sense of ideas, where learning is happening, that may or may not be connected to the agenda the teacher has put forward.

Whereas if the student didn't learn what the teacher was trying to teach, Hattie would see that as meaning that no learning occurred, and we wouldn't say that's necessarily so. That's something that everybody really needs to think about with how these things are going out in the world.

Sounds like a good challenge. What are you working on now? Is your current research a continuation of all of this, or are there new strategies or approaches now that you have years of practice and research behind you?

Our current initiative is looking at 'Cultures of Thinking in Action'. What we are trying to do is identify some core principles. One way to think about these principles is that they are belief sets or mindsets that really are foundational to the mission of creating a culture of thinking. We then want to help schools and teachers engage with those principles and build actions around them. So for example, I mentioned earlier: 'Students learn best when they feel known, valued and respected by their teachers and peers'. We believe that this is a principle that teachers have to take on board as a belief and then to develop practices around that.

So what does that actually mean in practice, beyond my saying 'yes, I agree with that'? What are the actions I need to take? What are the things that perhaps I should stop doing? Another principle we've identified is: 'Questions drive learning and thinking'. We've done a lot of research around questioning and how to focus our questions in classrooms so that they really do facilitate learning and thinking.

In addition to actions around each of these principles, we're developing tools to collect what we call 'quick data'. So this isn't test score data, but it's a way of looking at how we get data from students, from our teaching, from our observations, and from our colleagues that informs our teaching. We call it 'quick data' because it isn't meant to be something where we need to stop teaching to get it. Traditional testing actually stops teaching, stops the learning and says, 'ok, now we need to measure what has been done'. And so, what we're interested in doing, is finding out how to get the information we need that then propels us and moves us forward.

There's a popular idea around right now, particularly from progressive educators, that traditional classroom learning is on its way out. People often promote the idea that traditional classrooms are outmoded, and that digital learning is going to take over, removing the need for anyone to go into a classroom. There is a lot of money being put into initiatives to make that a reality. But the work you're doing suggests that it's actually the opposite – that right now classrooms are more necessary than ever and that it's the connections and the culture that are what supports people and develops their abilities to think, which is what we need for future success.

I think what we will see is that this trend, which is often supported by technology companies, is just a blip on the radar. In fact, one of the things we have learned about the use of computers and technology is that they can amplify good practices – but they can also amplify bad practices. Computers are good delivery devices for information. They can provide video tutorials and those kinds of

things, but learning doesn't occur through the delivery of information.

Learning only occurs when the learner does something, and that's why the interactional component is so important. What we do hear from business leaders and governments (not that we need to just all of a sudden follow what business leaders want) is that we need people who can work in teams. We need people who can collaborate. We need people who can innovate.

And so, it is necessary to recognise the important dynamic that happens in groups, and that learning really is a social endeavour. It used to be quite popular for schools to have one-on-one programs and bring your own devices initiatives. However, schools that I see that are further along in terms of really promoting learning have scaled those initiatives back because they found that, yes, technology can be effective, but it can also be a huge distraction. It's not the technology itself that is producing learning, it's the opportunity to really interact with others around ideas.

Everyone knows that you can take courses online, but very few people would opt to take a course online if they had an equal option to do the same coursework live with other people in discussion. We are social creatures. We know that the dynamic of being able to toss ideas around and think things through with others is crucial for the learning process. Learning is much more than just the delivery of information and gaining knowledge. Our understanding is developed in those interactional components.

So there is a focus now on what sometimes people (I think erroneously) refer to as 'personalised learning' and the idea that we can just put people in rooms and on computers and they can learn the same thing as they do in classrooms. But I think it's going to be a very, very short-lived blip. What we're more likely to see in the future is much more dynamic environments for interaction that bring people together to interact in really interesting ways to problem solve and create together in groups.

What are some of the other initiatives and lines of research coming out that you think are worth highlighting?

There really are so many, but I think one of the ones that is really on my radar that I find incredibly interesting is work being done by Ben Mardell, Mara Krechevsky and Daniel Wilson around the pedagogy of play. That's a project funded by the Lego Foundation. Researchers and educators are really beginning to take the idea of play seriously. And I think a lot of these ideas transfer into the classroom as we ask questions about how we bring in those components of playfulness, of joy, and again, of interaction. What are those components that make play such a powerful learning vehicle? And in fact, what we are learning more now is that play is very important.

You know, there was a time not that long ago where we thought the opposite. That we needed to keep kids on task. That we need to make schools more academic. That we needed to cut out the fluff. And so, in the States, schools reduced recess time. They reduced that time for interactions. And what we're learning now is that no, those are actually incredibly important times, not only for socialisation, but also for brain development, for idea development and for cognitive opportunity. We know now that during some of those downtimes, our brain is actually forming the richer connections and that students actually do better when we allow them those times. Rather than seeing that as a distraction, it is really integral to the learning process. So, for me the 'Pedagogy of Play' project is really a very, very exciting project going on right now that I'm following very closely.

Additional Reading:

1. Ritchhart, R. (2015). *Creating cultures of thinking: The 8 forces we must master to truly transform our schools.*
2. Ritchhart, R., Church, M., & Morrison, K. (2011). *Making thinking visible: How to promote engagement, understanding, and independence for all learners.* San Francisco, CA: Jossey-Bass.
3. Ritchhart, R. (2004). *Intellectual character: What it is, why it matters, and how to get it.* San Francisco, Calif: Jossey-Bass Pfeiffer.
4. More resources, including *Cultures of Thinking* resources can be found at www.ronrichhart.com

Thinking Routines

These routines are simple structures involving a set of questions or a short sequence of steps that can be used across various grade levels and content. They promote the development of students' thinking and help achieve deeper inquiry and engagement with content.

There are many types of Thinking Routines. Some are core routines, which can be used more generally, and others are geared towards understanding, fairness, truth and creativity. Some are good for introducing concepts and introducing ideas, some are great for synthesising and organising ideas, and others are geared towards digging deeper into ideas.

Here are a few of the core routines to get you started. Additional examples can be found in the book *Making Thinking Visible* by Ritchhart, Church and Morrison and on its supporting website http://www.visiblethinkingpz.org/.

Think-Puzzle-Explore
This routine is inquiry based, asking students to think about their prior knowledge, express curiosity and plan what they want to do to answer their questions. This is great for introducing a topic to help connect to prior knowledge, to stimulate curiosity and to lay the groundwork for more independent work. Ask the students to answer the following questions, individually and/or in groups:

1. Think: What do you think you know about this topic?
2. Puzzle: What questions do you have or are curious or puzzled about this topic?
3. Explore: How can we explore these questions or puzzles?

I Used to Think… Now I Think…
This is a good routine for students to reflect on how and why their perceptions, opinions or knowledge has grown or changed over time. It can focus on an ideal, like 'fairness' or 'truth', or on a topic or unit such as 'creative writing', a book that they've read, a mathematical process like measuring angles, a world event in the news or in history. Students are simply asked to reflect on paper (can be in words, pictures, diagrams, etc.) in response to these prompts:

- I used to think …
- Now I think…

What Makes You Say That?
This teaches students to provide evidential reasoning for their observations. It helps them describe what they observe or know and then encourages them to support their interpretation with evidence.

Through this exercise, students are also encouraged to recognise and understand alternative explanations and multiple perspectives. After presenting students with a particular concept or object, ask them the following questions:

- What's going on?
- What do you see that makes you say that?

Knowledge Trails:

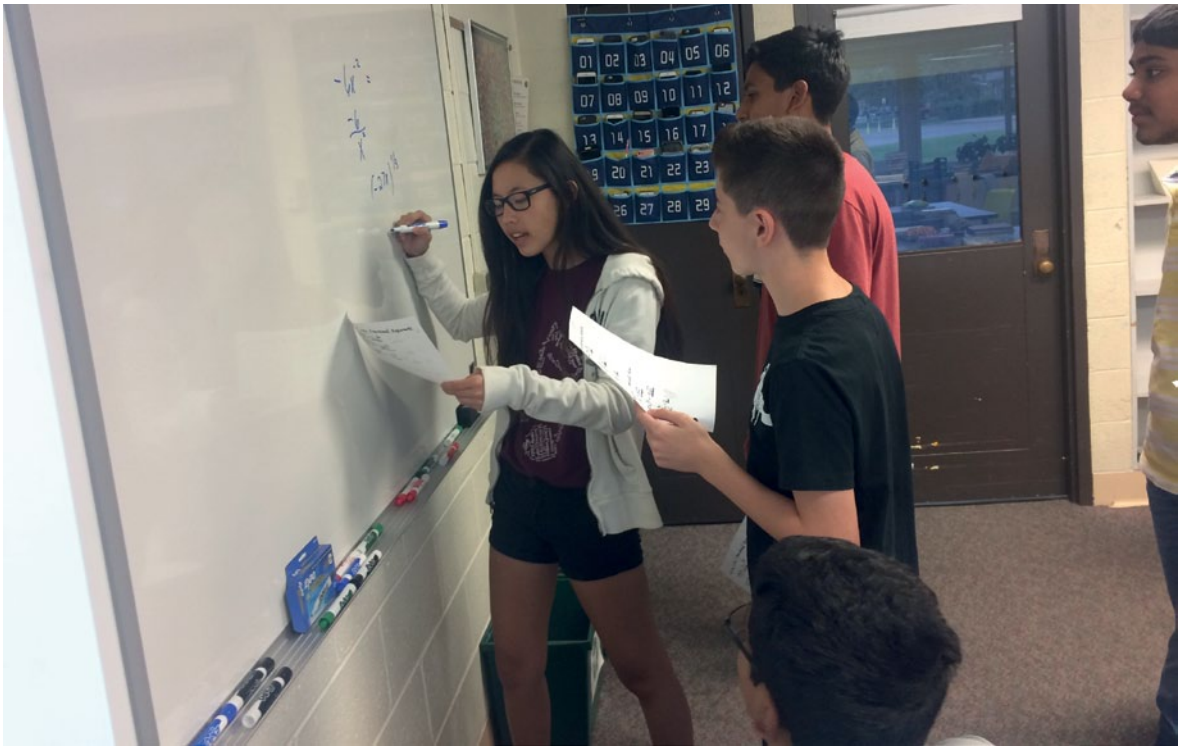
1. **The Real Power of Questions** https://library.teachingtimes.com/articles/ctl24thepowerofquestions
   Promoting a deep-thinking classroom culture is a result of teachers posing the right type of questions, says Ron Ritchhart.
2. **Cultivating a Culture of Thinking** http://library.teachingtimes.com/articles/acultureofthinking
   Cultural forces exist in all classrooms that can be leveraged to develop a culture of thinking. Jeff Watson and Roger Winn demonstrate how to harness these forces to develop students' thinking skills in secondary Maths and Chemistry classrooms.
3. **Shaping Reality with the Language of Thinking** http://library.teachingtimes.com/articles/shapingrealitywiththinking
   The power of language extends beyond the world of syntax. Erika Lusky shows how using the Cultures of Thinking framework is transforming the learning culture and offering students the ability to truly think for themselves.
4. **The Thinking Skills Debate** http://library.teachingtimes.com/articles/thethinkingskillsdebate
   Does the teaching of thinking skills help learners or is it a waste of time? Peter Gardner, Steve Higgins and Geoff Hinchliffe debate their points of view.
5. **Framing Learning as a Social Endeavour** https://library.teachingtimes.com/articles/framinglearning
   Student-led collaboration can bring out the individual gifts of students as they develop within a community. Julie Rains shows how group learning and reflection can make students feel successful as active participants in their own learning.

Cultivating Cultures of Thinking Part II

Transferring Ownership of Learning

Finding opportunities for interactions within the classroom is crucial for empowering students to take ownership of their learning and gain deeper conceptual understanding. Continuing on from their previous article in CTL (8.2-8.3), teachers **Jeff Watson** and **Roger Winn** continue to share how the 'Cultures of Thinking' model is changing their Maths and Science classrooms.

The *Cultures of Thinking* framework developed by Project Zero's Ron Ritchhart focuses on eight cultural forces that exist in classrooms: expectations, language, time, opportunities, interactions, environment, routines, and modelling. According to Ritchhart, these forces exist in every classroom whether they are given attention or not. The idea is to properly leverage those forces so that classrooms become places where thinking, collaboration, independence, and deep-learning rule and become commonplace, rather than classrooms that stress compliance and work, and which are teacher-centred.

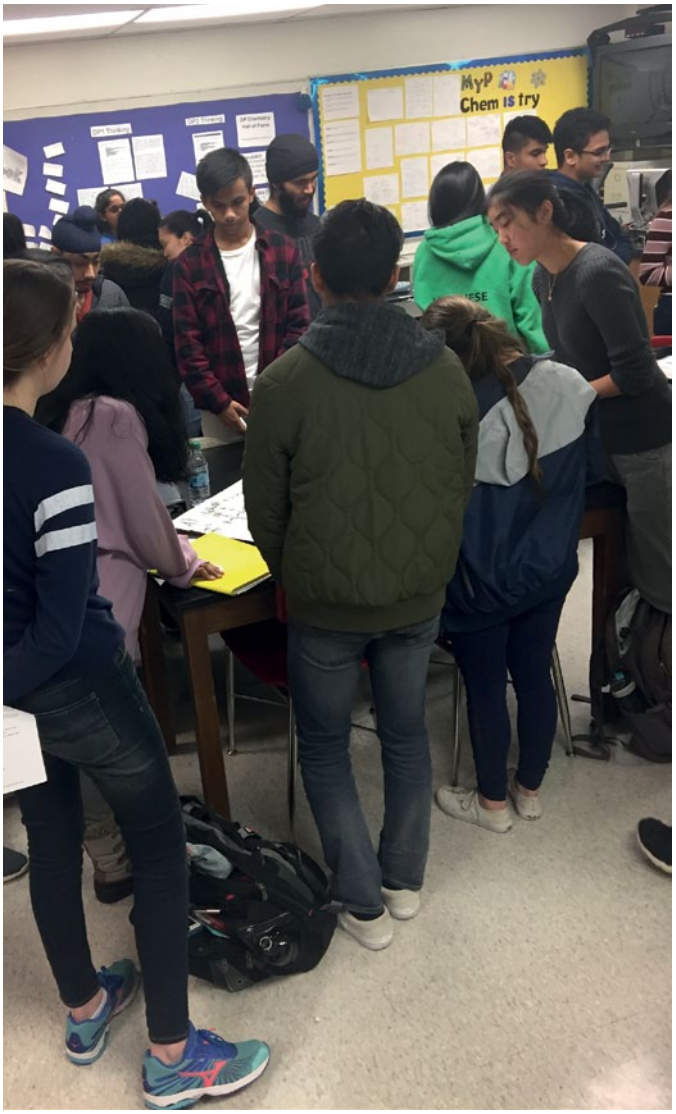


Harnessing meaningful **interactions** is a crucial part of creating a Culture of Thinking in a classroom. As Ritchhart points out, 'At the heart of much of this theoretical work is the belief that transformative learning–that is, learning that cultivates the development of the whole person and strives for more than the simple transmission of information–is more likely to happen in community than in isolation. Such communities are largely democratic in nature, stressing mutuality, support, connection, and shared decision making'.[1] Our last article focused on leveraging **opportunities** through the restructuring of lesson plans.[2] This article will explore how to leverage **interactions** within existing lesson plans. Although many of the examples will focus on maths and science, the core principles that are drawn from these cases can be applied to any classroom.

Pressing for thinking

I used to think that a focus on coming to a consistent, reproducible answer in chemistry did not provide space for discussion about competing ideas. However, through a focus on concepts and pressing for thinking, I have found that richer discussions occur. Before embracing Cultures of Thinking I would solicit student

answers and give feedback on whether they were right or wrong. Now these discussions of problems are very different. During a discussion of ionization energy in MYP Chemistry,[3] some students shared that they thought the ionization energy would decrease a group, while some thought it would increase. Rather than pointing out the data that supports one thought and not the other, I had students share their reasoning with a partner and then had different students share their reasoning with the class. From sharing their reasoning and focusing on the 'why' of their choices, students were able to have a more nuanced conversation about the trend for ionization energy and come to a class agreement. This restructuring of problem discussion can be integrated into many existing lessons.



When transitioning to a classroom that focuses on thinking, the students need a cue to let them know to share their thinking. An easy way to communicate this new focus on thinking is using the 'What Makes You Say That?' thinking routine.[4]

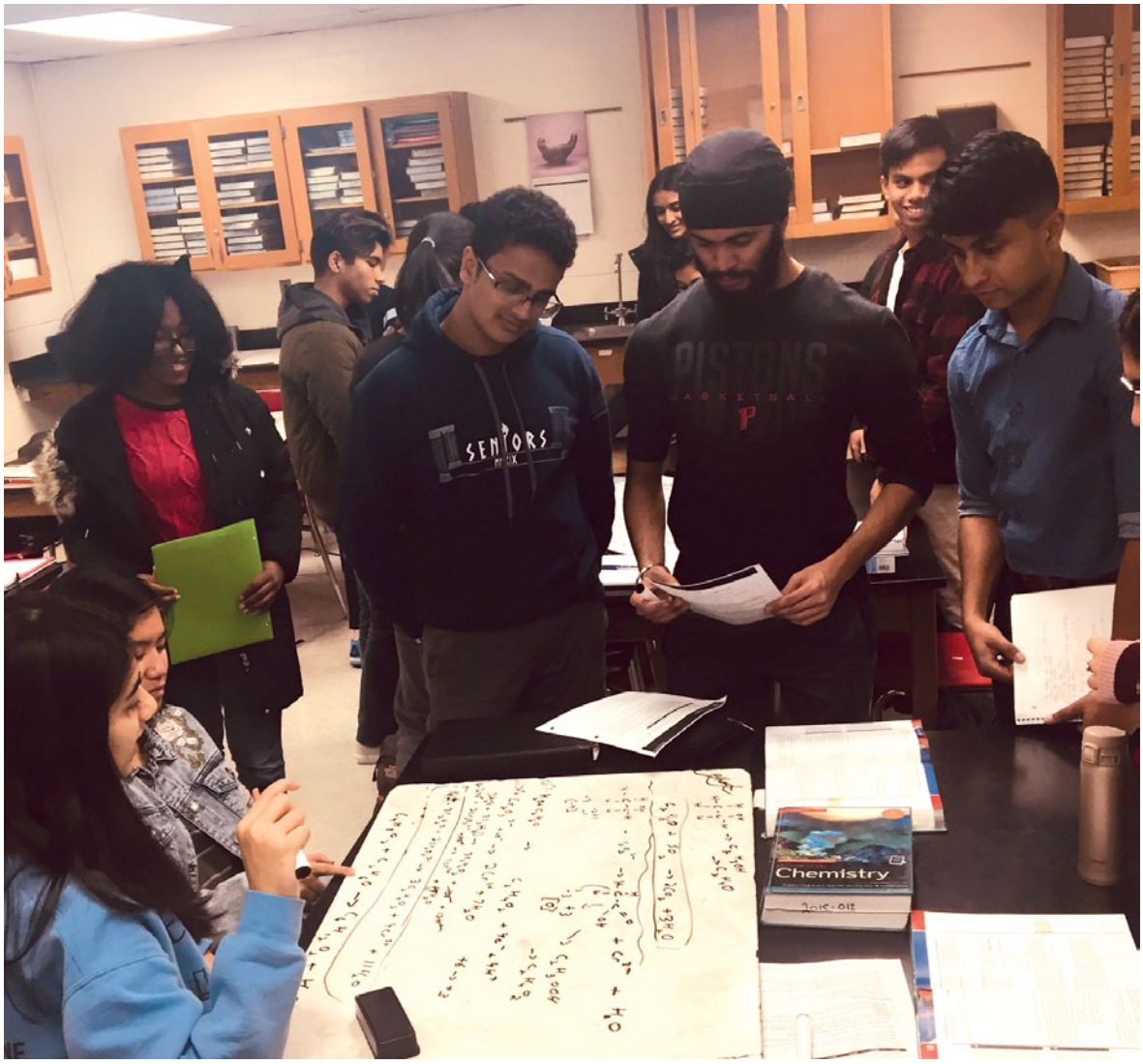
This short question communicates to the student that you are focused on the reasoning and not just the answer. A variation I have used that has also drawn out more thinking is asking the students to 'tell me more'. Students can struggle with sharing their thinking at times and providing scaffolds to help them organise their thoughts can help move the discussion forward.

If a student can't articulate their thinking, taking time for a 'Think-Pair-Share' routine to have students discuss their reasoning has been successful for me to help students articulate their reasoning.[5] This strategy was used above after students shared their answers. In addition, it engages the whole class in discussing their thinking, rather than just the students sharing their thoughts.

In the above example, the 'Think-Pair-Share' put every student in a position to contribute to the class discussion. As students shared their reasoning, they were able to see that both students had valid reasoning for their choices and the class came to an agreement on the trend for ionization energy. By the end of the discussion, students had gained a deeper conceptual understanding of the topic.

But what if the discussion in agreement on an answer does not match the scientific community? What if the students just stare at each other and don't talk?

Teachers still play a role in classroom discussions. As a teacher, I think about when I should interject with a question that could help steer students' thinking to a more consistent way of thinking. If, after asking questions about ionization energy in the above example, students still expressed misconceptions, I would have shown them data and asked them why the data does not match their prediction. It can be difficult to come up with these questions at times, but I have found that having students confront misconceptions does a better job of addressing them than telling students whether an answer is right or wrong.



- In some classes, students are reluctant to talk in whole class discussions, which is often because they are afraid of being wrong or nervous about what they will say. Adding in short routines that have students share their thoughts in smaller groups, like 'Think-Pair-Share' or a microlab routine, allows them to practice what they might say in a whole-class discussion and spread the ownership of ideas among more students. A student sharing what a group thought makes them part of a team and it is not necessarily their individual thoughts that they're presenting. I have found students take more intellectual risks when the ownership of the risk is spread.

Supporting student autonomy

Before embracing the ideas of Cultures of Thinking, in class, we made ourselves the authority of chemistry and maths knowledge. In chemistry, Roger would provide his students practice problems, and the next day would show them an answer key and have them ask questions. Students were able to assess their understanding with this method, but all conversations were student-to-teacher interactions, and the teacher was an integral part to their understanding. In Cultures of Thinking, the goal of the teacher is to find ways, '...to step back so that students can step forward'.[6]

To support student autonomy, Roger changed the ways that students interact with practice problems through the 'Explainer / Explorer' method of problem

review. Each group of students (usually 2-4 students) are assigned a problem to become experts on. Students solve the problem on a whiteboard and discuss it among their group.

After students have completed their problem, each group member is randomly assigned the role of 'explainer' or 'explorer'. The role of 'explorer' is to visit other groups and be responsible for asking questions of at least two other groups, while the 'explainer' remains at their table and answers questions asked. After a set amount of time, students switch roles.

With this method, students have conversations in a smaller setting, which I have found increases the conversation between students. With this method, the authority of knowledge is placed in the hands of the students, yet is still debatable. Through this practice of students answering each other's questions they internalise knowledge using resources in addition to the teacher to aid their understanding.

In maths, Jeff set used to set his classroom up so that he was the only mathematician in the room. The answers, notes and hard problems all went through him, and apps or solution guides were something to be hidden away and given only in rare circumstances. Now, he continually presses students to be mathematicians and to use many resources – 'read the textbook – the mathematician who wrote that book has a good example on division', 'watch this video on polynomials', 'use the "Photo Math" app to check that answer and see what that provides' – to build their understanding.

In our maths and chemistry classrooms in the past, the amount of peer-to-peer interaction was very limited, and when things got loud, we felt like we were losing control. We were sometimes afraid that if somebody walked by they would think that learning was not happening. Now, while promoting student autonomy in the classroom, the volume may increase, but so does the understanding and rich interactions.

But, how do we ensure students are learning the information without misconceptions if they are autonomous learners?

- Student autonomy does not mean that students have no interactions with the teacher. If a teacher notices an issue in a problem, addressing it (preferably with a question), is beneficial for student understanding. If students view the teacher as ***a* resource** rather than ***the* resource** for learning, they will still remain autonomous.
- While students are in the 'explaining' and 'exploring' phase, the teacher can join conversations passively by listening, or actively by contributing thoughts. Being part of a conversation is another way to address misconceptions. While jumping from conversation to conversation, you can also check for on-topic conversations.
- Having misconceptions about maths or chemistry is not something to fear – it means that learning is happening. The idea is to give the students enough supports to rectify these misconceptions or misunderstandings – that is what learning (vs. knowledge) is supposed to 'look like'.

Beyond QRE

Another way to foster rich interactions is to move beyond the QRE pattern of discourse present in many classrooms (teacher **Q**uestions, students **R**espond, teacher **E**valuates). In a lesson on solving systems of linear equations, Jeff used to show the students a system and would ask them how to solve it using a certain method. A few students would raise their hands, and he would call on them to move things along and to save time. They would tell him the way to perform the operation and Jeff would write as they would talk. The rest of the class would vigorously write down everything he was doing on the board and then he would consider it as 'taught'. This is a classic QRE situation. The

interaction would only exist between the teacher and the student providing the information. As Ritchhart says, this is 'resembling a Ping-Pong match back and forth between the teacher and a single student, leaving much of the class out of the interaction'.[7] If a student asked a question along the way, Jeff would answer it for that student, and again the interaction would only exist between him and that student. What the classroom needed was different patterns of interaction, so instead of Ping-Pong, perhaps basketball would be a better metaphor. Jeff decided instead to try the '+1 routine' as a new pattern of interaction. He gave them these directions, pausing after each step to give them time to think and reflect:

1. Write for two minutes about solving systems of equations.
2. Now pass your papers clockwise. Read the list. Add one new thing about systems that you don't see on the paper.
3. Keep passing clockwise and repeat until the paper reaches the original owner.

Then he continued, 'Now, take a few minutes and talk with each other and compare your lists. What's different? What is the same?' The groups of students then were given some time to discuss with each what they had written down. Students then had time to mingle a bit as they had been sitting for a while: 'Those who feel comfortable, write some items on the whiteboard from your list.' Students would start heading to the board to write information. This allowed Jeff to circulate to those students who were still at their desks to see if they had any questions or confusion, or just to talk about what they had written down. It gave the students some space to ask him things that maybe they wouldn't have asked in front of the whole class. Once the whiteboard was filled with information, Jeff then told the students: 'Let's take a few minutes and head to the whiteboard with a marker and put a question mark next to any item that is puzzling to you. Perhaps you can put a star next to the items that you feel comfortable with.'

Consider for a minute about this type of interaction versus the original QRE interaction. In the original way of introducing systems, the teacher and one other student were telling the class what system to solve and how to solve it. It left little room for debate, questioning or creativity. The new pattern of discourse gave the students time to get all of their thinking sorted out, then gave them a chance to bounce it off of their peers, while allowing time to get it on the board for clarification.

Finally, the new way allowed students to put question marks next to their puzzles in a somewhat anonymous manner so it took any stigma away of being 'wrong'. It also allowed the students' ideas to direct the lesson for the day. Why spend time on, say, the substitution method of solving a system if none of the students put a question mark next to it on the board?

'But, what about whole group discussion? We can't always break away from that and do something else - it's going to happen. How do we change it?

This is a very important question. There will be times where you will be standing at a whiteboard in front of the whole class – that is inevitable. What are small things that can be done to promote better interactions in this circumstance?

- Try to instill the idea in your students that what you say as a teacher is important, but that is only one piece of the puzzle. What their peers contribute is key as well. We have noticed many times that when a student has a contribution to make or has a question, other students will tune out because it is not their question or their contribution. We will say to students, 'be sure to listen to what everybody is saying in whole group discussion. Listen carefully as if you had to respond to everybody's contribution.'
- When a student asks a question or is providing a comment, look at the floor or look elsewhere. This will force the student to make eye contact with the other learners in the room as they won't have anywhere else to look. We sometimes tell them, 'look around at your peers as if you are talking to all of us, because you are!' This will help to break the QRE model.
- Many times a student will ask a question. Another student will start responding to the question, but they will look at the teacher when they are doing so. We will frequently point to the originator of the question and say to the student answering, 'talk to them'. The two students then look at each other and start interacting and discussing.
- Change your location in the room. If you position yourself with other students in between you and the speaker it will encourage them to make eye contact with other students.
- Instead of the 'hands-up norm',[8] try using the TeamShake app available on your smart phone. It allows you to enter your class lists, and then you can tap on the list to generate a random name to call on. We use this not as a 'trap' or a 'gotcha', but as a way to help more students to join the conversation.

As with ***Opportunities***, the ***Interactions*** that we are fostering in our classrooms are a work in progress, ultimately aiming to move away from simple transmission and placing more emphasis on rich interactions. Designing lessons that leverage these forces is an iterative, exciting process that takes time, creativity and trial-and-error.

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Notes

1 Ritchhart, Ron. (2015). *Creating cultures of thinking: The 8 forces we must master to truly transform our schools.* New York: San Francisco: Jossey-Bass, 2015, p. 203.

2 Watson, J., & Winn, R. (2018). Cultivating a culture of thinking. *Creative Teaching and Learning,* 8(2-3): 30-37. https://library.teachingtimes.com/articles/acultureofthinking

3 MYP is the Middle Years Programme – the pre-diploma years of the International Baccalaureate Programme https://www.ibo.org/programmes/middle-years-programme/

4 'What Makes You Say That?' *Visible Thinking,* www.visiblethinkingpz.org/VisibleThinking_html_files/03_ThinkingRoutines/03d_UnderstandingRoutines/WhatMakes/WhatMakes_Routine.html.

5 'Think Pair Share.' *Visible Thinking*, www.visiblethinkingpz.org/ VisibleThinking_html_files/03_ThinkingRoutines/03d_UnderstandingRoutines/ThinkPairShare/ThinkPairShare_Routine.html.

6 Ritchhart, 218.

7 Ritchhart, 213.

8 Ritchhart, 225.

Writing For Creative Teaching And Learning

Creative Teaching and Learning is a magazine aimed at teachers, school leaders and educational advisers.

The magazine seeks to explore new approaches to teaching and learning that have the express aim of developing children's thinking and creative learning skills. The current economic climate requires that we create students with a high degree of adaptive and transferable cognitive and creative skills in order for them to lead successful and fulfilling lives, and for us as a nation to compete in a global marketplace.

The magazine:

- offers materials and approaches for raising the quality of teaching and learning in all areas of the curriculum
- promotes teaching that stimulates and challenges learners by encouraging them to question, research and reflect
- provides ideas and resources to teachers who want to help learners think more creatively and critically and to develop such qualities as reasonableness, independence, persistence and good judgement
- helps foster enthusiasm for thinking and learning by suggesting alternative approaches to teaching subject content
- suggests a rage of learning activities out outside the formal school day
- encourages discussion and debate about the place of critical and creative thinking in education

With these aims in mind, *Creative Teaching and Learning* will publish:

- reports on good teaching for thinking in curriculum areas
- descriptions of successful methods of teaching thinking and creativity
- summaries of research
- teaching resources
- interviews with key thinkers, writers and teachers
- clear background articles on relevant theories
- commentary on educational policy developments

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Assessment Reimagined

Shifting the 'Who, What, When, Where, How and Why' of Assessment

Done well, assessment can spark the deepest kind of learning. Yet narrow definitions of assessment persist in education. **Mara Krechevsky** and **Tina Blythe** explore how Project Zero is reimagining assessment and share examples of assessment practices that foster learning for both students and teachers.

'What does learning look like?' is one of the key questions Project Zero (PZ) has explored for much of its 50-year history. In recent years, our work has been equal parts grappling with the thorny reality of schools and bureaucratic systems on the one hand, and trying to imagine 'What if… What other possibilities might there be?' on the other. One form this work takes is developing alternatives to traditional notions of assessment and accountability and expanding what 'counts' as learning

in classrooms and schools. Because the way learning is assessed directly influences what gets taught, assessment is an especially powerful lever for transforming teaching and learning.

PZ researchers have investigated questions of assessment in a variety of research projects and, from these investigations, produced many resources that offer alternative ways of conceptualising and enacting assessment, including the *Arts Propel* handbooks, *The Teaching for Understanding Guide*, *Making Learning Visible*, *Making Thinking Visible,* and many more. (For related resources, see *Additional Reading* at the end of this article and http://www.pz.harvard.edu/50th/assessment-reimagined.)

Of course, PZ is only one of many centres and organisations that have worked on these issues over the years, and we have collaborated with a number of them, including EL Education (formerly Expeditionary Learning), educators from the preschools in Reggio Emilia, Italy, the Educational Testing Service, state departments of education and numerous schools and school districts.

Taken as a whole, this collective work on assessment invites a reimagining of the 'who, what, when, where, how and why' of assessment. This reimagining involves four fundamental shifts.

Assessment Reimagined: Four Fundamental Shifts

FROM	TO
Assessment driven by what can be easily quantified	Assessment driven by the most important goals for student growth and learning, whether those goals can be quantified or not (**the 'why'**)
Assessment done to teachers and students	Teachers and students as protagonists in the assessment process (**the 'who'**)
Assessment of a final product at the end of a learning experience	Assessment of process as well as product, integral to the learning experience (**the 'what' and 'when'**)
Assessment as a one-on-one activity (teacher assesses student; principal assesses teacher)	Assessment as a collective and relationship-building process that happens in context (in classrooms, faculty meetings, etc.) (**the 'how' and 'where'**)

As illustrations of these shifts, consider two examples from public (UK state) school classrooms in the US, one primary and one secondary:

Example 1: Joan Soble, Secondary School English Literature Teacher

One semester, as Advanced Placement (AP) English teacher Joan Soble gets to know her 11th and 12th grade students (age 16-17), she is struck by the sorts of public figures they voice admiration for. 'We live in a culture that confuses 'celebrity' with 'greatness', Joan reflects. She wonders: Do her students understand this difference? Joan decides this is an important topic to focus on with them—especially given how their understanding of greatness might influence their future aspirations as they move beyond high school. Joan

formulates the central question with which she wants students to engage (What do we mean by 'greatness'?), chooses a reading and plans for the class to discuss it in both small and large groups.

In the large high school in which Joan teaches, AP courses are open to any student who elects to take them. As a result, Joan's students reflect a broad range of learners with diverse perspectives, which she expects to emerge as they discuss the complex topic of greatness. She hopes this will become a good opportunity for students to listen thoughtfully to differences of opinion and work through them to achieve consensus about the definition of greatness.

Class conversations pose challenges almost immediately. The students all hold different points of view—which Joan feels has the potential to generate meaningful learning conversations—but the students seem more interested in expounding on their own perspectives than on really listening to those of others. Could class consensus on 'greatness' be reached (as Joan and a number of the students hoped)? Was that even a desirable goal?

Concerned about the nature of the group's conversation, Joan decides to consult with her colleagues who meet regularly to share and discuss student work. She brings a videotape of the class discussion, along with excerpts from the students' written reflections to the group's next meeting and asks her colleagues to use a protocol (or structured conversation) to give her feedback.

Listening to her colleagues' feedback, Joan realises not only that consensus among her students might not be possible, but also that it might not be that important. As a result, she

shifts her focus in the classroom to helping students engage more deeply with one another's thinking. After making adjustments to her approach over the course of a few weeks, she again brings more documentation back to her teacher-colleagues for examination in the context of a protocol.

Her colleagues' reflections on the video clips of class discussion confirm Joan's initial impression—the students are still voicing arguments about their own views, but the tenor of the conversation has changed. They seem to be arguing more for the sake of understanding one another's thinking than for the sake of 'winning'.

To double-check her colleagues' interpretations, Joan brings a video clip of the teachers' conversation back to her classroom and shows it to the students, asking them whether, in their opinion, the teachers' interpretations of their learning are accurate.

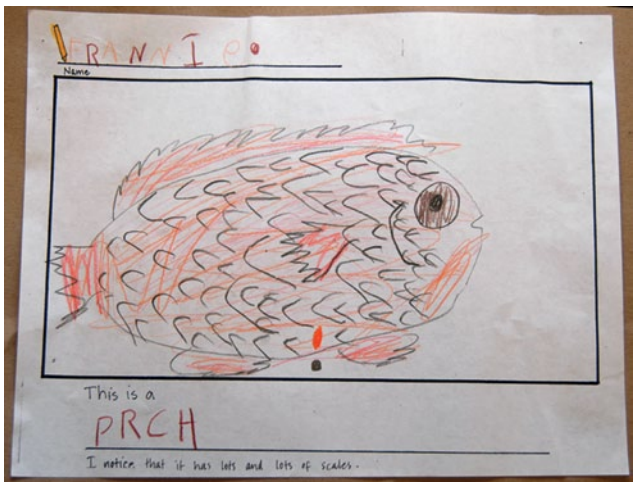
Students share their reflections on their learning as well as on the experience of watching the group of teachers interpret their learning.

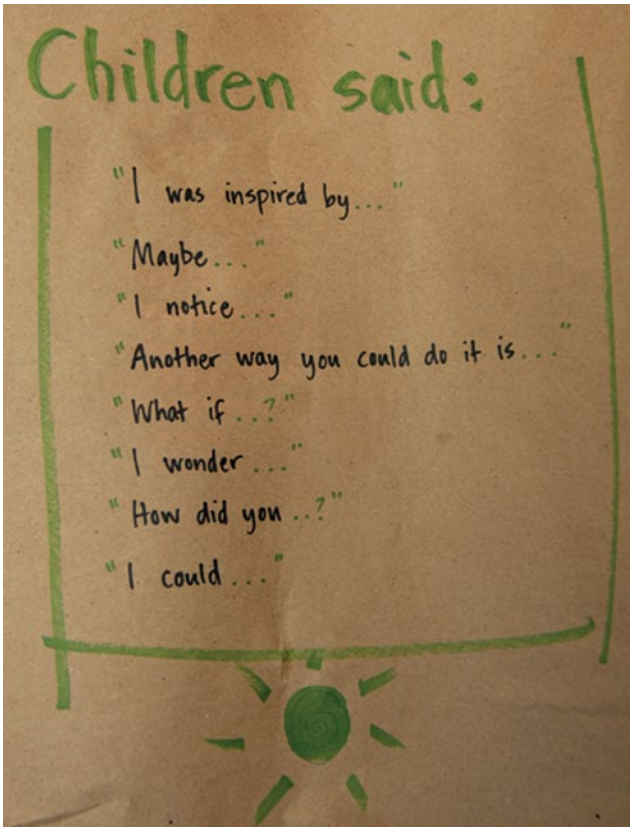
- Owen: For an AP class, this went so far. This class taught me how to think … It was so much more than test prep.
- Liam: … Like someone [a teacher] said on the video, we really did come to care about greatness.
- Violet: What also happens is that teachers want you to come to a common definition or a consensus about something, and since that's what the teacher wants, people's thinking gets lost.
- Thalia: I felt like I could have my opinion. I had to think about other people's opinions, but I could express my opinions and still keep them…

Joan also shares her final reflection with the class:

'… That's what I had to learn from you guys. I started the term thinking we could come to some consensus about greatness. The real goal was to have

everyone really know what they thought, and what everyone else thought and why—so everyone had to think about everyone else's thinking before being sure about their own. So even though we have no consensus, I feel very happy about where we ended up, because all of you really understood what each other thought and why.'





Example 2: Melissa Tonachel, Kindergarten Teacher

Kindergarten teacher Melissa Tonachel is leading her 5-year-old students in a study of ocean life. Her goals include helping students learn observation and observational drawing. As children in small groups draw sketches of an ocean perch donated by the local fishmonger, Melissa notices that only a few students actually look at the fish. Some children start to draw before even glancing at it.

Another important learning goal Melissa holds for her students is helping them become thoughtful collaborators who learn with and from one another. She suspects that, with practice, the children could become more effective than she in supporting one another to create more satisfying visual representations. So she decides to take the opportunity to help children build a habit of collaborative, positive critique instead of competitive comparison. She gathers the children together to look at the drawings and asks three questions:

- What do you notice in a drawing that reminds you exactly of how the fish looked?
- What details did someone include that are very important?
- Is there something in someone else's drawing that you wish you had included in your own?

The conversation is respectful and generative. As children begin work on their second fish drawing, they start to use a new vocabulary of observation when comparing ideas.

The next task of creating collages of ocean life proves challenging for some. Again, Melissa gathers the group to look at the collages, make observations and ask questions about how the artists worked. Afterwards, children who had previously considered their work finished return to their pictures to try new techniques.

Melissa displays samples of the children's work outside of her classroom, engaging the students in deciding what to post. She uses post-its to invite feedback from the community, in effect expanding who can learn from and contribute to the learning in the classroom.

Later, Melissa comments,

'We have explicit conversations about where ideas come from, how they change and how we get good ideas from each other. As Elisa [one of Melissa's students] says, "Sometimes somebody looks at what somebody else is doing,

and they like it so much that they want to do the same thing." In this way, children still feel connected to ideas they sprout, but they release ownership of them, allowing their ideas to grow, to be transformed, reconsidered and ultimately to become part of the group understanding.'

Melissa nurtures a classroom culture in which children and teachers talk openly and productively about student work. This process of constructive critique helps children to become genuine collaborators in learning, contributing both to their own thinking and learning and to their ability to engage productively with others.

Reimagining the Who, What, Where, When, How and Why of Assessment

How do Joan's and Melissa's classrooms reflect the fundamental shifts in conceptualising and carrying out assessment?

The Why Shift: Assessment driven by what can be easily quantified → Assessment driven by the most important goals for student learning, whether they can be quantified or not

Rather than relying solely on the AP curriculum to dictate goals, Joan's goals emerge from her observation of her students and her growing understanding of the ways in which they construe the world around them. While addressing the AP curriculum remains important, equally central is Joan's desire to help students connect their learning to the broader culture in which they live. She designs her assessment practices to target this goal. Similarly, Melissa wants children to understand the social nature of learning and to develop the skills needed to participate effectively as members of a learning community. She also values observation and observational drawing as important skills for living in and understanding the world. While Melissa wants students to develop basic numeracy and literacy skills that are central to most kindergarten curricula, she also wants to focus on other goals that are just as essential for living in a democratic society.

The Who Shift: Assessment done to teachers and students → Teachers and students as protagonists in the assessment process

In Joan's classroom, the students and Joan are both active in the assessment process, taking stock of individual learning as well as the class' progress through written reflections and reflective discussions. Joan's colleagues also play an important role: Joan and her colleagues belong to a learning community in which each has the opportunity to bring forward his or her work for reflection, analysis and feedback from the group. Her colleagues offer Joan a form of peer assessment, which, in concert with Joan's own self-assessment, generate new ideas for instructional strategies to deepen students' engagement with the course topic and one another. Insights gleaned from the conversation about Joan's students inform future conversations about other teachers' classes. In this way, teachers become protagonists in their own learning.

The What/When Shift: Assessment of a final product at the end of a learning experience → Assessment of process as well as product, integral to the learning experience

Assessment in Melissa's classroom becomes part of the learning experience. She assesses—and enables children to assess—their learning during the learning process itself. It is not necessary to wait until the end of the experience to know that learning is taking place.

Melissa notes that, while many people like the children's final drawings of the perch, she knows these products do not reflect all of the students' learning. In order to capture the evolution of the children's thinking and collaboration, she uses documentation[1] such as children's drafts and her notes about their verbal comments on their own and others' work to make visible the learning not typically captured on standardised tests.

Similarly, Joan uses students' written reflections as well as video of class discussions to capture students' thinking and provide the basis for collective reflection and learning. Such documentation moves assessment from a tool for stock-taking at the end of a learning experience (assessment *of* learning) to a method for tracing and shaping the knowledge-building process (assessment *of* and *for* learning). Such assessment has the potential not only to reveal progress toward a predetermined product or goal but also to shape the direction of learning.

The How/Where Shift: Assessment as a one-on-one activity (teacher assesses student; principal assesses teacher) → Assessment as a collective and relationship-building process that happens in context (in classrooms, faculty meetings, etc.)

Clearly, the shifts in the 'why, who, what and when' of assessment are interwoven with the shifts in the 'how' and 'where'. Collaborative assessment shifts the locus of authority from people outside the classroom to those actually engaged in the work—teachers and students. Assessment is not a decontextualised activity that is 'done to' children or teachers; rather, it becomes an opportunity to deepen relationships (with students, with colleagues) and to cultivate trust and respect, which in turn open up the possibility for deeper learning.

The children in Melissa's class are empowered to assess themselves and their peers, in the process becoming more receptive to different points of view. Joan not only brings the students' words to the adults, but also the adults' words to the students. In both learning communities, ideas of what a 'story of learning' can encompass are expanded for young people as well as adults.

Ultimately, these shifts in conceptualising and enacting assessment constitute a political act. The power and authority to define and evaluate learning become shared among teachers and students; the sources of evidence of learning

expand; and the assessment process becomes a more integral and powerful tool for enabling students and teachers to drive their own learning and to support one another in the learning process.

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Additional Reading

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Knowledge Trails

1. **Assessment as an act of love**
   http://library.teachingtimes.com/articles/assessment-as-an-act-of-love-ttc
   Our system is not geared up to measuring creativity, thinking, confidence and imagination. It simply is not possible to use existing assessment tools to chart children's progress in achievements which are seemingly intangible but which are more important.
2. **Putting pupils at the heart of assessment**
   http://library.teachingtimes.com/articles/assessment-pupils-at-the-heart
   Assessment has to be more than simply pointing out who can do what and who can't – it has to help pupils progress. Here, the UK's leading formative assessment expert, Shirley Clarke, looks at the top ways schools are making assessment count for every child.
3. **Assessing creativity?**
   http://library.teachingtimes.com/articles/assessing-creativity
   Assessing creativity may seem a contradiction in terms but Becky Lawrence reports that an assessment tool designed by a team at the Centre for Literacy in Primary Education appears to encourage creativity in the classroom.

Five Lessons Learned About Creativity

In the popular imagination, creativity appears as a flash or sudden insight and people are often seen as being creative or not. **Edward Clapp** shows us that actually, creativity is a socially distributed process and that it is not an individual gift that some people have and other people do not.

What Do We Know About Creativity?

Project Zero was originally established by the philosopher Nelson Goodman to study the cognitive benefits of the arts,[1] and over the past five decades, its research has expanded to include a breadth of research topics ranging from thinking and understanding to the intelligences and from civic and moral education to digital life and learning and—much, much more. Despite the diversity of the centre's research interests, the concept of creativity has been a mainstay of the work of Project Zero.

Interestingly, while the work of Project Zero is deeply associated with creativity, very few Project Zero studies have homed in on creativity as a focal point of research. Nonetheless, there have been a handful of Project Zero researchers who have undertaken the task of studying creativity, and many Project Zero studies that have explored the concept of creativity in a peripheral—but still important—way.

Given that so many different researchers have either directly or indirectly contributed to this work over the years, it is understandable that Project Zero does not have one consistent and agreed upon definition for the concept of creativity. Instead, a few guiding principles shape how most Project Zero researchers have come to understand this elusive concept. The first of these guiding principles is that creativity is not a flash of insight, but is rather a process that develops over time. The second of these guiding principles is that creativity is not an individual gift that some people have and other people do not. Instead, creativity is a socially distributed experience that allows different people to play different roles throughout the creative process. A third guiding principle is that creativity is not restricted to the arts, but instead an experience that can take shape in any domain of practice.

Explicitly Investigating the Concept of Creativity at Project Zero

As noted above, very few Project Zero research studies have identified the concept of creativity as a centre of gravity for their work. That being said, several researchers at Project Zero have individually investigated this concept. Amongst those individuals are Howard Gardner, David Perkins and Edward Clapp.

Howard Gardner and *Creating Minds*

One of the most well known creativity researchers to come from Project Zero is Howard Gardner. In his 1993 book *Creating Minds: An Anatomy of Creativity Seen Through the Lives of Freud, Einstein, Picasso, Stravinsky, Eliot, Graham, and Gandhi*, Gardner offered seven in-depth case studies of eminent figures from the Modern era—each of whom was associated with one of the seven intelligences that Gardner had famously described in his 1983 book *Frames of Mind: The Theory of Multiple Intelligences*.[2] Gardner argued that creativity shadows the intelligences and made the case that the individuals described in *Creating Minds* were not generally creative, but that their creativity was particular to a specific field of study, something Gardner described as a domain.

In other words, just as Gardner had previously argued against there being a general form of intelligence, in *Creating Minds* Gardner further argued that creativity wasn't domain-general, but rather domain-specific. To support his domain-specific stance on creativity, Gardner points towards what others have called the

ten-year rule for creative success.[3] The ten-year rule suggests that it takes ten years of practice within a domain in order for an individual to develop the mastery necessary to make a creative contribution to that domain. Though focused on the work of individuals, Gardner took a systems-based approach to describing creative achievement,[4] recognising that individuals operate within broader domains of practice that are overseen by others who determine what new ideas will—or will not—be added to those domains. In this way, Gardner argued, creativity is socially distributed.

David Perkins and the *Eureka Effect*

Much of David Perkins' research at Project Zero has supported the concept of creativity, however, his interest in creativity is most explicitly explored in his 2000 book *The Eureka Effect: The Art and Logic of Breakthrough Thinking*.[5] As an earlier contributor to the work on distributed cognition, like Gardner, Perkins also believed creativity to be a socially distributed process.[6] Also like Gardner, Perkins had an interest in the breakthrough moments that lead to creative achievements. In *The Eureka Effect,* Perkins described the pursuit of such breakthrough moments in terms of following a path riddled with clues. In this way, one clue leads to the next, with a creative breakthrough—or *eureka!* moment—at the end of the path.

From Perkins' perspective, some creative paths are more linear and straightforward, while others are winding, circuitous and full of unexpected twists and turns. Interestingly, while Gardner's work on creativity was inherently tied to his work on the intelligences, Perkins argued that sometimes intelligence isn't even necessary for creativity to take place. As an example, Perkins referred to evolution and natural selection—wherein nature innovates quite successfully, seemingly without any brand of intelligence or cognition driving the process of change.

Edward Clapp and *Participatory Creativity*

A third Project Zero researcher who has explicitly considered creativity through his work is Edward Clapp. Like Gardner and Perkins, Clapp also considers creativity to be a socially distributed process. In his 2017 book *Participatory Creativity: Introducing Access and Equity to the Creative Classroom*, Clapp described creativity as a socially distributed process that takes place over time and involves the contributions of many different individuals.[7] Perhaps taking the

word 'social' to a bit of an extreme, Clapp argued that no one person nor even a group can be creative, instead, ideas are creative.

By reframing creativity in this way, Clapp suggested that all people can participate in the development of creative ideas in ways that best suit their talents, expertise, background experiences and cultural perspectives. Clapp further suggested that there is no one way to be creative, but rather multiple ways to participate in creativity. In doing so, it was his intent to make participation in creativity more accessible to a broader swath of young people and adults, including those who may not have seen themselves as 'creative people' under more traditional definitions of the term.

To make his case, in *Participatory Creativity* Clapp suggested that instead of looking at the biographies of supposedly creative people (as Gardner had so carefully done in *Creating Minds*) we should instead look at the biographies of the ideas those people are most known for—if we are to understand the essence and complexity of creativity. Should we do that, we will see that many people participate in the development of creative ideas over time—and that they do so in not one, but in many ways. Clapp referred to this new approach to understanding the development of creative ideas over time as the *biography of an idea*.

Five Lessons Learned about Creativity in Education

Beyond Gardner, Perkins and Clapp, several research initiatives at Project Zero have explored the concept of creativity in either implicit or explicit ways. From Project Zero's half-century of educational research, there are many lessons to be learned about creativity in education. Below is a short list of five lessons learned and their implications for the educational sphere.

Creativity is a Process that Takes Place Over Time

Many Project Zero researchers and research projects have taken the stance that creativity is a process that takes place over time—not in an instant flash of inspiration. Though there are countless memes that suggest creativity is like a flash of lightning in the night or light bulb flipping on all of a sudden, what Project Zero researchers, and many others have come to understand is that creativity requires ongoing work.[8]

Any sort of insight—or breakthrough eureka moment—is the product of following clues, developing expertise, working with others and responding to one's environment. This is a process that takes place over time. This approach to understanding creativity not only resonates with Gardner, Perkins and Clapp's work, but also with other researchers at Project Zero. For example, in its model for supporting inquiry-based innovation, the Creating Communities of Innovation research team has suggested that innovation is sustained and iterative, meaning that creativity emerges through the process of exploring different approaches to practice, learning from what works and what does not work, and then trying again.[9]

Educators interested in supporting creativity in the classroom should structure creative learning experiences in ways that support the development of creativity over time, rather than seek out isolated moments of insight from young people. To do so, educators may consider what knowledge, skills or expertise their students need to develop as part of their creative discovery process, what clues young people should look out for—and what they may learn from those clues, and how they may prototype and experiment with ideas in a manner that is iterative.

Creativity is Socially Distributed

Though they come at the concept from different perspectives, Gardner, Perkins, Clapp—and many other Project Zero researchers—all agree that creativity is not an act of individual ideation, but rather a socially distributed process. What is important to note here is that taking a socially distributed stance on creativity means more than advocating for collaboration and group work. Indeed,

collaboration and group work may be a part of the socially distributed creative process, but more than everyone-doing-everything-together, a socially distributed stance on creativity acknowledges the importance of roles.

In other words, people play different roles when they participate in creativity—and there is likely a role for everyone to play in the creative process. Here, diversity of experience, expertise and cultural perspective are key to creative success.

Considering the various roles that young people and adults may play throughout the creative process is one of the most important things for educators to remember. By finding a way for all students to participate in creative learning experiences, educators can provide all of their students with the feeling of creative achievement—while at the same time over-stepping the pitfall of the 'I'm just not a creative person' sentiment that some students may bring with them to the classroom. Indeed, that is the point: no one is a creative person! Instead, there are infinite ways for all students to participate in creativity.

Creativity is Dispositional

While creativity is socially distributed, many Project Zero researchers will also argue that creativity is dispositional. What they mean here is that creativity is not a mere skill that some people have and some people do not, but rather creativity is a way of seeing and being in the world. Project Zero researchers have been forerunners in the work on dispositional thinking. Several Project Zero research projects such as Visible Thinking,[10] Artful Thinking[11] and Studio Thinking[12] have established the theory behind dispositional thinking, as well as created actionable frameworks for educators to use.

From a Project Zero perspective, dispositions consist of three components: *capacities*, or the skills and abilities associated with certain types of thinking; *inclinations*, or the motivation to engage in certain types of thinking, and; *sensitivities*, or the alertness to when it would be appropriate to engage in or otherwise employ a certain type of thinking.

As previously stated, there is no one way to be creative, but rather multiple ways to participate in creativity. That being the case, there is no-one-size-fits-all creativity disposition, but rather many ways that young people and adults may be disposed to participate in the development of creative ideas.

Whereas many educational frameworks default to the development of skills—including the skills that are narrowly associated with creativity—it is helpful to consider how to support young people in developing creative dispositions. This includes developing a wide breadth of skills that may be unique to each individual learner, paired with the inclination to participate in creative learning experiences, and the sensitivity to know and understand when and how to enact a particular way of thinking in pursuit of creative outcomes.

Creativity Develops through Individual and Group Learning

Positioning creativity as a socially distributed process does not equate to overlooking the contributions of individuals to favour broader social groups. Quite the contrary, many Project Zero researchers have advocated for the interaction between individuals and groups—suggesting that creativity develops through both individual and group learning.

This is an early finding of the Making Learning Visible project,[13] which looked closely at the practice of teaching and learning at the municipal pre-schools in Reggio Emilia, Italy. Through their work, these researchers learned that 'much, if not most, of the learning that goes on in and out of schools happens through the interaction of groups' (p. 284). What this study surfaced was that the individuals who participate in groups strongly contribute to the learning that happens there.

More recently, the Agency *by* Design research initiative[14] has made a similar assertion, suggesting that creativity takes place through individual and collective agency. Here, the Agency *by* Design researchers have argued that sharing

knowledge and expertise, learning from others, and building on the ideas that others have developed is a means for individuals to forward their work, and for groups to develop new ideas and innovations.

As an educator interested in supporting creativity in one's classroom, it is helpful to remember the interaction between individuals and groups. Indeed, young people and adults working together is important, but there is much that individuals can do on their own to further along more socially distributed creative endeavours.

In this regard, one should be careful not to lose the individuals within the group. Instead, one should seek opportunities to *leverage* individual students' knowledge, expertise, background experiences and cultural perspectives to best serve more socially distributed initiatives.

Creativity is Supported by Tinkering and Play

Creativity is by all means serious work. But it is serious work grounded in tinkering and play. Project Zero researchers are skilled at many things, but at their core, many Project Zero researchers are tinkerers who are well adept at play. Suffice it to say, there have been many Project Zero research studies that have supported creativity through tinkering and play. Foremost amongst these projects is the Pedagogy of Play initiative. What the Pedagogy of Play—or PoP—team has aimed to do is to understand how learning—and creativity—can be nurtured by play. The PoP team's popular playbook identifies three factors that contribute to playful learning: wonder, choice and delight.[15]

Relatedly, the Agency *by* Design research team foregrounds tinkering as a key element in the creative process. Loosely defined as messing about with materials to see what they want to become, tinkering is elemental to the work of many communities of makers—and creators—who see piles of stuff as fodder for creative opportunity.

However seriously one takes the work of creativity in his or her classroom, one should always remember that tinkering and play are often elemental aspects of the creative process. This is not to say that the work of creativity should always be goofy and silly (though it often can be), but rather to say that the serious work of play—of experimenting with materials and ideas in the pursuit of wonder,

choice, and delight—are no less important than establishing an objective, stating a hypothesis, developing a theory of action or proposing a business plan.

Conclusion

For the past fifty years, researchers at Project Zero have both implicitly and explicitly explored the concept of creativity and its role in education in myriad ways. As a result, there is no one definition of creativity that Project Zero institutionally agrees upon, but rather several guiding principles that shape the organisation's stance on creativity: creativity is a process that unfolds over time, creativity is socially distributed, and creativity is not the sole province of the arts, but rather an experience enacted in all domains of practice. Given Project Zero's long history of creativity research, there are many lessons to be learned from the research centre's work—and many more insights to come.

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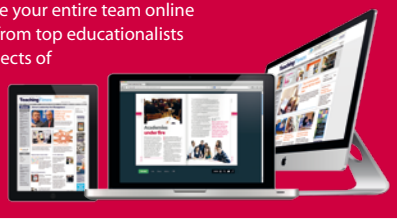

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