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Acera summer students launch their hand-built rafts as they learn about science, technology, engineering, and math.

EDUCATION

Learning While Doing at Acera

A Small, Startup School as a Microcosm of What's Possible

By **Stefanie Friedhoff**, Director of Programs & Outreach, The Acera School

Photos courtesy of The Acera School

When designer Julie Legault first visited The Acera School in Winchester, Massachusetts last year, she watched a group of 8 and 9 year olds pick up hammers and saws in a big, sunny maker space and get to work on a picnic table they were building for the school's playground.

In a nearby classroom, she found students as young as 6 and as old as 13 sitting in a circle, discussing their computer club projects for the day. Parnis wanted to continue programming her drawing application, which allows users to select a brush size, color, and texture. Shaun wanted to design an integrated circuit with eight lights embedded under a piece of paper, which could be turned on and off by simply touching the paper. Maya wanted to work on the cat face she was designing using 3D modeling software.

In the school's professionally equipped science lab, Acera's science teacher Michael Hirsch was working with students as young as 7 on extracting primary colors from markers using paper chromatography, and then isolating the pigments.

Legault recently started a new venture and was visiting the K-8 startup school north of Boston to lay the groundwork for a collaboration that would test her first product. While at MIT's Media Lab, she developed *Amino*, an affordable, beautifully-designed mini-lab for synthetic biology experiments that's easy to use, and helps non-scientists of any age learn how to grow and manipulate DNA in bacteria — by actually doing it.

What Legault needed next was a partner school steeped in experiential learning that would help her test and refine her prototype. A school that had molecular biology expertise as well as institutional freedom to join her in exploring and designing a student-driven, interdisciplinary curriculum for this groundbreaking, yet somewhat controversial,

technology. In short, Legault was looking for a school that was as innovative and experiential as her latest invention.

She came to the right place.

Yesterday's Schools

Eight years ago, in the midst of a successful career as a corporate consultant, the very last thing Courtney Dickinson wanted to do was start a school.

Yet here she was, finding herself in an unexpected struggle. By the first grade, her son was already getting into trouble, racing through worksheets, and being all together misunderstood at school.

Dickinson knew her son wasn't learning. Before even starting school he could read chapter books and was ready for third grade math. He was excited to check out books in

performance in a standardized system," says Dickinson. "But what we need today are problem-solvers, innovators, critical and creative thinkers, risk-takers. We need students who are digital natives and confident as they explore STEM (science, technology, engineering, and math) themes. It is widely acknowledged that the current system no longer serves the needs of society. It never served children, and how we learn. Nor teachers, who know what works and what doesn't in the classroom."

Dickinson, a fast thinker and exuberant talker, is easily one of the most passionate people you will meet in education. In 2009 she realized that the very traits she thought were important to building 21st century skills in her son — his desire to learn fast but on his own terms, his questioning of everything, his ability to dig deep into problems he was interested

When humans are emotionally connected to a learning experience, we work harder and remember better.

the school library but a strange rule limited kindergarteners to only borrow picture books. She thought surely there must be ways the school system could meet his needs and prevent him from losing his curiosity.

Although trained as a teacher, Dickinson hadn't really looked at schools for almost two decades. Now she was revisiting education from the perspective of both a parent and a management consultant. While the world had changed rapidly, schools hadn't changed much.

"Many schools are stuck in the industrial era of teaching compliance, test-taking, and

in — were the things that broke the rules and created problems at his current school.

Unlike most states, Massachusetts does not support programs for accelerated learners in public elementary schools. Elementary teachers in the state are supposed to provide differentiated instruction, yet many lack the training to engage quirky students who learn some things at different speeds, which often leads to clashes in the classroom.

In revisiting what happens in public schools, Dickinson realized that learners like her son were just one type of kid outside the

Theory of Multiple Intelligences

Howard Gardner



‘norm’ that a system relying on standardized teaching and testing fails to serve. “A school system that assumes there is an average and teaches to it, fundamentally misunderstands that each child has a unique profile and learning style, and that we need to get to know it to determine what each child is ready to learn.”

Starting with Howard Gardner’s groundbreaking Theory of Multiple Intelligences, first published in 1983, decades of research have shed light on the many different learning styles that drive people’s ability to take in and retain information, and to become independent problem-solvers.

For example, some students need to move their bodies in order to effectively listen and engage. Others are so visual-spatial that attempts to lecturing them verbally for long periods of time are doomed to breed creative disruptions. Some children need to work on a problem with their hands in order to integrate what they are learning in their minds. Still others need to follow their own line of questioning — not the one an adult had in mind — to be able to understand a concept.

“We expect schools to be successful in teaching kids how to approach complex challenges, how to ask the right questions and find several possible answers, how to work on a team and learn from failure — but

we do not provide them with the tools and freedom they need to do that, and to serve each student within her or his own set of gifts and challenges,” says Dickinson.

Dickinson decided she had to do something — she had to re-design school.

Getting Started

A charismatic and idealistic leader, Dickinson’s vision was a school where students could learn by ability, not age; where all learning would be project-based and student-driven; and where teachers could be facilitators of inquiry-based learning, not distributors of disconnected knowledge.

She knew that besides an educational vision, she needed a business plan, classroom space, operational tools, and perhaps most importantly, entrepreneurial teachers who were ready to help her reset the education system.

“Ours was the typical startup story: You invent the flag and share what the hill looks like, and then you get some volunteers on board and start marching up that hill,” Dickinson says. She gathered friends of diverse backgrounds to help make her vision a reality — including people who remembered their own hardships at school.

Dickinson also began inviting parents to information sessions at libraries in Winchester,

Arlington, Melrose, and Lexington — 30 people came to the first, over 40 to the second. By the third session, there was no longer any doubt that there was a need as well as demand for a solution.

How Do You Re-design School?

Helpful friends and interested parents met in Dickinson’s living room every Friday morning to help create a new kind of educational program.

Many approaches were discussed. Should the project start small as an after-school program? Should it be nonprofit? For profit? Would it work as a charter school? Was there a way visiting scientists could teach their subject matter to bring in real-world knowledge and practice? Maybe parents could act as coaches and facilitators to help keep costs down. The group envisioned classrooms with sofas and swings so kinetic learners could move around to adapt with emerging projects, similar to maker spaces and design studios. Allowing furniture to be moved easily was key.

Thanks to new legislation in the state of Massachusetts that approved new K-4 innovation schools within existing school districts, Dickinson began working with the town of Wakefield, MA to generate the program. Led by the city’s superintendent, an Innovation Plan Team began work on shaping the model to fit their community. But when the city’s tax revenues decreased, existing school programs were cut and a new K-4 program was impossible.

After several other public school collaboration attempts stalled, Dickinson and her team of passionate volunteers knew they had to push forward on an independent school program. “To become a change agent and catalyst, we had to create a microcosm of what is possible in education,” remembers Dickinson. “We had to build a school from scratch.”

It wasn’t the outcome Dickinson hoped for — raised with a strong sense of social justice, she felt people of all economic backgrounds should have access to this new model of learning. Starting an independent school would mean charging tuition — but it would also provide tremendous freedom to innovate.

Prototyping Acera

Consider this: before a single teacher was hired, or even a location for the school was secured, there were 65 applications for kids to attend the Acera School.

Giselle Ellis, a mechanical engineer by training, network specialist, and mother of two, saw an ad for a teaching position and said to her husband, “Whoever is building that new school knows our daughter. We need to join.”

The Ellises had been looking for an educational fit for their daughter Lila for a while. In pre-school, Lila taught herself reading, enjoyed math, and frequently tested her reasoning skills. “It was pretty clear she was bright, and when bored, she’d also tend to be disruptive,” said Andy Ellis, Chief Security Officer at Akamai, a cloud services provider in Cambridge, MA. “We could see the likely adverse consequences of putting her into a ‘one size fits all’ model of a school.”

Eric Alm, faculty at MIT’s biological engineering lab, wanted to send his 6-year-old son Kai for a different reason. “It is no longer important to have superficial knowledge on all types of topics. Technology has solved that. Prepackaged information is easy to come by,” he explains. “What students do need to know is how to explore subjects on their own and in teams, and how to ask good questions. When my grad students first come to work with me, they often have technical knowledge and are very smart, but don’t necessarily know how to formulate a question with enough clarity that it can be answered with a simple experiment.”

In his own graduate teaching at MIT, Alm had dialed back the amount of facts and knowledge covered in a course, and spent more time letting students experiment and discover fundamental principles on their own. He wanted a school that would allow his son to do the same from an early age.

“This is how we learn as scientists, and in the world outside of schools,” Alm continued. “If you can teach students this before they have amassed an enormous amount of knowledge, it’s actually easier.”

Of the early days developing Acera, Dickinson remembers, “There were many heart-wrenching stories about kids struggling in school and desperately needing a different environment. Parents pleaded for us to include 2nd graders, and 5th and 6th graders. Before we even started we had to adjust our initial plan and find a way to open with three classrooms instead of one.”

On a hot, late August day in 2010, Courtney Dickinson — a woman who never planned to start a school — cut a ribbon, gave a speech, and welcomed 37 children into a former Melrose, MA public school building that parents had scrubbed and painted themselves in preparation for the first day.

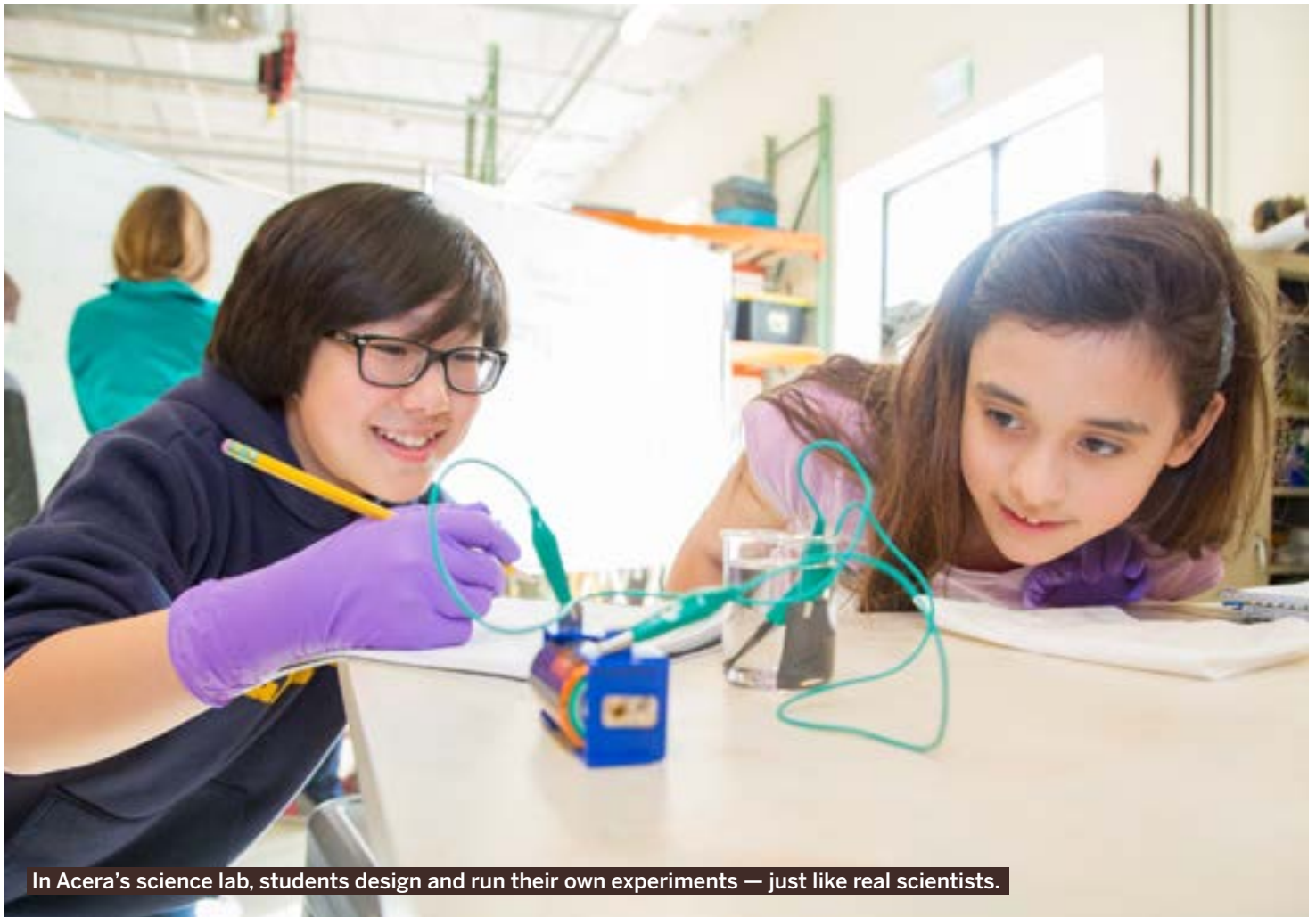
Among the students familiarizing themselves with each other and their new learning environment were Dickinson’s own — her ponytailed 5-year-old daughter Annabelle, and her 8-year-old son Benjamin. “It was tough being a parent and being in charge,” she admits. “But people didn’t think it could be done, so I had to keep doing it.”

The school these founding families were walking into was a prototype of a new model for learning, an attempt to strip away the barriers to student learning present in traditional schools and empower teachers to innovate. Here’s what it looked like:

- No teaching to standardized tests. A nationally-recognized, standardized assessment was used to evaluate students at the start of the school year, determining capabilities in reading, math, and writing; so the school could determine the right



Acera Founder & Director Courtney Dickinson outside the school in Winchester, MA.



In Acera's science lab, students design and run their own experiments — just like real scientists.

Two Models of Education

Traditional Age-based Standards

- Learning means coverage of state specified content, defined by age based standards
- Focus on foundational knowledge
- Teach to the middle, average, or “norm”
- Teacher as lecturer and sole source of information
- Convergent thinking, memorization of facts, predefined methods & approaches
- Advanced concepts and acceleration opportunities only introduced in middle and high school

Acera Individualized Discovery

- Learning is inquiry based, built around student passions and capacity
- Focus on complex thinking
- Individualize learning to cultivate curiosity
- Teacher as facilitator with access to world class scientists and mentors
- Divergent thinking, real, creative problem solving links to real world challenges
- Engage students in multi-disciplinary learning and innovation in elementary school to shift the learning trajectory

learning level for each unique student and measure progress over time, moving away from grade-based levels and expectations.

- Individual learning plans for each student. Flexible approaches served each student's needs throughout the school year — built and planned with input from pre-assessments, teachers, parents, and the students themselves. Teachers supported students in ways aligning with their skill level and learning style.
- Teachers were encouraged to be entrepreneurs in their classrooms — to try out new things and share their experiences.
- Teachers facilitated as many hands-on, contextual learning experiences as possible. They encouraged children to take risks, and to learn from failure. Creativity was woven into everything.
- There was no set curriculum — instead there were classroom themes. Teachers could use the Museum of Science (Boston) curriculum as a starting point and develop their own path from there. Students could pick passion projects within the theme. Classrooms focused on student-driven explorations of student-generated questions.
- Elementary students designed and ran real science experiments, and explored emerging fields of science like nanotechnology and bioengineering.
- Engineering design — an iterative process —

was woven into everything, from woodshop projects to art and writing.

- Math was the only subject taught in a set block of time — 60 minutes, four days a week. Students were placed in math groups based on ability, not age or grade level.
- Social emotional learning was an essential part of the environment. All interactions were opportunities to empathize and learn about — and with — each other.
- Parents were included in classroom instruction as much as possible.
- Students were supported if they decided to participate in competitions like spelling and geography bees.
- Tuition was set at \$10,000, about a third of what other independent schools in the region cost — a price point meant to entice parents into take the risk of joining a brand new school.

Learning and Iterating

“The first year felt as if this could have fallen apart at any time,” says Dickinson. “It was intense.”

“Oh, it was quite a chaotic start!” remembers parent Eric Alm. “A lot of parents were unsure because nobody knew exactly what this was going to be.”

“Some parents wanted vertical acceleration. We wanted to challenge students,

but not with loads of homework,” remembers Dickinson. “Also, our hiring model wasn't right. We had to learn and refine that process right away.”

Five students and one teacher left the school within the first two months. So did the office manager. The building which volunteers had prepared so carefully was leased out to a higher bidder the next year because of the upgrades parents had made. Things had just gotten started and there were already new discussions about the direction of the school.

The original concept included hiring creative, entrepreneurial people with deep subject knowledge to lead classroom instruction in close collaboration with teaching mentors who helped with classroom management.

But over time the importance of having core teachers with significant experience became clear. Engaging all these unique learners in ways that would work for each of them, required a deep understanding of multiple learning styles and how to accommodate them.

For the same reason, parents could not be primarily deployed in the classroom — but they continue to support the school in other important ways as tech team volunteers, curriculum collaborators, subject matter experts, and facilities support.

“Pretty much from day one we've been iterating on our original concept,” says



Dickinson. “The design thinking approach is built into this school as we are constantly designing new solutions, testing them, and then improve or re-design. We’re building the engine while flying the plane.”

An example of where the Acera team is iterating is student portfolios, samples of student work that are an important part of reflection and can showcase learning in the absence of grades and test scores. “We have tried many things, from big folders to Google Drive, and are now testing a student blog platform. We are getting better but are far from where we’d like to be. It’s hard given both the diversity and the depth of learning that happens here,” adds Dickinson.

Student-Driven Education Works

In its second year the school moved to a new location, a church annex in Melrose, MA. Christine Horan, an experienced project-based teacher and mentor, had joined the team and helped bring the school’s vision to life with high-engagement, student-driven classrooms.

“Before I found out about this new school, I felt my role as a teacher had gotten dull. I wanted to do interdisciplinary, connected teaching but had to teach science as a separate thing from humanities,” says Horan. “This new model was seeking to teach kids the way they learn best. I loved that there was no curriculum, that we could create learning

experiences together with students.”

In her class, students made catamarans out of soda bottles, then put motors on them. Together with Eric Alm, students ran an experiment that allowed them to smell cheese in a petri dish, even though there was no cheese, just bacteria. They collected water from a nearby river and analyzed its components. And they observed the heartbeat of a Zebrafish through a digital microscope.

“The baseline was, and still is, to make each day so engaging that they want to be a part of it,” says Dickinson. “Kids can be so smart when it comes to boycotting instruction they feel is forced or not authentic. We wanted to preempt that dynamic and let them be stewards of their own learning instead.”

Research shows when humans are emotionally connected to a learning experience, we work harder, remember better, and are more motivated to be on our best behavior. Engagement is, in many ways, the bridge to deep learning. At the same time, there are many misconceptions about so-called student-driven or passion-driven learning.

“People often think it’s a free for all, and that kids can do what they want and never learn things they are not interested in,” says Horan. “When in fact, there is a lot of structure, it’s just not the same for every student. By allowing students to understand who they are



In the StudioLab, students learn how to solder and program a complex circuit that will light up their painted mural.





Students enjoy focused reading time in the school's "cozy cubes."

as a learner, and what they need to succeed, we strengthen their executive functioning skills, which in turn increasingly enables them to tackle uncomfortable territory.”

This requires teachers to have an open mind, a willingness to learn, great flexibility, and a lot of creativity. In return the school must give teachers trust, support, and freedom to experiment.

Horan added, “Once, I’d planned a whole unit on biology and anatomy but it just didn’t resonate with my students. So I scrapped it, and reinvented it as a forensic science unit. That year the students didn’t want to break for summer.”

The Google of Schools

For Dickinson, creating and maintaining the scaffolding that supports students, teachers, and learning at Acera has been the hardest part of the job. Not knowing where the school would ultimately land, she applied for school board permissions in three cities. She had to learn code restrictions in order to ensure compliance for a professionally-equipped science lab. For months, she spent her weekends driving through neighborhoods looking for suitable empty buildings. She found one in Winchester, MA and raised \$400,000 for a down payment.

“It would be so much easier if we didn’t let students work with acids as they learn about them. If we didn’t let students use real tools in the woodshop. If we didn’t let them climb trees in our nature playground,” Dickinson says. “Developing safe ways to do truly experiential learning is not easy. Communicating what we do to parents can be a challenge. But it can be done!”

With the move to its permanent home in Winchester in Fall 2013, Acera gained some stability with a building that fit the vision. The school includes a maker space, woodshop, science lab, and art zone. Acera now serves 128 students in eight multi-grade classrooms. It’s a building full of light, with places to cuddle, read, move, and tinker. It looks more like a design studio than a school. Or, as Acera’s technology and STEM specialist, Suzana Somers, says, “This is the Google of schools.”

Growing the school has allowed Dickinson to hire a unique set of teachers, among them a civil engineer, computer scientist, biotech scientist, a gifted artist, and a designer. They collaborate with core teachers, developing projects related to the class theme and student interests.

In one middle school classroom, for example, students read Michael Pollan’s *Omnivores Dilemma* as an anchor text, exploring nutrition, agriculture, meat production, food insecurity, narrative non-

fiction writing, and more. Simultaneously, with the computer science specialist, they tracked their caloric intake over a weekend, learned how to log the data as well as how to sort and interpret it, which also led to a discussion about body image with their health & wellness teacher. For art integration, students made bento boxes – the Japanese art of turning food into sculptures. Facilitated by the school’s civil engineer, they designed their own projects related to food and agriculture – and they executed them, building a cold frame to grow plants, a compost system for the school, and even a hydroponic system.

Children are Natural Innovators

After Acera students had a chance to test the first prototypes of Julie Legault’s mini-biolab, she returned to the school. The students provided important user feedback including ideas for new experiments they’d like to run on the *Amino* – experiments they could envision and design themselves.

In an effort to be a true lab school, willing to test what works and what doesn’t in education, Acera has hatched many such collaborations. The Boston University Social Development and Learning Lab, for example, has run studies at the school, and is developing a ‘prisoner’s dilemma’ experiment together with Acera students. The Harvard University Graduate School of Education recently sent a group of teachers studying innovation to observe the school’s model.

John Maloney thinks, “Acera is the kind of school Seymour Papert envisioned,” referring to the visionary MIT educator and “father” of the maker movement. Maloney is the lead-developer of the popular kids coding program *Scratch*. He continues, “Students here are always excited about learning. They are open, engaged, and ask great questions.”

Maloney recently tested a new coding program at Acera, a follow up to *Scratch*. “One time, a 6th grade student in my session got up from his computer and laid down on the floor,” he recalls. “He had been playing with symmetry in the program. His expression was one of deep focus and intensity. Several students and a teacher casually checked in with him, and he said he was okay. Ten minutes later, he got up and explained to me what he had been thinking about. He had basically invented polar coordinates. That’s college math! I found it remarkable how the school knew this child, and how to accommodate his needs.”

Perhaps it’s how innovators like Julie Legault and John Maloney see Acera that reflects its important learning model. They see Acera as

more than a school, they see it as a place where concepts are explored and ideas are born.

Beyond that it’s the words of the children and parents involved with Courtney Dickinson’s vision that punctuate Acera’s impact:

“My child asks questions fearlessly. I attribute that directly to his experience at Acera.”

— Parent of Toby, 11

“Students learn to create safely and they truly understand the often missed connection between what works on paper and what works in real life. These skills empower and thrill them as children and will allow them to thrive in adulthood.”

— Parent of Maya, 11, and Owen, 13

“I learned more in one day at Acera than in an entire year at my last school. I couldn’t learn at my old school. I was too busy being good.”

— PJ, age 13

“The only thing wrong with Acera is that there is no school on weekends.”

— Albert, age 12 •

Stefanie Friedhoff is director of programs and outreach at the Acera school. She is also a freelance writer.



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