

# Putting the STEAM in the River: Potential Transformative Roles of Science, Technology, Engineering, Arts, and Mathematics in School District Culture, Organization, Systems, and Learning Environments



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## 1 Introduction

The Rio School District's STEM-to-STEAM story was an effort to change a vision of learning and teaching. In 2012, Rio began building a culture of inquiry among key stakeholders, including teachers and students, to transform the District-wide vision, and teaching and learning, toward a twenty-first-century inquiry model. These efforts inevitably came to include the movement, in 2013, from STEM to STEAM (and beyond-STEAM) as an integral part of that model.

We present a case study, based on research from an ethnographic perspective (e.g., Castanheira et al. 2001), of a 5-year journey within Rio School District. In presenting this study, we make visible the importance of a leader with a clear vision and an investment in a distributed leadership model. The District's new vision included twenty-first-century practices and inquiry at its core and led to early decisions to focus on STEAM and other integrated disciplines, using a transdisciplinary approach rather than the more commonly used STEM approach.

Rio School District is a small- to mid-size public-school district on the West Coast of California. The District borders the state's Santa Clara River. Its population includes 90% Latinx students and 80% low-income students. Many of the District's students are English Language Learners. Rio (which means river in Spanish) currently has eight schools (six K-5 schools, two middle schools, and one K-8 Dual Immersion Academy). A new K-8 STEAM Academy will be the ninth school.

Dr. John Puglisi, one of the authors of this chapter, became the superintendent of Rio District beginning with the 2012–2013 school year. In the following excerpt

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from an interview with him, he provides an overview, context, and rationale for the journey we present, which began as he began his tenure as superintendent:

Some five years ago... I took an initial assessment of the existing learning environments, teaching and learning practices, infrastructure and other aspects of the school district as part of my leadership plan. What I saw was not uncommon in many districts I had worked in or observed over the last thirty plus years. In fact, it was not unlike many school districts across America and especially in California. The Rio School District's vision of teaching and learning in 2012 was an amalgamation of a variety of pedagogical approaches. This amalgamation was loosely tied to a theory of standardization aimed at increasing the number of students achieving basic academic skills as they related to the California standards and as measured by the California Standards Tests (CSTs) which were multiple-choice assessments. There were many practices and activities that were attempting standardized and rote learning schemes and few opportunities for students to talk, make, create, and deeply think and problem solve. For this reason, I engaged staff and community in exploring new paradigms, practices, and mindsets. Many of these were well communicated and contextualized by the EdLeader21 network of Districts and schools (<http://www.edleader21.com>) and its focus on 21st Century learning practices, dubbed the '4 C's' (Collaboration, Communication, Creativity, Critical thinking). Along with participation in EdLeader21, we began to give permission for and encouragement of many learning activities that were less prevalent or non-existent in Rio's recent past. Since then, we have been evolving and clarifying a vision of learning and teaching that aims at developing 21st century practices through inquiry based learning activities that are more student driven and call upon students' abilities to think, create, and express their understandings by solving problems. Together with a broader set of organizational change processes, these catalytic endeavors helped forge a move towards a vision of inquiry-based 21st century learning environments and activities that naturally began to envelope the movement from STEM to STEAM. All of these efforts were aiming to transform learning environments such that children of all ages would be more engaged, more motivated, more included, and have more opportunities to collaborate, communicate in diverse ways, think critically about challenging academic work, be creative, and generally care for themselves, each other, their community and their learning and schooling. (September 2017)

In the following sections, we describe how this view unfolded. We share the framework that has guided our district's inquiry efforts. We also address some of the common constructs we have taken up as part of our approach to transforming teaching and learning by placing inquiry and the "5 C's" (the 5th C, "Caring," added by Rio in 2015) at the center. We do this to better explain what the 5-year inquiry efforts "looked and sounded like" and how these efforts informed the District's approach to "STEAM" rather than "STEM."

## **2 Using an Ethnographic Perspective in Order to Take an Inquiry Stance**

We use Interactional Ethnography (IE) (Green et al. 2003), as a logic of inquiry, providing an orienting theoretical/methodological framework for our research and for our overarching inquiry as a District. In taking up this perspective (Green and Bloome 1997), we draw on Anderson-Levitt's (2006) argument to view ethnography

as epistemology, a way of knowing, and therefore, as a logic-in-use rather than as simply a set of non-theoretically-based tools. From this perspective, we view classrooms and other educational settings, such as a school or a school district, as cultures-in-the-making, in which members co-construct patterned ways of being, knowing, and doing through their actions and interactions (e.g., Santa Barbara Classroom Discourse Group 1992).

By drawing on an IE perspective, complemented by microethnography (Bloome et al. 2005), we were able to conduct contrastive analyses both within and across time and events, including moment to moment interactions as reflected in oral and written discourse. This complementary approach further enabled us to examine, at multiple levels, the ways in which particular visions and perspectives, goals, processes and practices were initiated and (re)formulated over time. We identify, through analyses presented in our case study, processes and practices that were especially relevant at the district level over time.

### **3 A 5-Year Inquiry Process: A Case Study**

In this case study, we describe how particular changes occurred over time, including changes in public discourse. We also address three factors that supported particular kinds of change – including the decision to incorporate STEAM as a central piece of the District’s transformative efforts. The three factors are: (1) the role of particular kinds of leadership, (2) the importance of an inquiry stance (cf., Cochran-Smith and Lytle 2009), and (3) the importance of catalytic overlapping initiatives, which became patterns of practice/processes across time (e.g., Green et al. 2003).

Our consideration of leadership includes discussion of a leader who may also serve as an ideas/vision catalyst (sensu Brafman and Beckstrom 2008). We also consider the importance of a shared-expertise approach to distributed leadership (e.g., Gronn 2010). We found all of these factors were essential while building a culture centering on inquiry.

#### ***3.1 Key Leader as Catalyst***

The “story” begins in 2012, when Dr. Puglisi entered as superintendent. He brought a clear personal and professional vision that, while continually evolving, was grounded in his 30 years as a teacher and administrator, including several years as superintendent of two smaller districts. He also brought a perspective on inquiring, an openness to observing and asking questions, on thinking in an integrated way about disciplines, and on thinking out of the box. These perspectives were grounded in both his professional and personal experience as an artist and musician, with interests in mathematics, science, and multiple other disciplines. His work as a

graduate student in ethnography and technology also contributed to his personal and professional vision. This vision and experience would affect Rio's own vision and actions as a District.

From an ethnographic perspective, entering an existing community/culture required a period of stepping outside of his own experience in order to study that community. It required time to transition. The District's goals, adopted for 2012–2013, reflect that transition period, as well as what the superintendent was learning about the Rio school system's "vision of teaching and learning." The following excerpts from Rio's goals that year under the heading of "Student Achievement" serve as an example of what Dr. Puglisi was learning about the District in this area:

- (a) *Improve % of students scoring proficient or advanced on CSTs...(CA State Standards, California Standardized Tests)*
- (b) *Improve % of students with a positive level of changes on CSTs....*
- (c) *Improve all API scores... (CA Dept of Education Academic Performance Index, still in use in 2012–2013).*

Clearly, Rio's orientation to teaching and learning at that time was tied strongly to student achievement, as measured on standardized, multiple-choice tests. However, the superintendent started inserting his vision, placing ideas into public space early in the academic year, via the superintendent's blog on the Rio website. In the following blog entry (Table 1), the language of "world-class learning" appears in the Rio District public discourse for the first time. Through this written discourse,

**Table 1** Dr. John Puglisi blog entry – world-class learning – 12/4/12

World-class (wŭrldkls)
<i>adj.</i>
<b>1.</b> Ranking among the foremost in the world; of an international standard of excellence; of the highest order: a world-class figure skater.
<i>What does it mean to be a world-class learning organization?</i>
Students have access to world-class educational opportunities and achieve world-class results?
Employees have access to world-class educational opportunities and achieve world-class results?
Partners have access to world-class educational opportunities and achieve world-class results?
The organization itself achieves world class results in its own learning processes?
The organization incorporates and develops integrating the best classical educational elements with the most modern and innovative twenty-first century tools and contexts.
It emphasizes access.
It emphasizes equity.
It emphasizes innovation and creativity.
It emphasizes excellence and striving.
<i>It emphasizes critical thinking and collaboration.</i>

<http://rioschools.org/blog/world-class-learning-organization-12-4-12/>

the superintendent proposed a potential change in Rio’s vision and in its perception of itself as a District (i.e., how Rio might position itself in others’ eyes).

An analysis of the discourse in the blog text makes visible the potential work being accomplished here. The superintendent shared, first, a dictionary definition of “world-class,” rather than offering his own personal definition. He proposed this definition at the outset, inviting his readers (staff, families, the public beyond the District) to begin thinking about an educational organization within this context. The notion of “ranking among the foremost in the world” was new to the discourse by and about the Rio School District at this time. Rather than simply telling his readers, or positioning himself as the expert on world-class, he instead posed questions and invited readers to think about what these terms meant. Finally, he placed language into the public space that later, in various forms, became part of the District common language: examples included “21st century tools and contexts,” “innovation and creativity,” and “critical thinking and collaboration.”

Fichtner (blog entry, retrieved 10/11/17) describes certain key leaders as catalysts when discussing Brafman and Beckstrom’s (2008) review on theories of leaderless organizations. She describes catalysts as “visionaries that develop amazing ideas. But instead of holding onto those ideas for themselves, they share their ideas with others. And they *inspire* others to take action on them. And then, the Catalyst steps out of the way and lets the community carry the idea to incredible results.” We don’t suggest that Rio District is without leaders or a key leader. Rather, we contend that Dr. Puglisi was a visionary catalyst, in the context of a form of distributed leadership (Gronn 2010). In this particular distributed leadership arena, ideas are proposed and taken up, or not, by various stakeholders. We also suggest that the superintendent uses a particular approach to leadership, distributing it both vertically and horizontally. This leadership style focuses on notions of shared expertise, which is a critical factor in supporting change efforts in the area of STEAM. In other words, Dr. Puglisi has described, and our ethnographic evidence supports, that, as the number of participating stakeholders and their contributions grows, the collective result becomes increasingly co-constructed, rather than the product of one individual. Illustrative of this argument are the practices Dr. Puglisi identified in a presentation he gave at a STEAM Consortium in Northern California in 2015. These practices (Table 2) embody support for teachers in moving toward “do[ing] STEAM learning”:

**Table 2** Superintendent practices: “STEAM learning – do it!”

Setting goals/vision
Giving permission
Providing resources
Supporting professionals developing
Networking and partnerships with the broader community

### 3.2 Vision, Mission, and Goals Statements

The symbiotic process between superintendent vision/ideas and stakeholder ideas developed and became evident through adjustments in the publicly adopted District vision and mission statements and the Rio District goals. We offer evidence of such changes in vision and mission statements (Table 3). Information in Table 3, and information offered later in a discussion of Goals, establishes context for the subsequent discussion of corresponding changes in practice.

Although changes occurred in vision and mission statements between 2013–2014 and 2015–2018 (Table 3), references to empowering students were retained as a central aspect both times. The focus on empowering students appeared later in discussions of the work of Inquiry-Based Instructional Designers (IBID), a teacher-driven inquiry group. Empowering students also became a goal for the new STEAM Academy, emphasizing student-driven learning and student-driven/teacher facilitated investigations.

The focus on student-driven learning is even more explicit in Rio District’s revised mission statement for 2015–2018. In addition, twenty-first-century “curriculum and tools” as well as the “5 C’s,” discussed below, are now central to what the District wants students to be “self-driven” to do. This change in mission statements, adopted by the Rio Governing Board, makes visible the efforts to coalesce and codify the transformative efforts summarized below.

**Table 3** Rio vision and mission statements

2013–2014	2015–present
<b>Vision statement</b>	<b>Vision statement</b>
The Rio School District seeks to reflect a world and nation where society understands and values the <b>interdependency*</b> between nation, state, community, family, the democratic process, and the role of public schools in educating for the future. Within this vision, <b>students are at the center</b> of our commitment to stimulate empowerment and achieve the greatest possible potential as part of living in a diverse and changing world.	The Rio School District and community <b>empower</b> students to <b>achieve their full potential</b> in our community, our American democracy and our diverse and changing world.
<b>Mission statement</b>	<b>Mission statement</b>
The Rio School District nurtures the increasingly challenging <b>learning and development</b> of children from our pre-school through 8th grade utilizing the kind of curriculum and programs that can serve as a <b>hub for community development</b> as a whole.	The Rio School District and community nurture <b>learners to be self-driven</b> to fully engage with the twenty-first century curriculum and tools aimed to develop the <b>5C practices</b> : Communication, Collaboration, Critical Thinking, Creativity, and Caring.

\*Bolded words, inserted in originals by Rio District, represent intent to place emphasis

Examining District goal statements at three different points (2012–2013, 2013–2014, and 2015–2018) renders changes resulting from transformative efforts that occurred within the District even more explicit (Table 4).

For example, STEAM was first included in the District’s goals in 2013–2014. This inclusion codified efforts to strengthen STEAM approaches through a Rio-led county network. STEAM Colloquiums were started, too (discussed below). In 2015–2018, Rio District adopted a goal to become “a 5C Focused, Digital Learning, S.T.E.A.M. (Science, Technology, Engineering, Arts, and Mathematics) community hub.”

**Table 4** District goals across the 5-year case study period

2012–1013 (adopted 1/16/13) *	2013–2014	2015–present
1. Student Achievement	Create a love for learning, engage in creativity, and value the process of inquiry and investigation.	Develop proficient and engaged readers, writers, and mathematicians.
(a) Improve % of students scoring proficient or advanced on CSTs District wide, at each school, and at each grade level	Provide world class learning opportunities for our entire educational community.	Improve the rate of English language development for all learners.
(b) Improve % of students with positive level changes on CSTs District wide, at each school, and at each grade level	Achieve and document achievement results based upon world class learning.	Develop teacher capacity as reading instructors and facilitators of the 5 Cs: Communication, Collaboration, Critical Thinking, Creativity, and Caring.
(c) Improve API scores District wide, and at each school, for all students, and for all sub groups of students	Be a role model for twenty-first century education in California and nationally, focusing on the 4 C’s: Communication, Critical Thinking, Collaboration, and Creativity.	Develop the District as a 5C Focused, Digital Learning, S.T.E.A.M. (Science, Technology, Engineering, Arts, and Mathematics) community hub.
2. Student Health & Well-being	Develop our STEAM Education Center in Ventura County linked to broader efforts across the country.	
3. District Fiscal Well-being	Ensure the Financial Stability of the Rio School District.	
4. Dist/Schools short & long-term planning	Develop and implement the Master Plan for facilities growth and maintenance.	
5. Dist/Schools/Community Climate		
6. Tech Integration/ Innovation		
7. Facilities Development & Maintenance		
8. Partnerships		

\*2012–2013 had eight major goal areas and multiple sub-goals. Only sub-goals for Student Achievement, with its focus on students, are used here for the contrastive analysis

### 3.3 *Catalytic Patterns of Practice/Processes*

Changes in vision, mission, and goal statements reflect the evolution of the District and its efforts toward building a STEAM-embedded culture of inquiry. We present a time-map of identified, interrelated major events for the Rio District, including those already discussed, to show what we refer to as transformative change efforts (Table 5).

Table 5 shows the flow of activities in the District, within and across years. It is also possible to see not only shifts in what has occurred in the District, but also the kinds of events or initiatives that appear to (re)occur across years, associated with those changes.

In 2012, Rio District was one of only a few, if not the only, districts in the EdLeader21 PLC serving predominantly students of color and/or low-income or state-defined “low-performing” students, many of them second language learners. Still, Rio’s vision of becoming an organization for “world-class learning” and of engaging in twenty-first-century learning was in synchrony with the vision of EdLeader21. Shortly, thereafter, “4 C’s” (Collaboration, Communication, Creativity, and Critical Thinking) became part of the common language. Later, the team incorporated the 4 C’s into the public language and actions of the District, and, as shown in Table 5, a fifth C, “Caring,” was added in 2015. The 5 C’s, in documents, in language and in classroom practice, are combined with, and as important as, the CA State Standards (e.g., Common Core and NGSS) in Rio District (see Table 3). We have identified and highlighted several additional catalytic processes/tracks in Table 5. The relationships among these processes are exemplified by EdLeader21, the 5 C’s, and the evolving development of inquiry and inquiry design as central cores for teaching and learning. For example, we see inquiry as integral to the 5 C’s. Inquiry practices such as asking questions, observing, making an argument, and collaborating with others, and processes such as innovating, and imagining, all flow through the actions of collaborating, thinking critically, communicating, being creative, and caring (empathy). As a result, a focus on inquiry has been compatible with the efforts to implement the 5 C’s, and the 5 C’s are catalysts for movements in multiple directions.

Central to our STEAM effort has been the growth of a teacher-driven inquiry group, IBID (Inquiry-Based Instructional Designers). IBID is a grassroots inquiry group, evidence of the shared expertise approach to leadership. IBID began with seven teachers (representing five grade levels) and two facilitators. The facilitators were part of the superintendent’s efforts to secure resources to support teachers in implementing an inquiry stance for teaching and learning. The efforts of IBID are deeply grounded in looking at their own practice, developing capacity to design inquiry-based instruction, guiding students in empowering themselves to drive their own inquiries/learning, and actively integrating disciplines using a practice-based approach. Table 6 contains an excerpt from a written reflection on IBID by a partici-



**Table 5** Timeline of selected key activities driving the Rio district’s inquiry process toward transformative teaching and learning and selected key patterns of practice/tracks

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
2012–2013	2013–2014	2014–2015	2015–2016	2016–2017	Fall, 2017 (Present)
New Super. starts	Super. active member of EdLeader21 (4 C’s)	EdLeader21 teams begin meeting ‘Caring’ added – 5 C’s	EdLeader21 Team meetings ongoing	EdLeader21 continues	EdLeader21 continues
Transitional goals adopted	New goals adopted, include “inquiry & investigation”	New goals, vision, mission adopted for 2015–2018			
IBID (Inquiry-Based Designers) formed from Summer PD Institute – Year 1	IBID Summer Institute & academic year meetings Year 2	IBID Inquiry group academic year meetings & Summer Institute Year 3	IBID Summer Institute & Inquiry group meetings. Year 4 (membership grows)	IBID Inquiry Group & Summer Institute (new members) – Year 5	IBID Inquiry Grp continues Year 6
VCSTEAM’N initiated - #s 1&2	VC STEAM’N Colloquium #3			STEAM Colloquiums #4 & 5	
	Summer Science Academy – Year 1	Summer Science Academy – Year 2	Summer Science Academy – Year 3	Summer Science Academy – Year 4	Plans for Summer Science Academy – Year 5
	Facilities Master Plan adopted (incl Science Academy, STEAM School)	STEAM School Bond passage	STEAM school stakeholder design continues	Recruitment for STEAM faculty & hiring	STEAM Academy official groundbreaking ceremony
		Stakeholder design for STEAM school begins		Orientation & first Summer Institute for STEAM Academy faculty (Curriculum & instruction design begins)	STEAM faculty testing & trying out – ongoing curriculum & instruction development

(continued)

**Table 5** (continued)

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
2012–2013 Inquiry-oriented consultants hired	2013–2014 Inquiry-based consultants as thinking partners begins	2014–2015 Inquiry-based partners as thinking partners (invited by teachers)	2015–2016 Inquiry-based partners as thinking partners	2016–2017 Inquiry-based thinking partners (invited by teachers)	Fall, 2017 (Present) Inquiry-based consultants continue as thinking partners
CA Common Core State Standards adopted (PD)	CC & inquiry centered PD/Curriculum & assess development	PD – Project-based Learning and inquiry (CC)	PBL & inquiry-based PD (CC & NGSS)	Additional emphasis on literacies & mathematics ‘Transdisciplinary’ enters	Focus on literacies/ student-driven learning

**Table 6** Teacher reflection on inquiry-based instructional design

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Now I see IBID can take on many forms throughout the disciplines. Using literacy-based instruction, using animals, using plants, art. It is more about the learning journey that you allow your students to experience.

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These empowering experiences allow students to unfold their thinking, their questions, and skills. When a student travels through this discovery and investigative process, they gain so much internally and are more confident in showing, sharing, telling, trying and collaborating. It is truly a transformative process that takes place and it will stay with them forever. (IBID Teacher, Summer, 2017)

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pating teacher in the 2017 Summer Institute. This excerpt succinctly supports our view that the “IBID” track is a key catalytic process in moving to STEAM in our inquiry-based model.

With these overlapping efforts, several questions emerge. Why STEAM, for example? What is the relationship between STEAM and STEM, and why has STEM not been a part of the “official” language of the Rio District since 2012, even as it remains prevalent in other local, state, and national settings?

### ***3.4 Why STEAM in the Context of a Culture of Inquiry?***

To explore this question, we looked further at the events and patterns of practice in Table 5. We also examined the ways in which our catalytic leader and other partners have come to think about STEM and STEAM in the context of inquiry.

As noted earlier, the Rio superintendent began using STEAM rather than STEM in his personal and professional conversations in late 2012/early 2013. He did so because it made sense to him. At the time, STEM was a term used by teachers, and used in literature and in other settings. For the most part, the acronym STEM was invoked primarily by teachers and others in Rio (as it was in many districts and other public settings) as an acronym for four separate disciplines – as an easy way to think about these disciplines and encourage a focus on them in schools.

On one hand, while focusing on inquiry, as Dr. Puglisi described in an interview, “STEM (science, technology, engineering, and mathematics) learning activities provided an easy platform for many teachers and community to relate to in terms of doing things differently in schools. The District began these efforts by moving towards becoming a one-to-one District or one-to-the-world District, which provided each child a networkable computer device. Simultaneously, we looked at what we were doing in the name of science and math and for opportunities to engage in more hands on, minds on doing activities and projects that connected the STEM subject areas and practices.”

As shown in Table 5, a key catalytic track, the Rio Summer Science Academy, began in 2013–2014 in the spirit of Dr. Puglisi’s description above. This Academy was started in partnership with Dr. Jerome Clifford, a Physics Lecturer at California

State University, Channel Islands. The Academy has increased teacher and student capacity, and it allows teachers to pilot hands-on, minds-on activities for classroom use later.

But the issue of STEM versus STEAM, in public naming, was not really an issue. This was because Dr. Puglisi, first, and then the Rio District later, did not see it as an issue. As Dr. Puglisi described, his decision to focus initially on the STEM disciplines – as STEM – was pragmatic. In his mind, the arts were always present, as were the Humanities, Social Science, Literature, and so on. In addition, the superintendent and other partners also had inquiry and the 5 C's at the forefront of their thinking. Finally, multiple, sometimes arbitrary and confusing, definitions of STEM complicated matters (Seikmann 2016). Was it inclusive or exclusive? Was it compatible with our views of multidisciplinary approaches, for our view of twenty-first-century learning and inquiry? Some definitions hinted at yes, while others suggested no. So, in fact, STEM as a construct for District public discourse (and therefore overarching approach) was not particularly relevant or useful in Rio, despite particular activities in practice in the district in 2012–2013 and beyond. It just made more sense to include the arts and use STEAM.

In February 2013, Rio held its first VC STEAMN' Colloquium. This event centered on Symmetry (across disciplines) and was open to teachers throughout Ventura County. Dr. Puglisi named this widely popular event. By 2014, two additional Colloquiums had followed. As shown in Table 5, this key catalytic track, along with the later mission statement and goals, began codifying STEAM in the common Rio language and approach. STEAM became part of a system of professional development, too, that included a focus on Project Based Learning.

STEAM made sense to us in the context of our other transformative efforts. First, we saw inquiry and inquiry practices at the center of both STEM and STEAM. Second, as an artist and a musician, the superintendent understood how these disciplines fit with science, technology, engineering, and mathematics. Further, engaging in creativity (5 C's) and artistic thinking in multiple disciplines, and collectively bringing these multiple perspectives to solve complex problems, made sense to him, and to us. We took these transdisciplinary ideas and proposed them to teachers in various existing inquiry-oriented contexts. But key to this process was the leader as Catalyst, who proposed ideas and perspectives and then let go of them as members of our larger community (e.g., teachers, students, administrators, etc.) were inspired to assimilate, (re)formulate, and act on them. In doing so, they drew on the common language of inquiry, transdisciplinarity, and STEAM that we've co-constructed.

STEAM also makes sense in the context of our evolving notion of transdisciplinarity, which in turn has its roots in the context of the open nature of inquiry-based practices and design and of twenty-first-century learning practices. Transdisciplinary approaches are used primarily in higher education, but we see potential for their use

in K-8 schools, as well. Transdisciplinarity involves (metaphorically speaking) looking through multiple disciplinary lenses (Klein 2000), making something new. We see value in working with students to draw on multiple perspectives, from multiple disciplines, to develop new approaches for solving problems. In other words, it takes multiple perspectives, whether they're included and named as STEAM disciplines or in addition to those disciplines, to address "wicked problems." Therefore, it makes sense to us to bring this to bear in problem-based learning approaches. At the same time, we value a practice-based approach. For this reason, we also consider artistic thinking and practice (Marshall 2014) as essential to transdisciplinary approaches. STEAM allows problems to be reviewed through different perspectives, but it is also a starting point for bringing additional perspectives to bear from other disciplines.

Why STEAM? Because the arts and artistic/musical thinking are essential and because all of our transformative efforts to date to build a culture of inquiry in the context of twenty-first-century learning, from a transdisciplinary perspective, cannot help but include STEAM as a central component.

All of this comes together (Table 5) in what has been a three-year journey to design, build, and open (in Fall, 2018) a new K-8 Rio STEAM Academy. While space does not permit a full description of this journey, we offer an event map to make it visible (Table 7).

As shown in Table 5, a new STEAM school was first envisioned in a Rio Master Plan and adopted in September 2014. There is no evidence in the Plan that there was ever any discussion of a "STEM" School.

Multiple interrelated processes occurred over time, including stakeholder Design Team meetings and conversations with a Chumash elder (a group spiritually and historically tied to the school site). All of these activities affected architectural plans and decisions about the STEAM Academy. As part of this same process, recruiting and selecting faculty for the school from existing teachers occurred in May 2017, more than a year and a half before the school was expected to open. Early hiring was unique, but also important, so that teachers could begin building community, develop a common language, and design guiding principles for planning curriculum and instruction.

Overarching goals (Table 8) for the STEAM Academy currently guide faculty work. Importantly, the Academy goals are grounded in the superintendent's vision, the broader Rio District vision, mission, and goals, and in what was co-constructed, over time, by the Design Teams and other stakeholders.

STEAM teachers as of this writing had participated in a 2-day orientation and a 3-week Summer Institute. Table 9 provides excerpts from reflective writings by faculty at the end of the Institute.

In these excerpts, we find references to key constructs, to community, and to STEAM, as well as reflections of the larger vision for the school that, in turn, was grounded in earlier and simultaneous transformative efforts over time.

**Table 7** Event map/timeline: Overview of STEAM Academy development process to date

Year 1 (Aug 2014–July 2015)		Year 2 (Aug 2015–July 2016)			Year 3 (Aug 2016–July/Aug 2017)			
Aug-Dec	Jan-Apr	May-July	Aug-Dec	Jan-Apr	May-July	Aug-Dec	Jan-Apr	May-Jun
Facilities Master Plan Overarching goals for STEAM School	STEAM School sites tour (small group)	Citizens Oversight Committee meeting.			Draft initial Environ Impact Analysis report completed	Larger extended group development partners meet.		
Citizen Oversight Committee established (Board)	Initial meeting COC							
Measure “G” Bond Passage								
Design Team meetings 1&2 (sites and overarching hopes and vision for school)	Day-long Design Team Sessions and general meeting 3	Design Team general session 4 First meeting with Chumash elder and architect (and other partners) re: site spiritual and physical history, relationship to school design.	Design Team meeting 5	Ongoing meetings re: indigenous ways of knowing related to nearby river, to school design	Design Team meeting 6 (architect and Chumash elder present)			STEAM info meeting open to all Rio teachers Hiring process – positions opened to current Rio School faculty members.

					<p>Core team leadership meetings begin (toward staffing, PD, etc.)</p>	<p>Preliminary draft framework for teamwork (professional work)</p> <p>Process for determining PD/ curriculum and instruction development facilitation</p>	<p>Core team leadership meetings</p> <p>Finalize overarching goals description and application materials for staffing</p> <p>Facilitator (PD) confirmed</p>	<p>Applications, interviews, hiring (completed by April 6)</p>
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**Table 8** STEAM Academy initial overarching goals

Twenty-first-century learning practices
Transdisciplinary, multi-age, student-driven/teacher-facilitated, STEAM-oriented content learning
Commitment to designing and planning inquiry-based curriculum and instruction in the contexts of place, culture, and “real-world” problems
Commitment to creating a STEAM school and team that will be a fluid and collaborative effort, welcoming of input and expertise from multiple sources, whether it be from students, other teachers, family members, or Chumash elders, Mixtec community groups, and other community members supportive of culturally responsive ways of learning, as well as other community partners

**Table 9** Excerpts from STEAM foundational faculty end-of-summer-institute reflections

A	I used to think transdisciplinarity was a complicated concept and applying it will require a group of mindful people who can embrace chaos. Now I’m realizing that this group of educator/learners is up to the task and will be patient, empathizing practitioners as we navigate this new river.
B	I used to think the STEAM Academy was simply a school site that we would fill with students, teachers, and administrators. I’m now realizing that we are building a culture that will catapult the curriculum and our community into places that we’ve never been to. And that uncomfortable uncertainty is a good thing.
C	I used to think that we were designing a STEAM School. Now, I think we are building so much more. ... a new way of being.
D	I used to think the STEAM Academy would be similar to a traditional school, just with more STEAM aspects to it and maker spaces. Now I’m realizing the STEAM Academy will be much different. I learned what transdisciplinary was and how everything will connect. I also realized our grades won’t be siloed and we will be teaching multi-age.
E	We have a dynamic group of educators and leaders, where we all have individual strengths and personalities. What we have in common is the goal of becoming better teachers and leading our students to become stronger learners and future leaders. We are all willing to take chances and understand that we need to “go with the flow,” regarding uncertainties/ challenges that will arise with a brand new school. I’m proud to be a member of this group.. .

## 4 Conclusions

In this chapter, we reviewed a transformative journey toward change in teaching and learning over time in one school district – a journey toward building twenty-first-century learning within a culture of inquiry, which in turn encompasses a STEAM approach orientation rather than a STEM approach. A key leader who also served as a catalyst was critical in this journey, proposing ideas and visions, then stepping back to let the community consider them and reformulate them to create something new.

1. Rather than a “leaderless organization,” the key leader supported a shared-expertise model of distributed leadership that facilitated change efforts.
2. Inquiry was a central aspect of both the transformative journey (inquiry as stance) and a central process (inquiry-based design and learning); it led to ways



of seeing inquiry at the center of STEAM, providing a rationale for including artistic thinking and practice as important components.

3. A series of through-time patterns of practice could be identified that served as catalytic processes. These processes were key in how STEAM efforts were named, codified within the public Rio space, and then (re)formulated.

The transition to new approaches to “doing school” has taken time to develop. It is not a top-down process of prescription and transmission. Rather, it is a process of envisioning and exploring and of dialogue and negotiation and a process of proposal and take up – or not. For some teachers, change has come slowly, particularly at the middle-school level. For others, especially in K-5, change has come more rapidly. The opportunity to really hear students’ questions, to empower them to investigate them, or the opportunity to explore exciting possibilities through art and music together with science, technology, engineering, and math – it’s all very exciting. Some of the teachers can take it up more fully; others are taking small steps. Over time, however, we see that STEAM activities and learning environment transformations are becoming more common each year.

Rio’s classrooms are now more inquiry-based, transdisciplinary, engaging, differentiated, student-driven, blended, passion-based, and culturally situated. As a result, student and employee attendance has improved; student citizenship has improved; standardized literacy assessment results have improved; student, teacher, and parent perceptions of the District have improved; and a state-of-the-art K-8 STEAM Academy is (as of this writing) well on the path to opening. Rio is moving toward a more effective twenty-first-century learning organization that continues to aim to be “world class” by various measures or perceptions.

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