A **Day in the Life of Victoria:**
A Tenth-Grade Student's Experience with STEM Education
at Southwest New Tech High School, an Inclusive STEM High School

Sharon J. Lynch
The George Washington University

Courteney M. Coyne
The George Washington University

Inez N. Moore
The George Washington University

Ann House
SRI International

Author Note

Correspondence should be addressed to Sharon Lynch, Department of Curriculum and Pedagogy, Graduate School of Education and Human Development, 2134 G St, NW, Washington, DC 20052. Email: slynch@gwu.edu

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The objective of the Opportunity Structures for Preparation and Innovation (OSPrI) research program is to examine the opportunity structures at exemplar inclusive STEM High Schools (ISHSs) created to engage, inspire, and prepare students for STEM fields. In contrast to highly selective STEM-focused schools that target students who are already identified as gifted and talented in STEM, ISHSs aim to expand workforce development, prepare STEM professionals, and develop new sources of STEM talent, particularly among underrepresented minority students. In addition, the ISHSs explored in this study have college preparation as a primary goal.

The OSPrI research team identified eight exemplar ISHSs across the United States to explore the questions, *Is there a core set of critical components designed and implemented in well-established, promising ISHSs? Do other components emerge?* The research was conducted in two phases. In Phase 1, the goal was to characterize the schools from the perspectives of a variety of informants within and outside the ISHSs. The case studies for all eight schools are available to read on the OSPrI website (https://ospri.research.gwu.edu/).

In Phase 2 of the OSPrI study, the goal was to capture students' perspectives of ISHSs as well as STEM programs in comprehensive high schools. One school of focus was Southwest New Tech High School (a pseudonym, now referred to as SWTech) in a southwestern state in the U.S. We conducted the Phase 1 site visit in May 2012. The resulting case study illuminated how its educational program contributed to this award-winning school's remarkable successes (AUTHOR et al., 2013). SWTech showed evidence of all 10 critical components listed in Table 1. Especially prominent, however, was its instructional program, which was built entirely on project-based learning and the philosophy created by the New Tech High instructional model (New Tech High, 2009). Four other critical components (see Table 1) were also apparent: the quality of SWTech's extensive STEM-focused, student-centered, cross-disciplinary curriculum; a well-developed technology infrastructure that supported ambitious instruction; a well-qualified teaching staff with strong and varied STEM backgrounds; and a well-developed network of supports for students from underrepresented groups such as students first in their families to attend college. Emergent themes revealed the students' strong sense of a school family and a positive school climate nurtured by the school administration and teachers. SWTech's personalized education provided students with social capital and developed 21st century skills to prime students for further success after graduation. Student outcomes showed SWTech to be a highly successful STEM school that appeared to reach each student and prepare them for college.

In November 2014 we returned to SWTech for the second phase of the study. The purpose was to capture how two students, one female 10th-grader and one male 11th-grader, experienced their school days. The research question was, *From the points-of-view of students underrepresented in*

STEM fields, what are the educational experiences and opportunity structures provided by their school? Two pairs of researchers shadowed each student for 2 school days. We followed the students from the moment they arrived at school to when they left for home, observing them in classes and during informal activities. The classroom observations were guided by an observation instrument that focused on the class-level activities as a whole while another instrument was focused entirely on the target student. Using semi-structured protocols, we also interviewed the students and their parents, as well as the principal, guidance counselor, advisors, and teachers. We recorded common themes in the classroom observation notes and transcribed interviews, noting once again the presence of the 10 critical components in Table 1. We also found a new set of themes that emerged from the students' points of view of the school. After each case study was written, we provided drafts to the principal and participating students to check for accuracy, and to approve the case. This case study of Victoria (a pseudonym) is the result of this site visit and interpretation of findings.

Table 1

Ten Critical Components of Inclusive STEM-Focused High Schools

Critical Component	Practices Observed
1. **STEM-focused curriculum**	• Strong courses in all four STEM content areas • Engineering and technology offered or intentionally integrated into STEM subjects and non-STEM subjects • More STEM requirements than school district or state
2. **Reform instructional strategies & project-based learning**	• Active learning; project-based learning or inquiry in STEM classes • Incorporation of 21st Century Skills into goals and products of instructional practices • Performance-based assessment practices • Research opportunities
3. **Integrated, innovative technology use**	• Technology an explicit part of school design and implementation • Technology used to connect students with information systems, models, databases, teachers, mentors, and social networks • Technology used for student production
4. **Blended formal/informal extended learning**	• STEM activities extend beyond the boundaries of a typical school day, week, or year (e.g., afterschool clubs, mentorships, internships; apprenticeships and summer programs)
5. **Real-world STEM partnerships**	• Students connected to business, industry, and the world of work via mentorships, internships, or projects applied to STEM learning
6. **Early college-level coursework**	• Flexible school schedule designed to provide opportunities for students to take classes at institutions of higher education or online; college credits accrued
7. **Well-prepared STEM teaching staff**	• Teachers are qualified and have advanced STEM content knowledge and/or practical experience in STEM careers • Teachers are collaborative and buy into school mission
8. **Inclusive STEM mission**	• The overarching, inclusive, STEM-focused mission of the school manifests itself in school practices • Active recruiting of students from underrepresented groups
9. **Administrative structure**	• Varies (school within a school, charter school, magnet school, etc.) and most likely affected by the school's provenance • Networked; able to garner community support • Leadership is mission-centered, nimble, innovative • Flattened hierarchy and shared leadership with staff
10. **Supports for underrepresented students**	• Systems of advisories, tutoring, and data and communication used to create a personalized education for every student • Extensive college and career counseling

OSPrI Day in the Life

Southwest New Tech High School (SWTech), a public secondary school (grades 9–12), sits on the outskirts of a major city in a southwestern state. The downtown area of the school district consists of a couple of blocks of down-at-the-heels early 20th century storefronts and small businesses. While it may seem out on the edge in some ways, Southwest New Tech is the center of 350 high school students' daily lives.

SWTech opened its doors to students in 2007, resulting from a confluence of opportunities and incentives. While the large comprehensive high school in the district was struggling to meet state assessment standards and failing to graduate a large proportion of students, funding opportunities to open a new school came from the Bill & Melinda Gates Foundation, as well as the state-level STEM High School initiative which included a roadmap for the schools and technical assistance from the state. In turn, the school district for SWTech provided funds to renovate a former middle school to house the new SWTech high school. So began this STEM-focused school with a look and feel strikingly different from typical high schools.

SWTech is one of about 160 schools in the New Technology Network. Using the New Tech project-based learning approach, "students collaborate on meaningful projects that require critical thinking, creativity, and communication in order for them to answer challenging questions or solve complex problems" (New Tech Network, 2015). Teachers provide authentic and challenging projects that students work on for several weeks. Over the project, teachers provide an entry document that introduces a real-world problem, optional workshops, and laboratory experiences, technology-based resources for learning, and individual tutoring — mostly without direct instruction or lectures. This approach to teaching and learning is designed to create an atmosphere of learning that is student-driven and engaging and that meets the needs of students with a wide variety of academic abilities. There is no tracking at SWTech.

Those interested in attending the school are accepted through a lottery open to all students in the district. As a result, the student population is diverse, though it has more white students and fewer economically disadvantaged students than the district or the local comprehensive high school (Table 2). Socially, however, students reported a very inclusive atmosphere (AUTHOR et al., 2013) in which they get along well, without cliques, and learn to work productively with a range of students in their class projects.

Table 2

Demographic Information on Southwest New Tech High School and School District (2012–13)

	Southwest New Tech High	School District
	Percent	
African American	21.5	23.5
Hispanic	47.6	61.7
White	25.6	10.2
Economically disadvantaged	51.5	79.6
English learner	1.8	31.0

Source: AUTHOR et al.(2013).

The course of study at SWTech keeps students very busy over their 4 years. Graduation requirements include 5 years of science, 5 years of mathematics, 2 years of engineering, and 2 years of technology elective credits. This outpaces the high school graduation requirements set by the state, and SWTech students typically take several of these courses for college credit.

The result of this design and culture is a school that shows strong results and has received many accolades. While students enter SWTech with achievement scores similar to those who attend the district's nearby comprehensive high school, substantially higher percentages of SWTech students pass the state standards in all subjects (AUTHOR et al., 2013). SWTech has a 100% graduation rate, and every graduate gains admission into a 2- or 4-year college. The school has been used to show what is possible in STEM education and has influenced policy makers and from all over the U.S. and beyond. SWTech has won numerous awards and recognitions.

Meeting Victoria

Victoria[1] came to school on Monday, November 3, wearing black jeans, a T-shirt, and sneakers; her long dark hair was pulled back under a striking black and gold baseball cap that featured the Ferrari emblem of a rearing horse. Victoria had attended the Formula One Grand Prix over the weekend with her father. Using a combination of his money and hers, she reported that she had bought the rather expensive ($35) hat because she valued its quality. Victoria values quality. Later in the day, a male student carefully adjusted the cap and tucked her ears under it, "to complete her cool look." Victoria is a 10th-grade student at Southwest New Tech High School, and she has the laid-back, unaffected manner of a southwestern girl. She is of medium height, both slender and fit. She was described by her teachers as sociable and a class leader who knows when it is time to play or get serious about schoolwork. She gets good grades at school and strives to do even better now that she understands how SWTech's system works and what its expectations are.

Victoria's family is from Mexico. Her parents explained that they speak Spanish at home, intentionally, so their children can be fluent in two languages[2]. Victoria is the second of four children with two younger sisters and an older brother. Her brother briefly attended SWTech, but the school was not what he wanted so he transferred to Southwest High School, the large comprehensive high school in the same district. Victoria's parents described her as happy, intelligent, and of good character: "From the time she was little, she was always very daring. She is fearless. She is friendly. She is a natural leader." Victoria's parents reported that she gets good grades but constantly strives to improve. They support her in her studies and ambitions. For instance, they said they will help pay for a school-sponsored trip abroad to Florence, Italy, later in the year, with the SWTech art teacher and other students. However, her parents were also concerned because this is the first time that Victoria will be away from home. The family seemed close, loving, and protective. Victoria's family made sure that that she has a computer, iPhone, and iPad and other resources for school. They often host groups of students at their home to work on school projects, although they cannot help Victoria much with the projects because of the advanced nature of the work. They encourage her and are proud of her.

Victoria arrived on time for school with all the materials she needed for the day in the backpack that she carried from class to class. Popular and gregarious, she was usually accompanied in the halls by at least one girlfriend and was greeted by boys and girls alike. Throughout the school day she chatted, smiled, and laughed with her friends and classmates, but then quieted down to focus intently on her work for long stretches of time. During classes, Victoria participated actively in small-group work and occasionally contributed to class discussions. She demonstrated

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[1] All of the names used in the case study are pseudonyms.
[2] The interview with Victoria's parents was conducted in Spanish. The quotes used in this narrative were translated from Spanish to English on December 10, 2014.

a good command of electronic technologies and used a combination of iPad, personal computer, and cell phone in her classes and at home.

When asked to evaluate her technology proficiency, she replied,

> From a scale of 1 to 10, I'm probably like a 7. I'm not really good. I haven't even taken a technology class yet, which totally sucks. I really need one. …I'm learning on my own at home or at school.

But she also said that she is the go-to person at home when there is a problem with her family's technology system.

Victoria and two close girlfriends, Lynn and Dallas, were proud that they initiated an afterschool fitness club at SWTech that has a small following. Victoria's friends seem to come from all ethnic/racial groups at the school. Victoria likes to be active in sports and intends to go out for soccer at the comprehensive high school during the next trimester. Because the soccer practice schedule at the comprehensive high school conflicts, she will not be able to continue a first-period art at SWTech, a class that she enjoys. (SWTech teachers remarked that the lack of an organized sports program at the school is a problem for some students who must juggle academics and transportation in order to play.)

Victoria reported a positive, friendly relationship with her teachers, whom she both respects and thinks are nice. She likes the way that they teach and work with students. She said,

> I think that the teachers are, like, very involved and very supportive with the students. If I have problems, like if I'm at home and I have, like, problems with the homework or anything, I can just email my teacher. Like at appropriate times; I can't be emailing them at, like, midnight; they will probably be asleep. But, yeah, usually when I do my homework after school at, like, 6, and I would email them for help and they would reply as soon as possible and they would help me out. ...If they don't reply quick enough for me, then I can just ask my friends that have classes with me, or…not in the same class with me, but they have a better understanding of it. I usually ask them for help and they help me out really well.

Victoria's STEM teachers said that she is outgoing and a class officer. She works well independently but maintains a jovial relationship in groups for Project Based Learning (PBL), the primary instructional model for all classes at SWTech. She always tries to get the work done on time. If she does not understand something, she is not afraid to say, "Hey, wait a minute. I don't get this. I don't understand," according to one set of teachers that we interviewed.

A teacher noted that last year, Victoria started to get a sense of when it is time to work and when it is time to play, saying, "I mean, she's what, 15, and that still can get mixed up sometimes. But I would definitely say…that she's able to self-monitor herself better than some of the other students." The teacher reported that Victoria passes this work ethic on to her peers in the groups

but does it appropriately. "She likes the stuff that she turns in and she likes to be proud of it." The teachers thought that Victoria was coming to understand how capable she is and was becoming more assertive in a positive, not aggressive, way. They believed that her growing confidence will aid her academically.

Victoria described how she feels about the school, saying,

> I love it here. Everyone's so friendly. Everyone is so nice. There is, like, not really a lot of drama here, which is awesome because it's just, like, relaxing. You go to school, do your work, and you do the same thing all over again the next day. It's really fun. …It's a great school that has a great culture. Everyone's like a huge family here. …It's a really nice environment to be in.

Victoria was aware of her personal growth since coming to Southwest New Tech as a ninth-grader:

> Last year was too easy, and I didn't feel the need to do a lot of extra work. But now…I think I would have done extra work and done a lot better. …Here it is a little bit more of a challenge. Like for presentations, I wasn't well prepared for that. I was just panicking every time. ... I was a very quiet person. Like, I really didn't communicate with other people, only, like, my friends. …But here they have, like, [end-of-project performance assessment] panels and stuff. Guests come in and then they ask you questions. …At first I was pretty afraid, then I did one and it was really fun. I just like to do those whenever I get a chance.

Victoria seemed ambitious. She spoke passionately about her goals after high school, aspiring to attend Southwestern University to study to be a forensic anthropologist. She had been influenced in the choice by the TV show *Bones*. She discusses her ambitions with her family but finds it is harder to make her friends understand, even at a school like SWTech.

How Victoria Came to Southwest New Tech High School

Victoria's parents encouraged her to attend SWTech her father said that they chose the school because it was reputed to be the best in the Southwest area. But there was more:

> It's supposed to be the best…because of the school's technique. When [students] graduate from here they can work on all kinds of things. It helped us to live close to here and choose quickly because we know that in the [comprehensive] high school there's an imbalance of play and studies. Students are here specifically to study and develop everything they have, all of their talent. …It's not the same as their elementary or middle school where they're always following the teacher, watching. … [At Southwest New Tech they] permit [students] to develop themselves, and study. So that was how we chose the school.

Victoria's views of SWTech were based on her brother's experiences; he attended for a while. She said,

> I heard about it from my brother, because he was here for it through freshman and half of sophomore year. He didn't like it, so he left to the [comprehensive] high

school. But I really like it, so I'm going to stay here for the 4 years. I [also] heard …good things from my teachers at middle school. …They were like, "Uh, you should go to New Tech, and it's such a great school" and all this other stuff.

Victoria went on to explain that because her brother had been at SWTech, she had a sibling advantage for admission, beyond the lottery. Despite her brother's misgivings, she decided to try out SWTech, knowing that she could transfer out. Her parents were pleased about her choice, remarking that Victoria knows so much about college:

> She knows about scholarships but cannot yet apply for college…but she already knows how to get [college credit] for subjects…before finishing high school. She has said, "I can graduate high school early, and I can take college classes," and so then by the time she graduates she could take about 6 months and many hours of classes and could be ahead.

Finances seemed to be an important consideration for the family, although the parents have the means to support Victoria's current goals.

Victoria's Day

Period 1, Art Class Day 1 and Day 2: "Let's Get the Party Started, Robert"

Victoria's first class was art with about twelve 10th-, 11th-, and 12th-grade students. The art room was small but had six work tables, a projector with the current PBL theme displayed, and 11 computers on counters along the perimeter of the room. Robert, the current class student-facilitator (a rotating position in SWTech classes giving student an opportunity to help lead the class) began the class with announcements and attendance while the teacher roamed the room, chatting companionably with students. She was relatively new to the school, from a well-known art gallery. She later commented, "Students here design differently, based on what they know about engineering and building. …The best learning is in 'process'; every group is encountering problems to be solved." As she discussed the sculpture projects that students were completing that day, she reminded them to include elements of design, forming opinions about the nature of beauty. She reviewed the rubric for the project: aesthetic beauty; elements of color, texture, and form; principles of rhythm, movement, and repetition; and inspiration or concept. She then directed students to disperse to their sculpture sites to complete their installations.

Victoria worked with another girl, Lee, a 12th-grader. The girls were completing their project, a 3-D sculpture that was required to be made of found or recycled materials, in this case, smashed half soda cans strung together on transparent fishing filament line. The strings of cans ranged from18 to 48 inches long. Victoria showed how the project evolved from a series of pencil sketches of a free-standing 3-D soda can sculpture to the smashed can mobile. The girls grabbed a ladder and their strings of cans and headed to a hallway to hang their art. Victoria climbed the ladder and tied the strings of cans to a wire cage that housed the exposed wiring for the school. The girls had in mind a specific order for the strands, based on the strand lengths and colors. Students walked by and commented, one asking, "What is it?" and "What is art?" The girls

worked easily together. Robert looked in on them, whereupon Victoria announced that she is terrified of heights. (She did not appear to be.) Robert cheerfully climbed the ladder and completed the installation according to the girls' directions. The work was smooth and efficient. Victoria picked up debris from their work. The teacher arrived to view the hung sculpture; she seemed pleased with the girls' work and asked how they felt about it. Victoria and Lee said that they were happy both with the finished product and with how they had worked together. The girls were not concerned about their installation being damaged by students in the halls, saying that all SWTech students do projects and respect each other's work. Next, Victoria took the lead to find a custodian and return the ladder to a storage closet. While both girls collaborated efficiently, Victoria seemed more in charge of such practical matters. At the end of class, the girls negotiated when they might present their project to the class; this had to occur on Wednesday because the 10th-graders were going on a field trip to the Renaissance Festival the next day.

In this class, at the teacher's direction, 100% of the time was spent on task; 9% was primarily teacher centered, 91% was small group centered, and 0% was spent on individual seatwork. This does not necessarily mean that every student used time in this way. It does demonstrate that the class was intentionally student centered, particularly small group student centered.

The art class picked up again on Wednesday morning after Tuesday's field trip. At 8:30 a.m., Victoria arrived to class dressed in professional clothing for the presentation, quite a contrast to her casual look on Monday. Her hair was in a loose braid pulled to one side, and she wore a silky beige blouse, brown pants, and tan heels, with nice jewelry. Although only a 10th-grader, she looked appropriately turned out for any serious business office in a major city.

After chatting briefly with the students about their trip to Renaissance Festival, the teacher turned to Robert, saying, "Robert, let's get the party started." The entire class moved to the hallway where Victoria and Lee's 3-D art project hung. During their presentation, both girls spoke coherently and in turn about their work, although they had not rehearsed. Victoria explained to the class, "We think it is beautiful because of the colors and how they come out." The girls intentionally chose a small hallway with good lighting and used four colors of cans with planned repetition of colors. They described the challenges of making the sculpture. Next, the teacher invited critique from the class, starting with positive statements of meaning. Every student offered comments, some examples being: "They used really thin wire so not to distract; like wind chimes"; "I like the spacing between cans; nice balance in length, not the same size but nice"; and "Kind of shiny and reflect light, like a good feeling." Next, the teacher asked for other opinions or observations, and one student suggested that it needed a title and the artists' names on the wall. The 20-minute presentation ended with the teacher and students congratulating the girls on making art with found or recycled objects.

Circle Time: "Good morning, Southwest New Tech!"

Victoria and her art classmates headed to the gymnasium for Circle Time (15 minutes long), an opportunity for the entire school community to come together for announcements, to celebrate student and staff achievements, or to make amends for any transgressions to the SWTech's school norms. Victoria sat on the floor with members of her art class and listened as a teacher enthusiastically greeted the school community, "Good morning, Southwest New Tech High!" The students responded by cheering loudly. The teacher introduced two U.S. Army recruiters who discussed their Army careers and college tuition assistance. The students were invited to visit the Army STEM van in the school parking lot. A school counselor was congratulated for completing her doctorate, and everyone clapped enthusiastically. Next, a student council member announced the upcoming Sadie Hawkins dance. Another student reminded the assembly that it was the end of the semester and encouraged his peers, "Keep your grades up. Keep your academic honesty and don't cheat. That's not tolerated at this school. Do what you're supposed to do." Music played as the students left for the next class.

Period 2, Practical Writing Class: Shaniqua Podcasts and Victoria Multitasks

In the Practical Writing course, 13 sophomores (6 girls and 7 boys) sat in a close U configuration of desks facing a large screen and projector. The students were using computers, cell phones, and tablet computers. The teacher began the class with an objective: The students were to identify fact versus opinion, bias, and target audience through a discussion of a "campaign video" on the merits of tablet versus personal computers. This was apparently a hot topic at SWTech. The campaign video had been made by a Southwest New Tech 12th-grade writing class. Students were directed to take notes in their journals as the video played and then to work in PBL groups of four and complete an individual writing assignment that would be graded.

Victoria pulled out her notebook, a bound paper journal. Each student had such a journal for each class. The teacher began the discussion using a question-and-answer format, tossing a soft foam ball to respondents who tossed it to each other to speak. Victoria seemed happy, interested, and relaxed. She munched on a hot crunchy treat, followed by a bowl of cereal with milk, sharing with other students. It is not clear where the food came from. She completed the first part of the assignment while eating and watching the video intently. Despite its weak sound quality, Victoria was interested in the video debate. Suddenly, a student who came to class wearing a long black and red wig (it is the week after Halloween) took on a new public persona. He spoke into his cell phone using a loud female voice. This was the flamboyant Shaniqua (a character from a 1990s hip-hop music video), and she was doing a live news podcast. Shaniqua seemed no stranger to the class and no one thought that her newscast was unusual. Another student brought the class back on track, saying, "I think we [students at SWTech] have personal bias [about technology] so our opinions may not change, based on the campaign." Victoria contributed to the discussion, observing that the world's population needs computers. Students moved flexibly between the paper journals and electronic media. Victoria diligently took notes and offered her thoughts and clarifying questions to her group of three girls as they seriously discussed the video. At one point, she gave her friend Dallas, who was in this group, her necklace to wear. The

necklace had a pretty plastic vial containing Victoria's DNA—she extracted it in her biotechnology class and made it into wearable art. The writing teacher advised students to save their work on the ECCO system so he could grade it later.

Victoria's group of four chatty girls joked with the teacher during the group work time. It was hard to tell from the banter whether the group was on task or not; they approached the assignment playfully. One girl noted that "work ethic" was being called "agency" this year at Southwest New Tech. The class was winding down, and Victoria talked about tomorrow's Renaissance Festival field trip. Students were excited. Victoria announced that she was bringing food for every hour of the field trip. She continued to write furiously, at one point saying, "This is crazy." Then, she closed her tablet, finished. She chatted with another girl while texting on her cell phone. Spirits were high; the students were still excited about Halloween and looking forward to the upcoming field trip.

Victoria was very socially engaged, but she seemed to get her work done, perhaps more so than most students. In this class 92% of the time was spent on task; 25% was primarily teacher centered, 25% was small group centered, and 50% was spent on individual seatwork.

Lunch: "**You shouldn't choose a job based on how much you make.**"

Victoria's lunch started at 11:30 a.m. She typically sat with the same group of good friends, 10th-grade girls and one boy (these friends were ethnically/racially diverse—White, African American, and Hispanic). Victoria noted that people are really friendly in this lunch period. Principal Duhovit burst into the cafeteria. Loud and excited, he enthusiastically engaged with a table of boys: Something good had just happened. The Army recruiters were set up along a wall of windows. Victoria and her friends, seeing them, discussed a life with the armed services versus civilian careers. Victoria wanted to visit the STEM van, parked at the school. Her friend Lynn responded, "You should join the Marines," and explained her family's connection to the Marines. Victoria observed, "You shouldn't choose a job based on how much you make." Next, the conversation turned to the cost of the school lunch, and Lynn noted, "40 cents for me, I'm reduced." Victoria said, "I'm free." The information was offered openly. They discussed an upcoming spring trip to Florence, Italy, with the SWTech art class. The girls considered the jobs they had, or needed, to help pay for the trip. When asked about their relationships with students who attend the large comprehensive school (Southwest High), they explained that because they went to the same middle schools, they know many of the students. Charles plays on the Southwest High School basketball team and said that he is neither welcomed nor ostracized there, commenting "If you're good at sports, they won't have a problem." When Victoria, Lynn, and Dallas finished their lunches, they headed outside to visit the Army STEM van. The van had three rooms of media, military scenarios, bright lights, and loud noise. The girls went through it in 5 minutes, with Victoria taking the lead in an electronic vehicle-building game, operating the controls. She seemed to be a quick study. None of the girls said that they are particularly interested in the Army, however.

Period 3, Advanced Biotechnology/Chemistry: Superheroes, Supervillains, and Lewis Dot Structures

Victoria and two girlfriends arrived late to the Biotechnology/Chemistry course because of the visit to the Army STEM van. No one questioned why they were late. The class was co-taught by two teachers, one male and one female. The warm-up on a white board was on ionic and covalent bonds. Apparently, in this project, PBL groups were to choose a bonding structure that would give superpowers to a character that they developed, a superhero or supervillain.

The classroom was crowded. Victoria sat perched on a lab counter, next to a lab table with five other girls. Victoria multitasked and socialized with her friends while completing the warm-up. Students used their notes, periodic tables, and tablet computers to complete the task as the teachers circulated to respond to students' questions and stamp completed work. This class session was an introduction to a new unit on bonding. It was traditional chemistry taught primarily through a highly interactive direct instruction method. The teachers gave a problem on Lewis dot structures for the students to draw and solve. The students tried it out in their groups as both teachers circulated to help, and then the teachers explained to the entire class. Victoria seemed equally engaged in socializing and the chemistry but got her work done and turned in the assignment for her group at the end of class.

When asked about STEM classes at Southwest New Tech, Victoria described how the classes like Biotechnology/Chemistry are taught and their difficulty:

> Some of them are co-taught, so usually one of the teachers starts explaining, like, what we are going to start doing. …The main teacher of that subject starts talking about it and giving us projects and everything. But they still add a little bit of the other stuff, like in Chemistry and Biotechnology, we would talk about, like, some stuff about chemistry, then we would get into biotechnology. ...For the chemistry part, we are kind of learning the same thing we did in eighth grade about the periodic table, like how to do the atomic mass and everything, but then we get into more of biotechnology, which is really different compared to middle school.

> They [the STEM classes] are kind of easy and they are kind of hard. Pretty much both 'cause there's some units where it's pretty easy and then others get a little difficult throughout the year. Right now, like, we are just learning about the periodic table which is pretty easy, but my junior friends told me once they introduce moles, then everything gets all difficult, and I just can't wait.

Victoria explained that a big difference between SWTech and middle school PBL was how students worked together:

> In middle school, we really only had one person in the group do the whole thing and, like, the other group members would add a little stuff. But here, we get, like, everyone in the

whole group adds stuff to it and that's how the final product is made. We can't just get, just rely on one person. Even if that one person would do it, they would still fail because they wouldn't get graded well for communication or research, because they didn't, like, include their peers.

The SWTech Biotechnology/Chemistry class seemed to be happy and productive, where all the students were engaged. Throughout the class, teachers praised student work and were accessible to aid students in need of assistance. In this class 100% of time was spent on task; 33% was primarily teacher centered, 56 % was small group centered, and 11% was spent on individual seat work.

Period 4, English/World History: Preparing for a Renaissance Festival Scavenger Hunt

The cross-disciplinary English/World History course was held in a large room, perhaps two classrooms combined, with tables and plenty of room for the 29 students to spread out and work in groups. Victoria was sitting on a rolling chair in the front half the room, facing a projector board. There were two teachers, one male and one female, ready to discuss class announcements and objectives.

At the start of the class, the male teacher reviewed student requirements for the Renaissance Festival field trip the next day. The students were clearly excited. This privilege had been denied to last year's 10th-grade class because of poor work. The trip was organized as a scavenger hunt, with students using electronic means to document what they found. They had specific questions to answer in photo format, using their cell phones or iPads. The information they gathered would help launch a new PBL unit on the development of western society. The hunt themes involved technology and weaponry; production and spread of text and literature; cultural representations of clothing, tools, and language; and theater and entertainment. Throughout this discussion, Victoria sat quietly and attentively. The intention of the trip was clearly a cross-disciplinary exploration of the intersections of the humanities, history, and technology.

Next, students spread out and broke into their PBL groups to work on their current projects on classical civilizations. Victoria was the only girl in a PBL group with four athletic boys. One boy said that he and Victoria had always been in the same PBL groups since school started in September; he seemed quite happy about this. Victoria was writing an advanced sonnet (14-line poem) using resources on the ECCO system. The project also involved essays on cultures and poems in forms characteristic of each culture. This was a highly sophisticated project, and remarkably the teachers were able to structure it to integrate writing and history while bringing in STEM themes. They circulated constantly among the students, asking if they could be of help and inquiring whether the students needed more instruction in a writing workshop.

Victoria worked on her own, using tablet and computer, but was in close proximity to the boys in her group. While the boys were sometimes off task, Victoria continued to work on the project. All students in the group were to receive the same grade for the project but would receive

individual grades for work effort. Victoria looked at the sample projects in the room from another year to see what the best ones contained and then worked conscientiously until the end of class.

In this class 100% of time was spent on task; 38% was primarily teacher centered, 62% was small group centered, and 0% was spent on individual seatwork.

Period 5, Geometry/Engineering: Building a Skateboard Park with Triangle Obstacles

Victoria's last period of the day was a combined Geometry/Engineering course with both 10th- and 11th-graders. This class was led by a female geometry teacher and a male teacher, a former engineer. The room was large, with set of desks arranged in a U-shape in front of the teacher for workshops and lined with counters with ample personal computer and Mac work stations. Victoria worked in a PBL group of two girls and two boys.

The PBL unit was designed from Southwest learning outcomes on triangle congruence. The driving question for the unit was: "How can we as architects create a new aesthetically pleasing mathematically enhanced skate park to suit the needs of a local skateboarding team?" The goal was to build a skate park using triangles as obstacles. For each required obstacle to be built, students had to develop a two-column geometric proof, an interesting combination of traditional geometry and a popular engineering challenge, although Victoria said that she has never seen a skateboard park.

The female teacher began class with a series of claps for attention and the students joined in, clapping rhythmically, while they sat in a cluster of seats in front of her. She discussed the challenges of geometric proofs. Victoria had her notebook out; it was filled with cutouts of geometric shapes. This project demanded formal reasoning and some creativity and freedom. After the introduction, students took notes on proofs individually for about 15 minutes. As Victoria moved back to her seat with her group, she saw that her good friend Dallas looked unhappy about the work, and she stopped and tapped Dallas gently and encouragingly on the nose. After note-taking, the teacher gave the students three choices about how to approach the proofs: they could work in their PBL groups on a structured exercise on ECCO, go to a workshop where she would provide direct instruction on proofs, or work individually with resources like the Kahn Academy videos. This was all by design, as the teacher later explained,

> So students, they had written resources, video resources, and the option for direct instruction. They could really monitor their own learning, and they could decide whether or not they wanted to read and take notes, watch a video and take notes, get information directly from me, and were able to pace themselves based on what they felt their needs were.

Victoria went immediately to a Mac, put on headphones, and connected her tablet to the Mac to work on Kahn Academy material. She yawned but used the Kahn Academy geometry for the rest of the class, switching from notebook to Kahn Academy video. She did not interact much with

her group but worked intently, uninterrupted until class ended. Later, she explained that she learned best from the Kahn Academy video and preferred to use it.

Meanwhile, about half the students attended the workshop. The teacher instructed the students to turn to a page in ECCO, and they begin to construct a proof. The teacher reassured the students about the challenge of proofs. She used direct instruction for the workshop, and her explanations were clear and well planned. Students were beginning to yawn, but the teacher persisted, a both gentle and commanding presence. Then a student time keeper loudly called out "6 MINUTES." The engineering teacher had been quietly circulating to support students working in groups.

Victoria demonstrated her ability to self-regulate, her intense focus, and her independence, yet she also was accomplishing work for the group. Later, the female teacher noted that this is characteristic of Victoria—sitting alone and pulling away from the group—when she wants to get things done. But the male teacher explained,

> Yeah, allowing them to choose, Victoria immediately went to her superstrength, which is definitely focusing in individually, knowing exactly what she wants to get out of it, and not being distracted. She will be a resource for her group now though. There's no question in my mind that if someone has a question, she will be prepared to answer their question. …She is very participatory.

The female teacher noted, "You know, it's kind of a good balance back and forth...kind of zone in, get her stuff done." Both teachers agreed that Victoria is an extremely organized student with a beautiful notebook and that she can be social but in a positive way. She is respectful but asks good questions, and she is very particular about the neatness of everything. She takes charge of her own learning.

In this class 100% of time was spent on task; 34% was primarily teacher centered, 22% was small group centered, and 44% was spent on individual seatwork.

Discussion and Interpretation: ¿Cómo era tu día escolar hoy?
"Victoria, how was school today?"

The goal of the case study was to see SWTech through the eyes of a student in a Day in the Life format. Although we did not keep track of Victoria's activities after school, given the obvious involvement of her parents in her education, we imagined them asking her about her day and perhaps about what she had learned. We imagined that a sociable and involved teenager like Victoria might describe her day at SWTech in a number of ways.

What Did Victoria Learn?

The description of Victoria's day shows that she was active, engaged, and involved in the construction of her own knowledge in every class throughout the day. She might tell her parents about her art class, where she and her partner, Lee, completed their 3-D sculpture and installed it. It was an act of design, problem-solving, and redesign, both creative and practical. She might plan her attire for the formal presentation of the 3-D sculpture, thinking about how she wanted to

look as she and Lee presented their sculpture to the class. The girls would talk about art and beauty and its attributes, through the experience of making their own piece of art. Perhaps Victoria would describe her Practical Writing class and the class debate about tablets versus personal computers or about the video produced by the older students and how she might improve upon it. Most certainly the family would discuss the upcoming trip to the Renaissance Festival and what she should take, including a charged cell phone to capture the pictures of objects that would lead to the History/English class' next unit on western civilization. Maybe she would talk about how easy the Chemistry/Biotechnology class was for her today but how she expected it to get harder, while at the same time reporting about the challenges of geometric proofs and how her skateboard park design was progressing. While taking it for granted, Victoria used multiple technologies throughout the day to access information, to produce her own ideas, and as a means of keeping track of what others in her groups were doing. She was building these skills with ease.

Was It Fun? (What happened from a social, emotional, and developmental point of view?)

Victoria seemed happy, socially engaged, and vibrant throughout the day. She has many friends, some close, and has time to socialize with them or work with them in her classes. She reported that there are few cliques at SWTech. She did not get into trouble with teachers or have hassles with other students. (Nor did we see any evidence of any other student in trouble or having hassles during our 2 days at the school.) She seemed to be in her element, and the school's positive culture was not lost on her. She was immersed in working with other students in PBL groups; in most cases, the groups were assigned by the teacher. This meant that Victoria's PBL interactions would include the full range of students at the school. She worked with all kinds of students and in a productive way—they had specific tasks to accomplish. This would help her further develop her collaborative and leadership skills. At the same time, she has learned to self-regulate her own learning and regularly tuned herself inward to accomplish her goals, even putting on headphones to focus on geometry proofs. She is developing the personal agency to accomplish things that she wants or needs, whether it is a response from a teacher when she does not understand something to creating a club or designing a project. Student agency is not an accident that occurs at SWTech; the students are given the freedom to make decisions about how they are going to get their work done. The teachers are conscious of how to build this into the PBL assignments while using the ECCO system to scaffold the work. They provide the supports for students who need help to rise to the challenges—challenges are an expectation for all. This is in contrast to many high schools where students are highly regulated in their work or must sit for long hours through teacher-delivered lectures and individual seatwork and where the main challenge is trying to focus. SWTech is in contrast, highly interactive and encourages the development of social and emotional learning, as well as academics.

Where Will This School Take You?

The strong STEM core was not the main reason that SWTech was founded according to its principal, Mr. Duhovit. Rather, the district needed a new model of a school that would remedy a

situation where too many students failed to go to school altogether or to graduate from high school. SWTech used the New Tech Network to provide direction toward Project Based Learning as the instructional model and to provide the technology to undergird it. SWTech has a near 100% graduation rate and college admissions rate. Its graduates know how to express their ideas to experts and peers and to work together, as well as to seek help when they need it. They will have completed hundreds of projects and presentations by the time they graduate. The projects in all the classes are based on Southwest education requirements, which all students learn through PBL. The school is not merely a "feel good" school, but demanded much of its students, academically and socio-emotionally. Nor does it depend on the background knowledge and advantages of affluent families to buttress school learning. The SWTech community is not rich; about half the students are the first generation in their families to attend college. The teachers use the learning standards to structure the PBL units by embedding them in each project. The projects are focused on something other than a textbook; the teachers structure them to make multiple transdisciplinary connections to the world outside of SWTech and the world of work. The projects are outward facing and designed for student production through extensive use of technology. Victoria's teachers are aware of her as a young person, developing intellectually and socially, and are eager to support her. Victoria's parents remarked about how SWTech is different from the comprehensive high school that her brother is completing. SWTech is preparing her for college and beyond. Victoria herself understands that she is changing and growing. She sees herself in college and in a STEM career and is eager to make it happen. SWTech may provide her with the means.

References

National Research Council (NRC). (2010). *Successful K-12 STEM education: Identifying effective approaches in science. Technology, engineering and mathematics.* Committee on Highly Successful Schools or Programs in K-12 STEM Education. Washington, DC: National Academies Press.

New Tech Network. (2015). *New tech network*. Retrieved from http://www.newtechnetwork.org

AUTHOR et al., 2013.