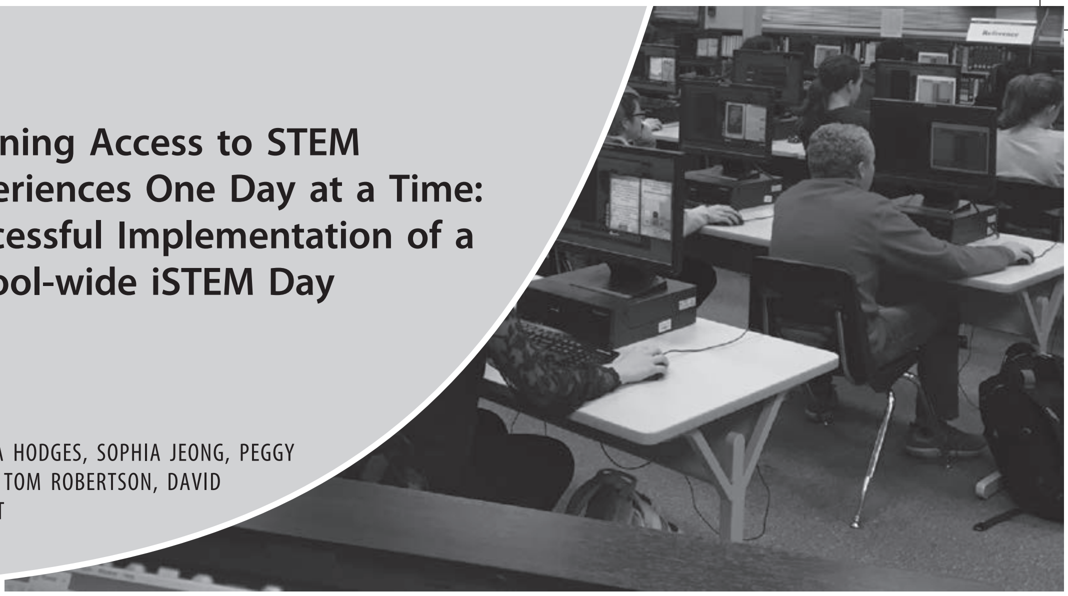
FEATURE ARTICLE

Opening Access to STEM Experiences One Day at a Time: Successful Implementation of a School-wide iSTEM Day



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Abstract

Creating partnerships that leverage skill sets from universities and corporate entities to improve STEM (science, technology, engineering, and mathematics) education is often discussed in theory. However, examples of successful models that might inform practice are scarce. This article describes how one STEM business, university educators, and middle school administrators and teachers successfully developed and implemented an integrated STEM education (iSTEM) experience for all eighth-grade students at a local middle school. We created a professional learning community to establish the goals and vision for the iSTEM day, which included the use of instructionally sound pedagogical methods, intellectually stimulating learning experiences, and a deeply developed understanding of the school context. Our team successfully completed a one-day learning experience that focused on the fundamental concept of osmosis and problem-solving skills. However, the broader impacts of this day included a new collaborative network between the university, the company, and the middle school that remains intact and productive.

Key Words: *Partnership; STEM day.*

○ Defining STEM

Across the nation, policymakers, parents, and teachers contend that meaningful educational experiences affect the livelihood of children long after they leave the classroom. As evidenced by the cheating scandal in the Atlanta Public Schools and by the controversy surrounding the No Child Left Behind Act– the most recent rewrite of the Elementary and Secondary Education Act (ESEA) – the United States lacks a consensus on just how to define and quantify this nebulous educational experience. In the science classroom, teachers are experiencing a similar quandary as they face the added challenge to create meaningful STEM (science, technology, engineering, and mathematics) experiences, which scholars define and quantify in markedly different fashions. The Arizona STEM Network has defined STEM in a way that resonates with our own collaborative team, as

> an integrated, interdisciplinary approach to learning that provides hands-on and relevant learning experiences for students. . . . It engages students and equips them with critical thinking, problem solving, creative and collaborative skills, and ultimately establishes connections between the school, work place, community and the global economy. STEM also helps students understand and apply math and science content, the foundations for success in college and careers. (Arizona Stem Network, 2014)

Our team entered this space to help support a school that aspired to integrate STEM but needed help in constructing the support system.

In the state of Georgia, educational leaders have narrowed the definition of STEM to "an integrated curriculum (as opposed to science, technology, engineering, and mathematics taught in isolation) that is driven by problem solving, discovery, exploratory project/problem-based learning, and student-centered development of ideas and solutions" (Aguilar & Lyon, 2015). Collectively, these conceptions of STEM education resonate with educators, yet they may seem overwhelming to many, including the scholars who study this. Trained as content specialists in distinct fields, such as biology or earth sciences, educators are now tasked with creating integrated STEM experiences when they still have hundreds of papers to grade, labs to prepare, lessons to construct, and end-of-course testing that requires alignment to specific content standards.

Our team entered this space to help support a school that aspired to integrate STEM but needed help in constructing the support system. We assert that teachers cannot be asked to develop such integration without support from people outside of the classroom, as we describe in our model. Our team developed an integrated STEM education (iSTEM) day and successfully conducted it with >200

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middle school students and 12 teachers. Committed professionals, these teachers participated in the development and deployment of the whole day, from changing the lunch schedules to coleading new activities. However, the science coach for the county provided the leadership for the integrated day.

○ Why Is an iSTEM Day a Good Idea?

You may be thinking that special days sound like fun, but they are a pain to plan and rarely teach anything worthwhile. Any sort of special day, whether it's a science day, math day, or integrated STEM day, requires extra effort, planning, and time. Not to mention that teaching integrated content is challenging and potentially unfamiliar, even for experienced teachers. Why then is an iSTEM day a valuable experience for students and a worthwhile commitment for teachers? Such an experience may have a lasting impact on students' success and interest in school as well as on their career choices. In this field-tested model, we show that an iSTEM day can be organized to provide valuable learning experiences for students, based on research-based best practices. Furthermore, an iSTEM day can provide an opportunity for teachers to pilot new practices before incorporating them into regular classroom instruction.

○ Creation of the Partnership

Often, teachers or parents have relationships with business owners who may have skills that support STEM goals. However, our model suggests that in order to successfully partner businesses, universities, and public schools, a science coach may most readily do this, given the flexibility of that job. During approximately 15 hours, University of Georgia faculty, the company Cogent Education, and the science coach for the Clarke County (GA) School District collaborated to construct a proposal that aligned specific learning goals for an iSTEM day (Figure 1). Upon completion of this document, the science coach contacted the administration at various schools within the county, and administrators from Highland Middle School responded favorably. After administrative approval was gained, the teachers at the school were contacted to determine whether there was interest in moving forward. It is important to note that the science coach, knowing how to maneuver within this specific school system, cleared obstacles for all the entities.

Next, the university faculty and the Cogent Education team met with the teachers and administrators at Highland Middle School to codevelop the flow of the day. Our team arranged weekly meetings that took place during collaborative planning time for the teams so that all members were present. Our teams met five times for 90 minutes, during which time we chose the specific activities that we would implement during the iSTEM day.

Figure 1. A pipeline to collaboration in secondary schools.

○ Clearly Identify Driving Goals for Each Team Member

In order to successfully collaborate, all participants must agree on the goals for the specific activity, in this case an iSTEM day. As such, we first examined the literature related to STEM integration to identify what the research has prioritized. According to a report by the Committee on Integrated STEM Education (2014) convened by the National Academy of Engineering and the National Research Council, STEM education, unlike much of traditional education in science, technology, engineering, or mathematics, includes integration across these disciplines. Across all STEM initiatives, the degree of integration and the relative emphasis of disciplines vary greatly (Committee on Integrated STEM Education, 2014). The report of the Committee on Integrated STEM Education (2014) outlined guidelines for integrated STEM experiences, and we implemented many of these:

- Supports for educators
- Partnerships between STEM educators, universities, and STEM industries
- Attention to student outcomes, including "learning, thinking, interest, identity and persistence" (p. 10)
- "Measured, strategic" integration (p. 5)
- Support of students' discipline-specific knowledge

Based on a shared understanding of the aforementioned guidelines for STEM experiences, our team constructed goals specific to our collaboration and ensured that they were aligned with the literature (Figure 2). This is an important step if teams intend to purposefully construct a day that readily meets goals agreed upon by the team. We then utilized this set of goals to frame the actual flow of activities for the teachers and students.

Goals for the iSTEM day. We developed explicit goals for the students and teachers who would participate in the iSTEM day that were informed by the research on STEM as well as the direct needs of the county. Specifically, the Committee on Integrated STEM Education (2014) set out four goals for an integrated STEM curriculum: (1) increasing students' STEM literacy, (2) increasing students' 21st-century competencies, (3) building a STEM-capable workforce, and (4) expanding students' interest and engagement in STEM.

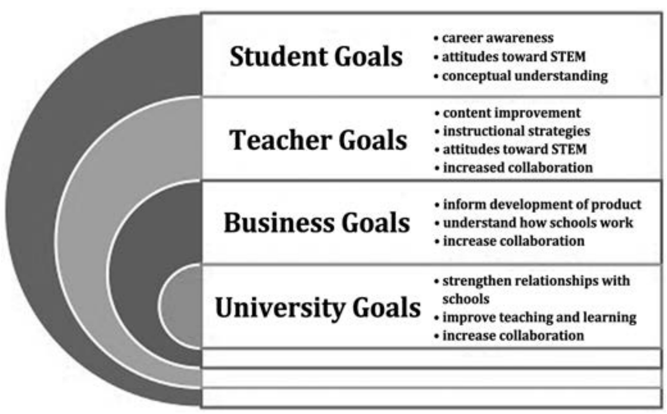

Figure 2. Establishing goals for all stakeholders.

Student goals. On the basis of these broad goals, the team articulated the following explicit goals for students:

- Preview STEM activities students would see in high school to assist in the transition from middle to high school.
- Provide an engaging and high-interest environment in which students could actively participate in STEM activities.
- Promote career awareness by creating a space for students to talk with STEM professionals, including biologists and software developers.
- Inspire students to take science classes in preparation for college and to consider STEM jobs.

Teacher goals. In addition to the suggestions of the Committee on Integrated STEM Education (2014), the team addressed the direct needs of Highland Middle School. We asked teachers to identify teaching strategies they would like us to help support, in addition to specific scientific content. On the basis of school-wide data, we identified osmosis as a concept that students had difficulty mastering and addressed this concept with multiple learning experiences. As such, we focused the entire iSTEM day on osmosis so that students would have multiple opportunities to interact with and master this difficult yet fundamental biology concept.

Instructionally, one of the county initiatives in use at Highland Middle School is the 5E model of instruction (Bybee et al., 2006), so we threaded this instruction throughout the day to help facilitate teacher understanding of the model. Prior to our iSTEM day, teachers attended a workshop on the use of the 5E model, yet the model had failed to gain traction in the actual classrooms. Therefore, the teachers asked if our team could model this approach during the iSTEM day. One teacher stated, "It's one thing to talk about the 5E model, or practice it in a PD session. It's a completely different thing to facilitate kids actually experiencing it." Due to ample support provided to teachers as well as an authentic opportunity to see the model in action, we hope that teachers now feel more equipped to utilize this methodology independently.

After creating an outline of activities, the research team met with all the teachers participating in the iSTEM day on four occasions over a two-month period to discuss the logistics required for the day. The activities included a 5E *Elodea* lab, a "Clark the Calf " case study, and a "Meet the Scientists" Q-and-A session. Students rotated through the learning experiences, attending each session for 45 minutes.

○ Activity 1: *Elodea* – A 5E Lab on Osmosis

This activity was conducted using the 5E instructional model, which has been repeatedly supported by research as a best practice in science education (Bybee et al., 2006). Compared to traditional lecture or "cookbook" labs, research shows that inquiry-based science instruction improves students' conceptual understanding and motivation (interest) while challenging students to actively work through and revise misconceptions (Bybee et al., 2006). As noted above, the STEM team utilized the 5E instructional model to guide the learning activity because Highland Middle School had implemented this model to train teachers.

All middle school science teachers in Clarke County had attended professional learning associated with use of the 5E model. Therefore, the incorporation of this instructional model provided another touch point for ongoing professional development on 5E for teachers and provided a familiar, high-quality instructional framework in which to situate iSTEM day learning. Team members adapted a traditional lab experience into a 5E learning experience. Throughout the day, the researcher led the learning experience while teachers assisted, so that new practices were introduced to teachers in their classroom. As a lead teacher explained, "It's paramount that teachers see best practice modeled for them *within* their school context."

The 5E model is rooted in the constructivist theory of learning, which states that students have preexisting ideas about natural phenomena and must actively build their own understanding of science content (Bransford et al., 1999; Bybee et al., 2006). The 5E instructional model consists of five stages that span a lesson, a series of lessons on a single concept, or a larger unit. The stages are Engage, Explore, Explain, Elaborate, and Evaluate (Bybee et al., 2006).

According to the original authors of the 5E instructional model, the Engage phase is usually brief and its purpose is to motivate students to investigate the central phenomenon or concept of the lesson (Bybee et al., 2006; Bybee, 2014). The Explore phase allows students to collect data and make observations to further understand the concept. In the Explain phase, students are given a chance to analyze the data and form their own ideas before the teacher shares scientific terminology and canonical explanations with them. Next, students participate in an Elaborate or Extend phase that, according to Bybee et al. (2006), gives students an opportunity to practice transferring their new knowledge by working with the same general concept in a different context. Finally, the lesson ends with an Evaluate phase that assesses students' conceptual understanding (Bybee, 2006).

Engage: The *Elodea* lab began with a discrepant event that revealed students' conceptualizations related to osmosis. The STEM team asked students what they thought would happen to "gummy bear" candies that were placed in pure water for 45 minutes. Students stated whether they thought the gummy bears would shrink, expand, or stay the same. They were also given the opportunity to justify their answers by verbally sharing them with the class. Most students agreed that the gummy bears would expand, but they were not sure why they would expand (Figure 3).

Explore: Students were then divided into small groups and asked to explore what happens to the cells of *Elodea* plants in three solutions: pure water, 5% salt (5 g table salt [NaCl] per 100 mL solution), or 10% salt (10 g per 100 mL solution). (These were hypotonic, isotonic, and hypertonic solutions when compared with the *Elodea* plant.) Students were guided through the process of focusing the microscope and making a wet slide with a live *Elodea* leaf. Then they were given the opportunity to predict the results of placing the *Elodea* leaf in each solution. They placed the *Elodea* leaf in sequentially more concentrated salt solutions and recorded their observations.

Explain: After collecting the data, students were encouraged to discuss in their groups what happened to the *Elodea* leaves and why they thought those changes occurred (the "think, pair, share" model). Multiple students began using their personal devices, including cell phones, to magnify their microscope view (Figure 4) and discuss with other groups. Once students had shared their answers in their groups and with the class, the instructor reiterated the key points and the

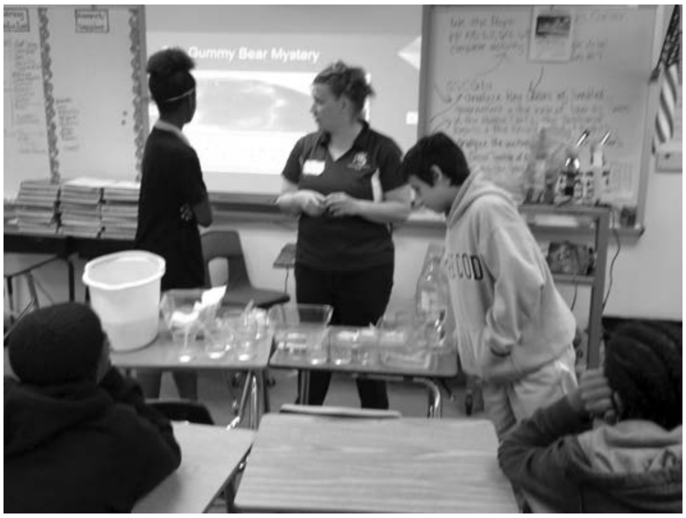

Figure 3. Eliciting students' ideas through a discrepant event.

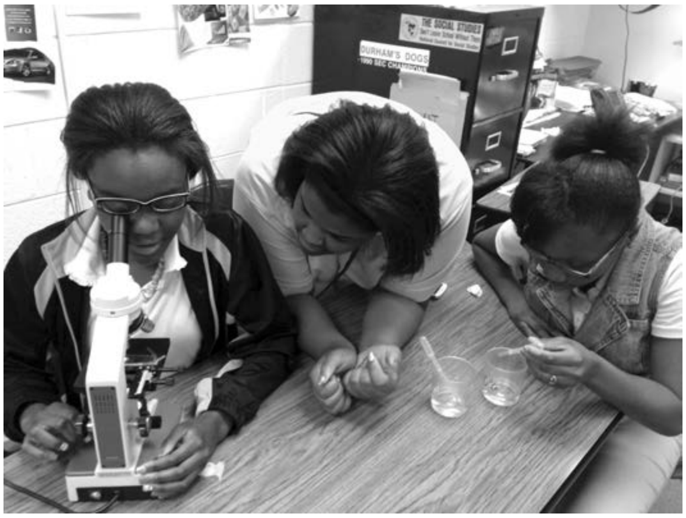

Figure 4. Creating and examining *Elodea* slides.

scientific explanation and introduced the science vocabulary term *osmosis* to describe the process.

Elaborate: In the Elaborate stage, students applied the explanations they had built in previous stages to understand why the gummy bears had grown in the water. Thus, they were able to return to their original predictions and revise them as well as apply the mechanism of osmosis across contexts.

Evaluate: This lesson did not have a formal Evaluate stage. In the future, the team hopes to incorporate an Evaluate stage into the iSTEM day to track growth in student understanding and to identify any misconceptions the students may still hold at the end of the lesson. Informally, the team was delighted by the caliber of discussion among the students and the connections students made to situations in the real world. For example, during the Explain stage, some student groups recognized the similarities between the shrinking of the *Elodea* leaves and the shrinking of their own skin when swimming. Students were also able to make connections between the *Elodea* lab and the gummy bear lab during the whole-class summary discussion. These comparisons suggest that some students were able to transfer the idea across contexts. However, these are informal observations. Organized data collection would be required to confirm the prevalence of these observations.

○ Activity 2: "Clark the Calf" Case Study

The "Clark the Calf" case study is an interactive, three-dimensional, virtual learning environment. A team of veterinarians and science education researchers initially conceptualized the interactive case study. In this immersive case study, students learn about osmosis while taking on a role of a health professional. They utilize problem-solving and critical-thinking skills that a scientist would use in real life to help save the calf. The addition of the immersive case study creates a model STEM program in which unique components of the case study contributed to a successful integration of technology into science, engineering, and mathematics. Also, the case study helped heighten students' engagement by using a complex story line, a sympathetic main character, and an active and social learning environment, which will be described below (the case study is available from Cogent Education: http://www.cogenteducation.com/products).

Initially, students were presented with a real-life story about a one-week-old calf named Clark. In the story, the owner of Clark, Cecil Bingston, called a veterinary clinic because Clark had diarrhea and was given 8 quarts of water in addition to his normal bottle of milk. He was lying down, nonresponsive and experiencing seizures. The message was clear: The students must help Clark or he would die. This real-life story line served as a "hook" to grab students' attention (Figure 5).

Many anecdotal stories of educators planning for STEM events discuss the importance of having "hooks" to motivate students (Davis & Hardin, 2013) and to increase their interest in STEM subject areas (Roberts, 2014). One study examined the impact of introducing a story line into a computer game on the players' level of involvement (Schneider et al., 2004). In that study, when the game was structured around a story, the players reported an increased identification with the game characters, a greater sense of presence, and more immersion in the virtual environment (Schneider et al., 2004).

In addition to *hooking* the students' interest, the case study provided a story line and a sympathetic character that held students' attention and interest for the duration of the lesson. Stories are powerful learning and motivational tools. Bettelheim (1976) described how children are often captivated by bedtime stories in which they may identify with the heroes or heroines and vicariously experience triumph and rewards. As such, the case study of Clark the calf gave students the opportunity to act as a hero or heroine by saving Clark's life as his virtual veterinarian. This role served as an intrinsic motivation to learn the science required for saving Clark. Furthermore, students found Clark to be a sympathetic character. In previous research using the same game, the university professors on the STEM research team found that, among ~1500 high school students of heterogeneous ethnic and racial backgrounds, most responded deeply to this case, in part because they valued saving an animal's life (G. Hodges, personal observation). The STEM team observed a similar trend in student engagement as the two elements of this case study worked in combination: a compelling story that hooked their attention and an animal protagonist that they wanted to help.

Figure 5. An overview of the "Clark the Calf" case study.

Figure 6. Exploring immersive learning environments.

Students worked in pairs throughout this case study (Figure 6) to execute a variety of tasks that assessed content understanding and the application of critical-thinking skills. For each task, students collaborated to solve a problem by applying their content knowledge about osmosis and information gathered from the case study. For example, one question asked, "Predict which way the free water molecules will diffuse [at a given concentration gradient]." In this task, students needed to understand that water would diffuse from an area of high free water concentration to an area of lower free water concentration in an environment with a semipermeable membrane that allowed only free water molecules to pass through. In subsequent activities, students applied this concept to understand how the diffusion of water into Clark's brain increased the pressure inside the skull and caused seizures. This continuous process of discussion, problem solving, application, and analytical thinking ensured that students learned to apply their knowledge within the appropriate contexts, and reinforced their understanding of the content in a contextualized setting.

In this particular case study, students "flew" into Clark's brain. Inside this virtual learning environment, students could explore anatomical features, such as neurons, red blood cells, blood vessels, cell membranes, water molecules, and sodium ions. Within the framework of modern theories of effective learning, our students were engaged in an "active, experiential, situated and problem-based" learning environment where learning is most effective (Boyle et al., 2011, p. 74). Students experienced virtual laboratory experiments, viewed animations of molecular and cellular components, and had immediate access to correct definitions of academic vocabulary within the software (note that one of the scientists who designed the software, Tom Robertson, stated that he did not want students going to Wikipedia because "that website is full of scientific inaccuracies, and especially regarding osmosis"). While collecting data, they could visualize the sources and types of data they were collecting. After data collection, they were taken to a virtual laboratory to analyze and interpret the implications of their patient's data in order to reach a goal: to save Clark's life by solving his medical issue. The STEM team suspects that because students took an active role in learning throughout the activity, their comprehension of osmosis improved. The cooperating middle school science teachers' feedback confirmed that the students were engaged in effective learning as shown by their improved performance on classroom exams and assessments for the osmosis unit.

Furthermore, a component of "immediate feedback" was critical in promoting effective learning outcomes (Boyle et al., 2011). The case study included several embedded assessment features, which were presented to teachers through a cloud-based data analysis system to provide the necessary feedback and track student progress in real time. As students worked through the case study, their answers to multiple-choice questions and their short responses were recorded. Students received immediate, automated feedback on all multiple-choice and other forced-choice questions. Teachers had the opportunity to view and respond to open-ended questions during the activity. This not only provided the teacher with a comprehensive view of individual students' progress, but also a macroscopic perspective on the entire class.

Feedback about the accuracy of their responses ensured that students were acquiring the required knowledge for which the task was designed. Teachers had access to real-time data on students' answers, which gave them the opportunity to address class-wide misconceptions if necessary. In addition, if students incorrectly answered a forced-choice question, they received immediate feedback in the form of written explanations of key concepts and visual animations to correct their understanding and/or misconceptions.

This particular scaffolding design of the virtual learning environment guides the students to think deeper about their responses in relation to previous questions and to new sets of data they collect throughout.

Lastly, it was interesting to see the interactions between each student pair as partners in this learning experience. Many studies have attested to the importance of social interactions in learning. Most notably, Vygotsky's (1978) "social constructivism" views social interaction as a key player in the process of cognitive development. Furthermore, Rahm (2004) reports that learning can be achieved through social interactions such as "interactions of multiple voices, students and teachers, reflecting on diverse interpretations, understandings, and personal experiences" (p. 225). Also, Tunnicliffe et al. (1997) and Tunnicliffe (2000) examined children talking while visiting science centers and found that they engaged in spontaneous scientific thinking. The main mechanism of learning in social constructivism is the discourse that takes place in peer-to-peer communication, which occurred while our students were working through the problems, applying their knowledge, and making the decision to administer a medical treatment to save Clark the calf. In this process, students were involved in constant discussion about what to do in a given situation to reach an end goal, which was to administer the correct treatment. Students did not always choose the correct answers to questions. When they answered questions incorrectly, they had the opportunity to discuss their mistakes with peers and reach a clearer understanding of the content. Students were given multiple chances so that they could talk about why their treatments did not work, reflect on the knowledge and information they have gained throughout the case study, and, once again, attempt to implement the proper treatment. For these students, conversations with other students helped them understand the process of osmosis and reach their goal of saving Clark. Thus, it was evident that our students achieved learning through social interactions with their partners in the process of "reflecting diverse interpretations, understandings, and personal experiences" throughout the case study (Rahm, 2004, p. 225).

In sum, the ideal qualities of the interactive case study include but are not limited to the "hook" for fostering intrinsic motivation, opportunity to learn problem-solving and critical-thinking skills, interactive and social learning among peers, accurate science content, and immediate feedback. These unique components can contribute to creating an exemplary STEM program in which students can learn the science and math content, experience the integration of engineering and technology into the subject matter of interest, and get a glimpse of the STEM careers that may interest them in the future.

○ Activity 3: Meet the Scientists

In the "Meet the Scientists" session, an artist, a computer programmer, and two University of Georgia science faculty members visited with students to answer their questions, give advice regarding their future academic planning, and discuss STEM career options. Thus, the aim of the session was to inspire and encourage students to pursue science in the future and to consider careers in the STEM fields (Figure 7).

According to the latest research reports, positive attitudes toward science and early exposure appear to be critical aspects for increasing student interest in studying STEM subjects. For example, one study indicates that "student motivation for and proficiency in science and math begin in the early grades" (Swift & Watkins, 2004, p. 72). Furthermore, a specific study conducted at the University of Bradford reported that approximately a third of 338 science and engineering students had made the decision to study science by the age of 12 and remained committed to their decision by choosing their major (Musgrove & Batcock, 1969). Thus, early integration of STEM education in our K–12 curricula is critical. According to DeJarnette's (2012) study, early exposure to STEM initiatives and activities had positive impacts on elementary students' perceptions and dispositions. Thus, exposing students at an earlier age to STEM content ensures that they are on a trajectory to complete the coursework necessary for a STEM degree at higher-education institutions and develop their interests in these fields (DeJarnette, 2012).

Figure 7. Informal conversations with scientists.

In the "Meet the Scientists" session, the facilitator did a quick survey of students who would be taking science courses when they enter high school. It was reassuring to see that many students were on track to take more science classes in high school. However, with the exception of a very few students, the general lack of enthusiasm about STEM subjects was evident. During the session, a female student asked a question that science and math teachers often hear: "When will I ever use algebra in life?" She continued, "I like taking pictures and want to be a photographer." In the context of that particular question, the programmer and the two University of Georgia faculty members were able to educate the class in the field of medical illustration, in which highly detailed artwork and high-quality photography are produced in collaboration with scientists and doctors. It was clear that the students initially perceived science to be irrelevant to their personal interests. However, by making a meaningful connection between science and their personal interests, the STEM team observed a positive shift in students' perceptions.

STEM, especially engineering, is traditionally a male-dominated field in which only a small percentage of women participate

(Carbonaro et al., 2010). It turned out that the panel of professionals during the session were all males. Girls' perceptions and experiences with science are different from those of boys (Carbonaro et al., 2010), and they begin to lose confidence in their ability to learn science during the middle school years (Dreves & Jovanovic, 1998). The researchers observed a similar trend during our session whereby male students were more engaged in asking questions of our faculty members and engineers. On the other hand, female students seemed more timid in approaching our panel with questions. One particular female student athlete asked her question not voluntarily but because her peers pressured her to do so.

Additionally, girls suffer from gender stereotypes and often perceive science, especially physics, as a subject for boys (Kessels, 2005). In order to encourage female students to pursue studies in STEM, science and mathematics educators must continue to understand the barriers that female students encounter and encourage gender diversity. As Kenway & Gough (1998) stated, "without gender diversity, there is a possibility that new ideas and potential opportunities in science will be missed." Thus, in this session, making a meaningful connection between science and students' personal interests and goals, especially for female students, may have played a critical role in improving their perception about science and increasing their interest in pursuing a career in science. For example, when the female student athlete asked a question about the relevance of science and mathematics in playing basketball, one of the engineers connected her interest in sports with how science and mathematics could be applied to improve her basketball shooting skills. Furthermore, care was taken to overcome the barriers to asking questions. To connect with the students, the panelists shared their personal stories of how they first became interested in the STEM fields and how they chose their professions. For example, the artist shared his passion and love for drawing and art, to which many students were able to relate. He then described the path that he took to become a digital artist and an animator for Cogent Education, which created the interactive case study in which the students had participated.

In sum, the panelists and the students were engaged in a conversation-like discussion about the students' personal interests. Also, connecting how the students' personal interests can be relevant to what they are learning in school, especially the science and mathematics courses, and vice versa, contributed to changing the students' perceptions about STEM learning and engaging their interests in possibly pursuing a STEM career in the future.

○ Conclusions

There is no evidence to suggest that one day can be all things for all students and teachers, but there is compelling evidence that iSTEM days shift the attitudes that students have toward science by showing them that maybe science is a field they should consider (Maltese & Tai, 2010).

In the next year, the research team plans to expand iSTEM days to other schools in the same district and across multiple districts around our university. In revising this model for the future, we assert that incorporating the 5E model across multiple activities within a school is an innovative and pedagogically sound method to deploy. To our knowledge, no iSTEM days have incorporated the 5E model across a full day of curriculum. Additionally, most iSTEM days include a variety of disjointed topics instead of deeply investigating one scientific phenomenon. Our team found that focusing on a concept that teachers identified as difficult for their students was invaluable. Teachers explained that by digging into a concept, they felt more equipped to teach the topic in the future in more meaningful ways.

Upon completion of the iSTEM day, the county requested that the university make this day an event for *all* middle school students, given the success experienced in one school. Teachers highlighted the new understanding they now have of fundamental biological processes that the team examined. We did not, however, collect measurable data regarding teacher understanding, because this fell beyond the scope of the iSTEM day. Teachers expressed a willingness to try novel instructional strategies and materials after we had modeled these in their school, using school computers and tablets. One teacher explained, "I feel equipped to change my teaching now, to try this next year, since I've seen it work here, at my school." If university and corporate partners sincerely aspire to support school systems, they must leave their buildings and enter the public school system. Next, partners must examine the school's learning goals as well as the currently practiced instructional methods. Finally, partners must collaborate with the teachers and administration to develop a cogent outreach plan. STEM outreach days provide all members of the school and the team with a low-stakes opportunity to provide students an unforgettable experience that may peak their interest in STEM careers. We believe that schools and universities may use iSTEM days, such as the day described above, as a platform to enrich the connections between various stakeholders who endeavor to improve educational outcomes from a community level.

○ Acknowledgments

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