PLACED-BASED STEAM

CEISMC EVALUATION

GoSTEAM

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WHAT IS STEAM?

STEAM stands for Science, Technology, Engineering, Arts, and Mathematics, but can mean many different things. For example, some use the "A" in STEAM to represent different arts disciplines (e.g., visual arts, music, or theatre), while others use the "A" to represent broader ideas, like creativity, problem solving skills, or making [1, 2]. Some use STEAM as a way to engage students in STEM through arts projects, such that the arts play a supporting or "subservient" role [3]. Others see STEAM as a transdisciplinary approach to integrating different disciplines, with each discipline valued equally and receiving equal attention in instruction and assessment [4]. We recognize the validity of different ways of defining STEAM, their unique purposes, and the important role of teachers in defining the STEAM approach that works best in their classroom.

Because there is no cohesive definition or STEAM or established set of STEAM best practices [5, 6], we looked for "high-quality lessons learned" in the STEAM literature [7]. We drew on existing models of integration, including Bresler's model of arts integration [3] and the National Research Council's STEM integration framework [8] to develop our own working definition of STEAM. For us, high-quality STEAM instruction involves student-centered instructional pedagogies (e.g., project-based learning, problem-based learning, inquiry learning), group learning, and real-world application to increase cross-disciplinary content knowledge through learning goals for students in both STEM and arts disciplines [9]. We understand that implementing STEAM can be complex and challenging. Thus, we envision STEAM as a continuum, moving from low to high levels of integration, collaborative practices, and complexity of STEAM projects.

WHY STEAM?

STEAM is being used across the globe in an effort to improve student outcomes in STEAM disciplines [10]. Studies in K-12 settings have shown that STEAM can increase students' STEM content knowledge, increase their intent to continuing studying or participating in STEAM, generate positive attitudes towards STEAM, and improve gender dynamics in the classroom [11-15]. With training and support, studies find positive pedagogical benefits for teachers, such as using authentic assessment, integrating technology in instructional approaches, and forming connections with resources and experts outside the school building to support STEAM instruction [16-18]. STEAM aligns well with approaches that allow teachers to step into a facilitator role, supporting student-led exploration, and to engage in collaborative relationships with their colleagues.

GoSTEAM@TECH

GoSTEAM@Tech is a professional development program designed to promote authentic integration of the arts into K-12 computer science, engineering, and invention instruction. The primary goal of GoSTEAM is therefore to create safe, interdisciplinary spaces where meaningful, cross-disciplinary collaborations can occur. Teachers from different disciplines, with the support of university-based coaches and Innovators-in-Residence, come together to design and implement novel STEAM lessons and initiatives in their schools. You can read more about the GoSTEAM@Tech program here: https://steam.ceismc.gatech.edu/.

PLACE-BASED STEAM

LESSON BACKGROUND

During the 2021-2022 school year, high-school teachers at a school in the metro-Atlanta area developed a STEAM lesson utilizing placed-based STEAM as a method for connecting students to their local community. As a part of the lesson, students created an app which featured businesses, museums, and other local spots to highlight the diverse culture of their community, metro-Atlanta. Paying homage to the Harlem Renaissance, teachers began to refer to the app as the "Atlanta Renaissance app." The goal of the place-based STEAM lesson was to provide students with new experiences that expanded their understanding of their community by integrating STEAM in science, social studies, graphic design, and computer science. Specifically, students explored the intersection of AI and Art, using tools like tools like Adobe Firefly, DALL-E, and Runway ML. Students were also presented with opportunities to explore their community through field trips to local sites and were encouraged to conduct research on community organizations and businesses that interested them.

Teachers continued to implement the place-based STEAM lesson during the 2022-2023 school year. Building upon the lesson from the 2021-2022 school year, teachers utilized their professional experience in ecology and environmental science to highlight environmental issues facing their community, such as food deserts, access to clean water, and pollution. Students were provided space to explore their community through field trips to STEAM spaces, including art galleries, and they also conducted research about businesses and organizations within their community working solve these issues. As a part of this lesson, students were tasked with uploading information and descriptions into the app developed the previous year, which encouraged students to learn about the cultural significance of their local community through the lens of STEAM.

Driving question:
How does place-based learning connect students to issues facing their local community?

LESSON IMPLEMENTATION

The initial place-based STEAM lesson was implemented by five teachers in the 2021-2022 school year with approximately 21 9^{th} – 12^{th} grade students in the fall semester. Teachers who designed the lesson taught subjects such as music, technology, science, computer science and social studies, and the lesson was implemented across classrooms. Students were unable to finish developing the app prior to the end of the fall semester, which was a disappointment to some who were eager to see the finished product. Thus, the teachers chose to continue their work on the app with a new group of approximately 52 9^{th} – 12^{th} grade students in the spring semester.

While students were developing the app, they were encouraged to do research regarding local businesses and organizations in the metro-Atlanta area. These businesses and organizations would then be featured in their newly developed app. Students conducted research during class time, after school, and during field trips. Teachers intended for the lesson to center social justice and equity, emphasizing that the place-based STEAM lesson captures the cultural diversity of the local community and connects students to real-world concepts. In particular, a teacher described the connection to real-world concepts, sharing,

> *"...The Renaissance app mirroring Harlem Renaissance in Atlanta. That to me feels inherently connected to social justice equity or, or even to just exploring like the lives of black culture experiences, food science, like all these aspects in Atlanta...was like mirroring Harlem Renaissance, Atlanta Renaissance."*

Findings from post-surveys completed by students suggests that students, particularly in the fall semester, enjoyed learning about new businesses, organizations, and facts about their local community. Students participating in the spring semester commonly explained that researching information was also a highlight of the lesson, and they also enjoyed designing and coding for the app, as well.

> *"...mirroring Harlem Renaissance in Atlanta. That to me feels inherently connected to social justice equity*
> *- GoSTEAM Teacher"*

As teachers reflected on the project at the end of the 2021-2022 school year, they noted the difficulty of finishing the project in one semester, and students' disappointment with not seeing the final result. The teachers decided it would be best to implement the lesson within the Science Club the following year because if students were unable to finish their work at the end of the fall semester, they would still be able to continue their efforts in the spring. Thus, in the 2022-2023 school year, 6 teachers further developed and implemented the place-based STEAM lesson with 9th-12th grade students as part of the school's Science Club, though a class of honors students participated in the lesson as well. The teachers also intended for the lesson to be implemented with the school's magnet computer science class, which was a part of the school's magnet program. However, due to a change in the school structure, the magnet program was not offered during the school year. This required teachers to pivot part of their lesson, as it was focused on developing an app. Instead, teachers utilized the app that was previously developed and updated descriptions of local businesses and organizations which had previously been featured. Teachers implementing the lesson taught subjects such as social studies, technology, computer science, music, and science. Throughout the year, teachers met with the students once a week to implement the lesson.

As a part of the lesson, teachers integrated their understandings of history, ecology, and environmental justice to expose students to issues facing their local community. Often, the project activities encouraged students to conduct research into organizations and businesses within their local communities. Additionally, teachers organized several field trips to galleries and community partners which reflect their community's culture. In focus groups, students explained that these field trips contributed to their understanding of their community, with a student sharing that the field trips "*took [them] out the classroom and put [them] in the city and like real world events, and [they] kind of like pinpointed different places and things around the city that [they] found interesting that [they] didn't even know realize was related to black culture."*

These field trips also helped students visualize how STEAM occurs in day-to-day life. In particular, students in focus groups described making connections between art and technology after visiting a local art gallery

> *…whether you're making digital design pieces, whether you're recording a video, or you simply just documenting your everyday life, that is some type of form of art.*
> *– GoSTEAM Student*

and community space. The multi-functional space aims to provide full-time artists with work space, gallery space, and event space. Students had the opportunity to interact with artists in the space. In doing so, they identified STEAM connections seen in the work of tattoo artists or in the work of one artist who students described as a "*documentarian. So, you basically can use technology to film your art, whether you're making digital design pieces, whether you're recording a video, or you simply just documenting your everyday life, that is some type of form of art*." This reminded student of their own experiences taking pictures on their phones because "*the camera is the technology, and the outcome is the art*." This integration of art and technology in their lives was so intertwined it was almost imperceptible, with one student explaining that "*they just go so well together you don't even see it*."

Students also mentioned attending several other field trips that year, such as a visit to a local historic arts district and a visit to Georgia Tech's film and recording studios. Because the high school was located about 40 minutes outside of the city-center, community partners also came directly to the school. Students participating in focus groups explained that staff from the Georgia Aquarium visited their school to do a showcase, which made it "*easier for students who are interested to learn about*" the Aquarium's initiatives. Often, students shared that the field trips were "*the most interactive*" they had while in school, expressing that engaging with community partners and Georgia Tech is a good way for students "*to know more about things like scholarships, new career fields, and things like that*." Students shared that by having the opportunity to explore their community and work with partners like Georgia Tech, they feel like their community is "*investing in [them]*."

CHALLENGES & RECOMMENDATIONS

There were some challenges faced by teachers who implemented place-based STEAM lessons, both in the 2021-2022 and the 2022-2023 school year. During the first year of implementation, teachers described challenges with building the app, as it required comprehension and experience in multiple content areas, such as coding and graphic design, which some teachers were unfamiliar with. In addition, the project incorporated various AI tools, such as tools like Adobe Firefly, DALL-E, and Runway ML. Thus, one of the participating teachers who taught computer science and the GoSTEAM Innovator worked collaboratively to support the other teachers during the app development portion of the lesson. If implementing this lesson without a computer science teacher, we recommend utilizing an app development framework or template, such as Jotform. Using an app development tool can lower the barrier to entry for teachers with little to no experience in computer science, as it provides a more user-friendly method for app creation. To further extend the AI connections present within this lesson, GoSTEAM developed an online guide detailing the Atlanta Renaissance lessons and sharing resources on AI tools to help implement lessons.

Another challenge that teachers perceived in the place-based STEAM lessons was that the lesson development required significant planning and collaboration time, which was not always available within their school structure. Instructional time was also a challenge in this lesson, with other curricular responsibilities leaving students unable to finish the project within one semester, as originally anticipated. Accordingly, teachers transformed the project into something that could be worked on in an extracurricular setting as a year-long lesson. While implementing the lessons in an extracurricular setting allows more flexibility in timing, in also necessitates clear expectations and commitment from students.

Even with the changes made after the first year of implementation, teachers implementing the lessons in 2022-2023 still required significant communication across teachers and grade levels, especially as common planning time was not always available. This was also important when planning for field trips to community organizations, as students were not necessarily coming from one class, but from the science club, distributed across multiple classes during the school day. One solution to alleviate these challenges would be to instead host guest speakers from community organizations at the school, allowing for more students to learn from and about their local community. However, because the place-based STEAM lessons encourage students to visit their local community partners, teachers can also closely with the external organizations to arrange fieldtrips that might benefit their students.

KEY TAKEAWAYS

During the 2021-2022 and 2022-2023 school years, teachers implemented a place-based STEAM lesson that aimed to connect students to their local community, demonstrating how STEAM relates to the real world. Students developed an app, titled the Atlanta Renaissance app, as a tribute to the Harlem Renaissance. In small groups, students conducted research on organizations, businesses, and nonprofits found in their area, which were then highlighted on the app. Teachers often organized field trips to local organizations, such as art galleries, providing students with tangible experiences. While the lesson evolved each year of implementation, the evolution reflects a concerted effort by teachers to consider previous challenges faced and acknowledge the needs and interests of their students.

RESOURCES

Below are links to resources that may support implementation of similar STEAM projects:

STEAM Pedagogical Approaches: A brief compilation of different pedagogical approaches for STEAM teaching. https://steam.ceismc.gatech.edu/pedagogical-approaches/

How to Integrate AI Into Art: Atlanta Renaissance: A lesson guide to support teachers interested in implementing the Atlanta Renaissance lessons and help teachers learn more about integrating AI and the arts.

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