How can curriculum be reimagined to meet the needs of students whose primary interests lie outside the ELA classroom? This discussion of STEAM and its literacy components explores one such possibility.

“Achieving Diversity through Integrative Scientific Research Experience” (ADISRE), a component of a five-year (2018–2023) National Institutes of Health (NIH) grant led by principal investigator Karla-Sue Marriott, has focused on developing close reading and critical thinking skills for cohorts of seven freshmen at Savannah State University (SSU), an HBCU. Marriott, who I met through a Governor’s Teaching Fellows Program, currently serves as interim chair of the Chemistry and Forensic Science Department at SSU. I work at another local university—Georgia Southern University—in the College of Education and was invited to collaborate on this NIH grant by presenting workshops at several points throughout the year to students and monitoring their progress.

ADISRE is about “Creating a Desire” for learning and the ethical application of useful scientific information. The goal of this program, funded by the National Institute of Biomedical Imaging and Bioengineering (NIBIB) as part of the Enhancing Science, Technology, Engineering, and Math Educational Diversity (ESTEEMED) initiative is to expand, leverage, and implement the program through achieving the following objectives: (a) expanding the number of high-achieving student participants; (b) increasing the emphasis on doctoral careers in the biomedical sciences through the nature of our training activities, including a holistic 6-week summer bridge program; (c) enhancing the ability of ADISRE scholars to gain entrance into competitive doctoral programs through rigorous and interactive training, negating the need for them to garner post baccalaureate experience; and (d) creating a broad, long-term institutional impact of integrative teaching and learning through the development of a new team-taught, core-area science laboratory course for freshmen and sophomores.

ADISRE seeks to spark a desire in students to become self-directed learners as well as open-minded, caring, and ethical biomedical scientists. The overarching goal is to produce STEM graduates with an internal drive to serve their community by pursuing a career in biomedical sciences. ADISRE will help to create a space for students and faculty to grow and enjoy learning and engaging in research, while fostering environmental awareness, personal discovery, and individual development.

**WHAT IS STEAM?**

Understanding STEAM and How Children Use It, National Center on Early Childhood Development, Teaching, and Learning

STEM v. STEAM: Do the Arts Belong? Edweek

ADISRE incorporates STEAM (science, technology, engineering, art, and math) curriculum, which integrates art and design-related strategies in conjunction with content-area literacy skills development as an outgrowth of traditional STEM curriculum.

**Perspective and Theoretical Frameworks**

There is a definite need on a broad scale to expose science students to integrative learning. There is a need for these science students to become more resourceful and to experiment with removing unnecessary thought-limiting boundaries, thereby learning how to make connections across multiple disciplines.

Cervetti and Hiebert (2019) explain that research has demonstrated that different kinds of knowledge have a positive impact on comprehension, from “knowledge of the topic of the text . . . to knowledge of the broader domain . . . to cultural knowledge and general world knowledge” (p. 499).

**HOW DOES STEAM EDUCATION BENEFIT LEARNING?**


New Skills: 4 Benefits of STEAM Education, Teach Thought

More Than a Trend: Crucial Ways in Which STEAM Shapes Student Thinking, SHARE

**STEAM LEARNING AND INQUIRY**

PBL and STEAM Education: A Natural Fit, Edutopia

The Art of Inquiry in STEAM Education, Resilient Educator
ADISRE is designed to improve students’ depth of understanding as well as their ability to communicate across disciplines, troubleshoot and solve complex problems, and think creatively. We believe that the successful implementation of ADISRE will provide learning experiences for our STEAM students that will assist them in developing the critical tools, skills, and knowledge necessary to graduate with confidence, which will enable them to create their own unique space in the world with benefits to society. Thus, we expect that the successful implementation of this program will result in increased student retention as competitive undergraduates in their rising junior year transition into our new institutional honors program followed by a graduate degree program and a career in biomedical sciences.

The ADISRE Summer Bridge program ensures that our scholars develop a connection with the campus and community by implementing a holistic approach involving faculty and professional academic advisors. It involves workshops that nurture integrative learning, effective study skills, depth of understanding through reading strategies, creativity, and innovation through teamwork, as well as service to the community through scientific contributions. Scholars who participate in the Summer Bridge program emerge empowered, having developed critical knowledge, ensuring their academic retention and success.

Close reading of science-based articles from a range of sources (such as PBS NewsHour, NPR, CBS News, and poetry; see Figure 1) encourage setting a purpose for student reading tasks.

In addition, articles from these sources that cultivate a sense of personal and cultural heritage are included in these close reading exercises.

The process helps students concentrate on what is being read, encourages sustained effort to fully understand the text, develops critical reading and thinking skills, and enables learners to become strategic and independent readers. Close reading encourages the development of skills and strategies, such as the ability to interpret words and phrases, analyze structural—visual and textual elements, understand the author’s reasoning and use of evidence, ask text-based questions, promote connections, and integrate ideas and knowledge from the text (Lehman & Roberts, 2013).

ADISRE scholars will greatly benefit from these workshops, as reading is crucial to understanding and having the ability to write clearly for meaningful communication. Too often, reading is neglected and preference is
Given to working on academic writing skills. We believe both are equally important and worthy of similar attention. Vaughn, Premo, Sotirovska, and Erickson (2020) explain that student agency—“the ability of individual students to influence and to create opportunities in the learning context through intentions, decisions, and actions”—merits consideration (Vaughn, 2018, p. 62). How do students develop the characteristics needed to persist and engage in the learning process? Vaughn, Premo, Sotirovska, and Erickson (2020) encourage educators to consider how students interact with a text “to exert influence and open up new learning opportunities” (p. 428).

Close reading requires prompting students to “unpack” the text to promote deeper comprehension. Regular practice with complex texts and a range of text types (including narrative, informational, and poetry) facilitates students’ ability to succeed with college-level text as well as text that they encounter in their everyday lives (see Figure 2). Close reading enables students to become critical readers as they build their knowledge through evidence gathered from narrative, informational, and other text types.

**Methods, Technique, and Mode of Inquiry**
In this study, learners further developed their close reading skills by working with multiple types of complex texts. Students were invited to participate in multiple close reading demonstrations and writing applications throughout the course of each workshop. For their first reading of the material, students were asked to preview the article in order to figure out what the text said. During the second reading, they were invited to consider how the text worked. This was followed by the “Knew-New-Q” (K-N-Q) activity (Gambrell, 2014), in which students annotated the text. Afterwards, students shared their reflections with a peer and wrote a sentence to solidify their “Knew-New-Q” insights. Additional close reading strategies were introduced and reinforced throughout the workshops. This included a “what do you notice?” chart to record ideas and spark discussion as well as additional annotation strategies that can be utilized while reading. Strategies such as rewriting the text as a series of tweets or text messages, discussion circles, analyzing a text from different viewpoints, and creating student-generated discussion questions to accompany a text were also introduced. Students were invited to employ a range of close reading and critical literacy strategies throughout discussions. These strategies included using Avery colored dots, incorporating the K-N-Q activity, making connections, creating visual outlines, and implementing annotation strategies, among others (see Figures 3 and 4).

**Data Sources and Results**
For each cohort, data was collected from pre- and post-session surveys on students’ reading memories and concepts of themselves as readers that were distributed at the beginning of each session (see Tables 1 and 2). In addition to results from the surveys, an audit trail was kept to document student learning. This included tracking workshop activities and student applications of the strategies in notebooks. Finally, a post-workshop survey was sent to students at 2-month intervals between workshops to document their progress as close readers with feedback sent to encourage continued growth (see Table 3).
A sample of results from the first two cohorts of student participants are illustrated in Tables 1, 2, and 3. By providing university students who are in the early stages of their degree programs with this curricular experience, these workshops appear to be accomplishing the strategic goals of providing transformative student learning experiences and increasing retention. According to the Association of American Colleges and Universities text General Education Transformed: How We Can, How We Must (2015), “Too many students experience general education not as a conspicuously useful and meaningful component of a coherent baccalaureate education, but as a curricular impediment that they must ‘get out of the way’ prior to study in a major … [and] they may be unable to visualize a meaningful trajectory in their curriculum, with an attendant loss of motivation and commitment to persist” (p. 5). To combat this, ADISRE connects STEAM with content-area literacy skill development, inspiring creativity and promoting collaboration across the disciplines.

Table 1. Reading Memories

<table>
<thead>
<tr>
<th>Student</th>
<th>Earliest memory of being read to from early childhood</th>
<th>Kinds of books/reading materials read to you</th>
<th>Feelings associated with experience</th>
<th>Key people who influenced your reading opinions</th>
<th>Where/how you acquired books/reading materials?</th>
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<tbody>
<tr>
<td>A (Freshman male)</td>
<td>Mom reading at night, Kindergarten</td>
<td>Dinosaur book—how they lived/ate/died; made me curious</td>
<td>Curiosity; that there was more to know</td>
<td>Mom; same taste in books and same taste in genres</td>
<td>Mom, library, friends, bookstore, Walmart, school, Target</td>
</tr>
<tr>
<td>B (Freshman female)</td>
<td>Preschool—learning the alphabet; road signs while driving to Georgia from New York</td>
<td>Food advertisements/brands; Dr. Seuss books</td>
<td>Excitement; eagerness; hunger (toward food ads)</td>
<td>My grandfather made reading important. My mother made reading entertaining.</td>
<td>The local public library or from family</td>
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<tr>
<td>C (Freshman female)</td>
<td>Mom reading “Little Bill” books to me</td>
<td>Dr. Seuss, Little Bill, Clifford, Dora, educational books, menus from restaurants</td>
<td>Before high school, I loved to read. Now, I don’t like to read as much.</td>
<td>My teachers, who often give a lot of books to read within a certain period of time</td>
<td>The library, Barnes and Noble, teachers from elementary to high school, mother, friends</td>
</tr>
<tr>
<td>D (Freshman male)</td>
<td>Phonics booklets for homework in preschool; bedtime stories read by mom</td>
<td>“When You Give a Mouse a Cookie…” series</td>
<td>Love</td>
<td>My mom and K–3/K–4 teacher Mrs. Duncan drove me to read more because they loved hearing me read.</td>
<td>School, or mom always bought books for me if I wanted to read them</td>
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Table 2. Self-Concept as a Reader

<table>
<thead>
<tr>
<th>Student</th>
<th>Kinds of books you like to read both in school and at home</th>
<th>Kinds of reading you do in what different formats</th>
<th>How do you find out about books/reading materials/online resources you like to read?</th>
<th>What are some of your immediate reading goals both in school and at home?</th>
<th>What could professors do to make reading for school more enjoyable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Freshman male)</td>
<td>Crime, horror, humor, human trafficking</td>
<td>iPhone, laptop, Twitter, e-mail, chat</td>
<td>Social media (Twitter) and Instagram</td>
<td>I want to be more confident reading in front of people. I want to start reading more.</td>
<td>Give some sort of incentive.</td>
</tr>
<tr>
<td>B (Freshman female)</td>
<td>Horror novels/thriller stories that make you want to keep reading; also science fiction and dramatic novels</td>
<td>Wattpad stories; Instagram and Snapchat posts</td>
<td>Other people make recommendation; suggestions based on what I’ve previously read</td>
<td>Always to comprehend on a higher level; be entertained and drawn into the story</td>
<td>Make reading relatable to some of the current youth or make them detailed and interesting [so we can] picture it in our head like a movie</td>
</tr>
<tr>
<td>C (Freshman female)</td>
<td>Fiction, African American and Latin writers, female writers, writers from other countries</td>
<td>Twitter, schoolwork, daily news, Google searches, Twitter, e-mail, text messages, Instagram, Snapchat</td>
<td>My mom or my teachers</td>
<td>Get back to loving to read again; read more self-help books</td>
<td>Don’t rush reading. It takes time to appreciate and enjoy a book.</td>
</tr>
<tr>
<td>D (Freshman male)</td>
<td>Classical novels, works of literary merit, poetry, science fiction, fantasy, mystery</td>
<td>My friends and I will sometimes share poetry we write online or with each other.</td>
<td>Through friends or past books or authors that I like who are publishing a new series</td>
<td>Have a better understanding of modern English</td>
<td>I already enjoy reading a lot.</td>
</tr>
</tbody>
</table>
Table 3: Post-Workshop Survey

<table>
<thead>
<tr>
<th>Student</th>
<th>What specific “close reading” strategies from the workshop have you applied in your own reading?</th>
<th>What kind of reading material have you used to apply the strategy/strategies?</th>
<th>Have you applied any of the note-taking strategies presented from the workshop in your own reading? If so, which ones?</th>
<th>What kind of reading material have you used to apply the strategy/strategies?</th>
<th>Did the close reading strategies workshop make you a more effective and strategic reader/increase your comprehension?</th>
</tr>
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<tr>
<td>A (Freshman male)</td>
<td>Colored dots; text-to-text/text-to-self connections; memorable word choice</td>
<td>Science text</td>
<td>3-2-1 discussion strategy; outline with your own connections; create own discussion questions</td>
<td>Science text</td>
<td>Very helpful and effective. I learned new ways to read and annotate text. It was interesting getting to use the different methods throughout the workshop.</td>
</tr>
<tr>
<td>B (Freshman female)</td>
<td>Author’s perspective; K-N-Q strategy</td>
<td>English literature; history class</td>
<td>Taking notes as tweets; Post-it Note diagram</td>
<td>English literature; history class</td>
<td>It gave me tools and strategies that I wish I had known earlier.</td>
</tr>
<tr>
<td>C (Freshman female)</td>
<td>Annotation coding strategy; discussion circles in a study group</td>
<td>Science text; news articles for current events</td>
<td>Outline with your own connections; create own discussion questions</td>
<td>Science text; news articles for current events</td>
<td>Showed me how to have a literary roadmap to understanding a text. There are many strategies and finding one that best suits your learning style can help expand your understanding of a work.</td>
</tr>
<tr>
<td>D (Freshman male)</td>
<td>Author’s perspective; K-N-Q strategy</td>
<td>Science text; science lab</td>
<td>Post-it Note diagram; sketches of key points with captions; 3-2-1 discussion strategy</td>
<td>Science text; science lab</td>
<td>I have used many of these methods since I took the workshop. It made studying so much easier by letting me focus on key notes on everything I read. I have also increased my test grades.</td>
</tr>
</tbody>
</table>

Figure 4. Student workshop activity from notebook—“How else can I write/create this?”—in response to a PBS NewsHour science article.


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References