

FOSTERING CRITICAL THINKING AND LITERACY THROUGH STEM-THEMED READ-ALOUDS AND CONTENT CONVERSATIONS

Masharipova Feruza Jumanazarovna, Ph.D.
Urgench State University named after Abu- Raykhan Biruni

Matlatipova Muslima
Student of Urgench State University named after Abu- Raykhan Biruni

ABSTRACT

This article discusses the importance of STEM-related picture book read-alouds in enhancing students' reading competence and critical thinking skills. Drawing on the NEGA project, co-led by specialists from the U.S. Department of State and Uzbekistan, the study highlights how innovative read-aloud strategies, specifically using *If I Built a Car*, *If I built a House* and *If I Built a School* by Chris Van Dusen, can connect storytelling with STEM literacy. By integrating the 5E instructional model—Engage, Explore, Explain, Elaborate, and Evaluate—educators can create dynamic lessons that foster creativity, collaboration, and problem-solving, preparing learners for interdisciplinary challenges.

The article emphasizes the practical application of read-alouds through activities such as relationship builders, classroom energizers, and content-focused conversations, designed to actively engage learners. This approach transforms passive reading into an interactive, student-centered learning process, encouraging learners to explore complex STEM concepts like design and engineering in imaginative ways. Teachers in Uzbekistan who applied these strategies reported improved comprehension, engagement, and confidence among students, highlighting the transformative potential of combining language and STEM education. The article concludes with actionable recommendations for educators to adopt these strategies, demonstrating how they cultivate lifelong learning skills, critical thinking, and deeper engagement with both texts and STEM disciplines.

KEYWORDS: Reading Competence, STEM literacy, 5E approach, Picture Book Read-Aloud, Critical Thinking, Creativity, Content Conversations, Adolescent Learners, Experiential Learning, Interdisciplinary Teaching.

INTRODUCTION

In the 21st century, literacy extends beyond traditional reading and writing skills, encompassing critical thinking and the ability to apply knowledge in real-world interdisciplinary contexts. STEM (Science, Technology, Engineering, and Mathematics) education has gained significant prominence as a means to prepare learners for the challenges of a technologically advanced and knowledge-driven society (Honey et al., 2014). However, one of the most persistent challenges in STEM education is enhancing students' reading competence, particularly in understanding complex technical texts and fostering critical thinking. Effective read-aloud strategies can play a pivotal role in addressing this issue by making STEM concepts more accessible and engaging (Strickland & Morrow, 2010).

Read-aloud sessions in STEM education are not merely about decoding words but about fostering rich content conversations that stimulate curiosity and critical thinking. Research suggests that when teachers incorporate interactive discussions during read-alouds, students develop a deeper understanding of scientific concepts and enhance their comprehension skills (Tippett & Milford, 2017). Picture books like *If I Built a Car*, *If I built a House* and *If I Built a School* by Chris Van Dusen have proven to be effective resources for linking storytelling to STEM literacy. By integrating storytelling with content discussions, students are encouraged to explore complex ideas in a creative and collaborative environment.

To further enhance the effectiveness of read-alouds in STEM education, the 5E instructional model—Engage, Explore, Explain, Elaborate, and Evaluate—has been widely recognized as a transformative framework (Bybee et al., 2006). This inquiry-based approach not only promotes student

engagement but also helps in building connections between prior knowledge and new concepts. The NEGA project in Uzbekistan, co-led by specialists from the U.S. Department of State, has demonstrated the potential of this model in enhancing students' reading competence and critical thinking skills through innovative read-aloud strategies. This article aims to examine the application of the 5E model in read-aloud sessions, highlighting how it fosters creativity, collaboration, and problem-solving in the STEM domain.

LITERATURE REVIEW

STEM education has evolved as a critical component of modern educational systems, emphasizing the need for interdisciplinary teaching and learning (Bybee, 2013). Reading competence plays a fundamental role in STEM education as it enables students to understand and analyze complex information, interpret data, and engage in scientific discussions (Shanahan & Shanahan, 2008). Despite its importance, many students struggle with reading comprehension in STEM subjects due to the technical nature of the texts and the lack of engaging instructional strategies (Fang & Wei, 2010).

Read-alouds have been identified as an effective strategy for enhancing students' reading competence and engagement (Fountas & Pinnell, 2006). When combined with content conversations, read-alouds help students make connections between the text and their prior knowledge, fostering critical thinking and comprehension (Dickinson & Smith, 1994). The integration of the 5E instructional model further amplifies the impact of read-alouds by providing a structured framework that guides both teachers and students through the learning process (Bybee et al., 2006).

The 5E model encourages active learning and inquiry-based exploration, which are essential for developing STEM literacy (Capraro & Slough, 2013). Each phase of the model plays a specific role in enhancing students' understanding and engagement. The Engage phase captures students' attention and stimulates curiosity, while the Explore phase allows them to investigate concepts through hands-on activities. In the Explain phase, students articulate their understanding, and the Elaborate phase helps them apply their knowledge in new contexts. Finally, the Evaluate phase provides opportunities for reflection and assessment (Bybee et al., 2006).

IMPLEMENTING READ-ALOUDS IN THE 5E FRAMEWORK

The implementation of read-alouds within the 5E instructional framework has shown promising results in enhancing students' reading competence and STEM literacy. During the Engage phase, teachers can capture students' interest by asking thought-provoking questions related to the picture book content. For instance, while reading *If I Built a Car*, students might be asked, "What would you include in your dream car, and why?" Such questions stimulate curiosity and set the stage for meaningful exploration.

In the Explore phase, students are encouraged to think freely and test their hypotheses within the limits of the activity. Teachers can facilitate hands-on activities where students design and sketch their dream cars, experimenting with different features and materials. This phase allows students to connect the concepts from the read-aloud to real-world applications, fostering creativity and problem-solving skills (Capraro & Slough, 2013). According to the teacher actions from the NEGA project, providing opportunities for students to test their ideas and discuss them with peers significantly enhances engagement.

The Explain phase is crucial for helping students articulate their understanding of the concepts discussed during the read-aloud. Teachers can guide students in summarizing the main ideas of the story and relating them to STEM principles. For example, students might explain how the design of their dream car incorporates principles of aerodynamics and fuel efficiency. This phase emphasizes critical thinking and effective communication, as students must justify their design choices based on scientific principles (Bybee et al., 2006).

In the Elaborate phase, students apply their knowledge in new but similar situations. Teachers could challenge students to design a sustainable school building after reading *If I Built a School*. This activity encourages students to use their previous knowledge and creative thinking skills to solve complex problems.

According to the NEGA project findings, activities that require students to apply their learning in new contexts help deepen their understanding and foster a sense of ownership over their learning.

Finally, the Evaluate phase provides an opportunity for students to reflect on their learning and assess their progress. Teachers can use open-ended questions and self-assessment tools to help students evaluate their designs and identify areas for improvement. Encouraging students to ask related questions and propose future investigations promotes lifelong learning and critical thinking (Bybee et al., 2006). The student actions outlined in the NEGA project emphasize the importance of self-evaluation and evidence-based conclusions in fostering deeper engagement with STEM concepts.

DISCUSSION

The integration of read-aloud books using the 5E instructional approach has demonstrated significant improvements in student engagement, comprehension, and problem-solving skills. In the Engage phase, the use of captivating narratives encouraged students to ask questions and connect prior knowledge with the content of the story. Teachers skillfully used visual prompts and storytelling techniques to spark curiosity and interest. The Explore phase allowed students to participate in hands-on activities and discussions, where they collaboratively investigated themes and STEM concepts presented in the books. Teachers guided learners by prompting them to observe, analyze, and test ideas. During the Explain phase, students articulated their understanding through group presentations, explaining connections between the story and scientific or real-world contexts. The Elaborate phase saw learners applying their acquired knowledge creatively through project-based tasks, where they developed models or proposed solutions inspired by the stories. Teachers facilitated brainstorming sessions to help students refine their ideas. Finally, in the Evaluate phase, students showcased their work, reflected on their learning process, and received constructive feedback, enabling them to recognize areas for improvement and celebrate their achievements.

TABLE 1
5E Instructional Phases

| Phase | Teacher Actions | Student Actions |
|----------------|---|--|
| Engage | <ul style="list-style-type: none"> • Pose thought-provoking questions to spark student interest. • Show intriguing visuals or demonstrations related to the topic. • Connect the lesson to students' prior experiences or real-world scenarios. • Encourage predictions and brainstorming to gauge initial understanding. | <ul style="list-style-type: none"> • Ask questions and share prior knowledge about the topic. • Show curiosity and interest in the lesson's theme. • Participate actively in brainstorming sessions. • Make predictions based on initial information or visuals presented. |
| Explore | <ul style="list-style-type: none"> • Provide hands-on activities without immediate explanations. • Facilitate group work to promote collaborative learning. • Observe and listen to students as they engage in exploration. • Ask guiding questions to maintain focus and curiosity. | <ul style="list-style-type: none"> • Participate in hands-on investigations and group activities. • Record observations and data from experiments or tasks. • Discuss findings and ideas with peers. • Test hypotheses and make connections to previous knowledge. |

| | | |
|------------------|--|---|
| Explain | <ul style="list-style-type: none"> • Encourage students to share findings and articulate their understanding. • Provide clear explanations and formal definitions after student input. • Use multimedia resources and visual aids to clarify concepts. • Ask for evidence and reasoning to reinforce learning. | <ul style="list-style-type: none"> • Present findings and articulate understanding in their own words. • Listen to peer explanations and ask clarifying questions. • Connect learning to formal concepts and terminology introduced by the teacher. • Provide evidence and reasoning to support ideas. |
| Elaborate | <ul style="list-style-type: none"> • Encourage students to apply their knowledge to new, real-world scenarios. • Pose advanced questions to deepen understanding and critical thinking. • Support students in designing and conducting their projects. • Use examples to extend student knowledge and connections. | <ul style="list-style-type: none"> • Apply newly acquired knowledge to solve complex, real-world problems. • Ask deeper questions to extend understanding of concepts. • Design and conduct further investigations or creative projects. • Collaborate with peers to build on shared ideas and solutions. |
| Evaluate | <ul style="list-style-type: none"> • Assess student learning through presentations, reflections, or projects. • Provide constructive feedback on student work and thought processes. • Encourage peer assessments to build critical evaluation skills. • Use both formative and summative assessment strategies. | <ul style="list-style-type: none"> • Reflect on learning experiences and outcomes. • Present projects or findings to the class with justifications. • Self-assess understanding using rubrics or guided questions. • Provide and receive constructive feedback from peers and teachers. |

The structured student and teacher actions throughout the 5E model created a dynamic and collaborative learning environment. Students actively engaged in discussions and activities, building critical thinking and teamwork skills. The Engage phase encouraged initial curiosity, while the Explore phase allowed learners to deepen their understanding through practical experiences. In the Explain phase, students developed communication skills by sharing insights and reasoning behind their conclusions. The Elaborate phase challenged them to think creatively and apply knowledge to complex problems, fostering innovation and adaptability. The Evaluate phase reinforced self-assessment and accountability, essential skills for lifelong learning. Teachers played a pivotal role in scaffolding learning experiences and guiding students through each phase. The overall implementation of the 5E approach in read-aloud book sessions enriched students' literacy and STEM competencies, demonstrating its potential as an effective educational strategy for holistic learning.

RECOMMENDATIONS

The integration of read-alouds and the 5E instructional model in STEM education has proven to be an effective strategy for enhancing students' reading competence and critical thinking skills. By fostering a student-centered learning environment, this approach encourages active engagement, creativity, and problem-solving. The findings from the NEGA project highlight the transformative potential of combining language and STEM education.

To maximize the impact of this approach, educators are encouraged to select high-quality picture books that align with STEM concepts and provide opportunities for interactive content conversations. Professional development programs should also be offered to help teachers effectively implement the 5E model and read-aloud strategies. By adopting these recommendations, educators can cultivate lifelong learning skills, critical thinking, and deeper engagement with both texts and STEM disciplines.

REFERENCES

- Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Carlson, J., Westbrook, A., & Landes, N. (2006). *The BSCS 5E Instructional Model: Origins and Effectiveness*. Colorado Springs, CO: BSCS.
- Capraro, R. M., & Slough, S. W. (2013). *STEM Project-Based Learning: An Integrated Science, Technology, Engineering, and Mathematics (STEM) Approach*. Springer.
- Chris Van Dusen. (2005). *If I Built a Car*. New York: Dial Books for Young Readers.
- Chris Van Dusen. (2012). *If I Built a House*. New York: Dial Books for Young Readers.
- Chris Van Dusen. (2019). *If I Built a School*. New York: Dial Books for Young Readers.
- Dickinson, D. K., & Smith, M. W. (1994). "Long-term effects of preschool teachers' book readings on low-income children's vocabulary and story comprehension." *Reading Research Quarterly*, 29(2), 104-122.
- Fang, Z., & Wei, Y. (2010). "Improving middle school students' science literacy through reading instruction." *Journal of Educational Research*, 103(4), 262-273.
- Fountas, I. C., & Pinnell, G. S. (2006). *Guided Reading: Good First Teaching for All Children*. Portsmouth, NH: Heinemann.
- Honey, M., Pearson, G., & Schweingruber, H. (2014). *STEM Integration in K-12 Education: Status, Prospects, and an Agenda for Research*. National Academies Press.
- National Research Council. (2011). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: National Academies Press.
- Shanahan, C., & Shanahan, T. (2008). "Teaching Disciplinary Literacy to Adolescents: Rethinking Content-Area Literacy." *Harvard Educational Review*, 78(1), 40-59.
- Strickland, D. S., & Morrow, L. M. (2010). *Emergent Literacy: Children in the Early Years*. Pearson.
- Tippett, C. D., & Milford, T. M. (2017). "Science Education Read-Alouds: Investigating the Impact on Science Achievement and Attitudes." *International Journal of Science Education*, 39(2), 131-146.