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Abstract

Traditional mathematics curriculum does not always meet the student's needs. Lecturing students does not engage, motivate, and activate their critical thinking skills. Essentially, the curriculum has become separated from the real-world context in which mathematical theorems are applied. Students don't understand the purpose in their learning. STEM curriculum focuses on the content areas of science, technology, engineering, and mathematics; however, the STEAM curriculum takes the STEM curriculum a step further by incorporating the arts into those content areas. By doing so, it reaches more students in an innovative approach of the creative process. The instructional strategy of story is the arts of STEAM curriculum. By incorporating story into mathematics curriculum, it is engaging and motivating students to learn the content from a student-centered approach. Students are become fully embraced within the story and use the mathematical content to apply and predict the story outcomes. It requires students to continuously reflect, communicate, and apply their mathematics ideas to the story.

Story as a Mathematics Instructional Strategy

Samantha F. Junkin

Mathematics curriculum needs to be meaningful, active, built on prior knowledge, incorporate problem-solving and critical thinking skills, collaborative, and have real-world applications (Balaskrishnan, 2008; Ediger, 2013; Gunbus, 2015; NCTM, 2000). The STEAM curriculum takes the STEM curriculum a further step as arts integration is an approach to teaching in which students construct and demonstrate understanding through an art form; students are engaged in a create process that connects an art form and another subject area and meets evolving objectives in both (Silverstein & Layne, 2010).

The economic growth depends on originality and creativity, also creativity may be the only thing that eventually sets us apart from artificial intelligence (Arrieta & Kern, 2015; Bonamici & Schonk, 2014). The overall implementation of STEAM, in any subject area, provides opportunities to enlighten students to the creative processes. STEAM applications are not building a relationship between the arts and STEM content but instead reintegrating the content areas together. Integrating arts into STEM content engages more and different types of learners (Ahn & Nanjoo, 2013; Arrieta & Kern, 2015; Bonamici & Schock, 2014; Bush, Cox, & Cook, 2016; Wynn & Harris, 2012). Students will imagine, examine, perceive, explore, experiment, develop, craft, create, reflect, assess, revise, and share.

STEAM represents the purposeful teaching of the arts to promote engagement and learning in mathematics (Katz-Buonincontro, 2018). Students need to be able to critically think, listen, apply their mathematical content knowledge, and comprehend orally (NTCM, 2000). Even

through understanding mathematical calculations and remembering scientific data are important, it is important to explore and apply beyond the basic STEM situations. STEAM curricula is an important part in changing the traditional mathematics curriculum, as it focuses on the importance of mathematics as a contextualizer while connecting it to the real-world (Larson, 2017). The incorporation of arts in mathematics helps students learn the content using creative instructional strategies, like story.

People are story animals and often referred to as 'homo-narrates' and as a result they learn from and through stories (Bruner, 1987; Engle, 1995; Freeman, 1997; Haven, 2007; McAdams, 1993). Story becomes familiar to students at a young age. The structure of a story provides more information than other narrative forms (McAlpine, 2016; Sarbin, 1998). It is viewed as childlike, so educators are reluctant to use it for learning. However, educators are beginning to understand that story is a valid way of learning things (Gunter, Kenny, & Junkin, 2018).

Students who were taught with stories outperformed the students who were not; in addition, there is little evidence to suggest that stories are not an effective method to teach, inspire, inform, and educate (Haven, 2007; Hemmati, Gholamrezapour, & Hessamy, 2015). In other words, the benefits are diverse and substantial. Egan (1989) stated stories have been shown as a way people most often perceive and preserve the connectivity of events that would otherwise be disassociated over time; this is one of the reasons people want to hear and tell stories so that they remember its content.

Schank (1990) found stories trigger memories and index labels in the mind of the listener. They are powerful because they communicate information in a memorable form and shape the listener's feelings about the information being communicated, while also creating vivid and powerful imagines in the listener's mind (Egan, 1989; Haven, 2007; Skoumpourdi &

Mpakopoulou, 2011). Stories incorporate imagination and visualization. Through the fantasy of stories, students learn and understand complex concepts they would normally struggle to grasp through logical, factual, or argumentative presentations.

Story is an effective instructional strategy to promote learning, motivation, and, overall, improving the learning performance of students. It can enhance memory by allowing learners to use their banks of prior knowledge and to increase communication among students (Bruner, 1996; Hung, Hwang, & Huang, 2012; Schank, 1990; Zull, 2002). A curriculum based on story has unlimited potential in the classroom. Situating what is to be learned in terms of story helps students select, arrange, and organize things in manageable chunks (Gunter et al., 2018; Schank, 1990).

Novak (2015) stated stories enhance learning by focusing on learner engagement and interest. They make learning fun and involve the students in the content to be learned. Teaching in story form makes the content more engaging and meaningful. Story uniquely engages students (Haven, 2014). Stories incorporate practical examples laced with strong emotional connections; the audience tunes in because they see themselves woven into the story (Haven, 2014; Taylor, 1996). It makes real life references. Stories do not claim to represent reality but instead to explore it and consider the possible meanings and significance (Bradt, 1997; Haven, 2007).

Story is not the content but the scaffolding in which the content is being described. Students need to see the context and relevance in order to believe that they have reason to learn. Story bridges the gap from mathematical content to application. Gunbus (2015) explained students need to be taught mathematical problem-solving skills within realistic problem-solving contexts, the real-world contexts allow students to comprehend texts and solve problems successfully. Students experience little mathematics in their daily lives, not including school. They only practice and use

mathematics in a classroom setting and are often unaware of the purpose, meaning, and application of the mathematical concepts.

Story characters are used to pose mathematical problems that engage students' imagination and create excitement (Casey, 2004; Skoumpourdi & Mpakopoulou, 2011). These characters are relatable and draw students into the story. The imagination creates vivid and powerful images in the listener's mind (Haven, 2000; Skoumpourdi & Mpakopoulou). It is often described as a movie is playing in the student's mind (Gunter et al., 2018). Students enjoy using story to learn about mathematics and the history of mathematics because it is not traditional learning. It provides students with an opportunity to reflect upon the mathematical steps taken. The mathematical content can change the story and/or the outcomes; students need to continuous reflect and check their work to see if their mathematical findings connect to the story and real-world contexts (NCTM, 2000). Ediger (2013) and Munakata (2005) found students become engaged in the story which leads to engagement in the mathematical content and, as a result, students explore the content further on their own time which helps the student in all academic areas.

Story enhances critical thinking and problem-solving skills while also expanding the pedagogical repertoire; it also increases awareness of the relationships between visual, auditory, and verbal representations while critical thinking and problem-solving in mathematics. It presents challenges for students to think and apply mathematical content in different situations that are not apparent, while providing a meaningful context for connecting mathematics and literature. It also supports the conceptual understanding of mathematical problems, structures and problem-solving skills and increases mathematical literacy for the interpretation of mathematics in various contexts (Albano & Pierri, 2014; Jonassen & Hernandez-Serrano, 2002; Starcic, Cotic, Solomondies, & Volk, 2016; Wilburne & Napoli, 2008).

Story makes teaching and learning mathematics more meaningful and engaging, which makes students feel safe to express themselves mathematically. Students become confident with their knowledge and skills in mathematics which results in a positive attitude toward mathematics (NCTM, 2000). Without the negative outlook, students are more open and eager to learn mathematics.

Story creates a productive learning environment and helps students feel safe to share and express their ideas to the teacher and fellow students. Balakrishnan (2008) and NCTM (2000) added students need to develop the communicative skills to grapple with their ideas and develop definitions with their own words for expressing them because it is an effective way to foster engagement and ownership. This enables students to communicate and formulate ideas about the mathematical terms and definitions for clearer comprehension and understanding. Story allows students to learn and reflect upon the mathematical content at a deeper level than the textbook teaching students to communicate mathematics (Munakata, 2005). Textbooks limit student's imagination and don't often provide opportunities to connect to the real-world. Students are able to use mathematical content to predict the story and possibly contradict the story by using the mathematical content found in the story.

In summary, by incorporating the arts into STEM it focuses on the creative process, which is a central component of STEAM education. It creates new learning opportunities using critical thinking and problem-solving (Katz-Buonincontro, 2018). It provides opportunities for students to learn in different ways. STEAM provides a greater emphasis on collaborative work, broad problems to real-world issues, and students to use drama, speech, songs, movies, and apps (Herro & Quigley, 2016). Story is an instructional strategy that is part of the arts portion of STEAM. It engages, motivates, and makes content relevant for students.

Students are required to understand mathematical content conceptually and procedurally to apply it to various situations. The use of story in mathematics helps meets those areas. Students become emotionally invested in the story and as a result engaged in their learning. The story presents mathematical content in story form and students are using that content to predict/change the outcome of the story. This process requires students to use critically thinking skills while consisting reflecting upon their work. Story as an instructional strategy can take the arts components in STEAM to higher levels of learning and engagement in mathematics.

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