Storytelling for Science Learning: Developing an Assessment Framework to Examine Adolescents' Multimodal Sci-Fi Narratives

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Abstract: Much research has examined the role of writing in science learning, but most of this work has focused on print-based expository writing. Much less work has explored multimodal narratives in science education. We designed a program that aims to engage adolescents in producing multimodal sci-fi narratives. In this study, we focused on analyzing the products students generated as a way to assess how students integrate science in their multimodal narratives. More specifically, we developed an assessment framework that includes two dimensions (science and integration). We applied this framework to assess the 35 products produced by 130 participants in 5 iterations of the program. The results show that about half of the products presented high quality in science integration. Multiple mechanisms were employed in these products to integrate science in their narratives. Instructional implications are also discussed.

Keywords: Science integration; multimodality; science fiction writing; assessing framework

Introduction

Writing in science has been viewed as a promising way for students to shape and clarify their science understanding and communicate science ideas with others (Hand, 2017; Prain & Hand 2006). Research emphasized the value of using a more diverse set of genres of writing and multiple modalities in promoting science learning (Torrance & Galbraith, 1999). Most of the existing approaches in science education, however, focus on reading activities or academic and scientific writing, including laboratory or research reports (Halliday & Martin, 1993), argumentative writing (Chen, Hand, & McDowell, 2013), and expository or persuasive essays (Balgopal & Wallace, 2013). To fill in the gap, project STEM+L was designed for engaging students in collaboratively producing science fiction with a variety of digital tools. The project has created opportunities for students in designing narrative plots, producing multimodal artifacts, and integrating science in their writing. As such, this project opened a new window to study the use of multimodal narratives for engaging students in science learning. Drawing upon the theoretical perspectives of a multimodal storytelling approach and science fictional writing, this study attempts to develop an assessment framework to examine how students express science ideas in multimodal narratives and how they specifically incorporate science in their science fictional writing.

Method

Project STEM+L is a program designed to engage adolescents (grade 5th-8th) in STEM learning through producing multimodal sci-fi narratives in small teams. Over the course of 5 rounds of implementation between 2015-2018, a total of 130 adolescents (grade 5th-8th) participated in the program and produced 35 multimodal narratives. We conducted content analysis (Cullum-Swan & Manning, 1994) to understand the features of the narratives. We iteratively developed and applied a scoring rubric to evaluate the narratives from two dimensions: science and integration. The science dimension includes two aspects: (a) description of the science or natural phenomena and (b) description of the scientific problem and solution. The integration dimension also includes two aspects: (a) integration between science and the narrative and (b) integration between the narrative and the problem/solution space. Six narratives (17%) were individually coded by independent coders to establish the inter-rater reliability. The weighted Kappa (K = 0.83) indicated there was an almost perfect agreement between the coders' judgement.

Results

Close comparing and contrasting students' products revealed that they applied different mechanisms to integrate science into their narratives. Four main mechanisms are discussed in the following.

Theme1: Diversity of science topics and cross-topic connections

Results showed that students' sci-fi narratives touched upon diverse science topics. The most popular science topic was related to environmental problems – nearly half of narratives covered topics such as pollution, global warming, endangered species, sea-level rising, and deforestation. Other science topics included space, bioengineering, nature disaster, and physical science. Most of the narratives involved more than one science topics and there were mainly two ways in which students built cross-topic connections. One way was to present a nesting structure of the science topics – one science topic was presented as the major theme, and the other topics were introduced through characters, events, obstacles, or conflicts/climax. Another popular cross-topic connection structure was the sequential occurrence of science topics, often linked by causal relationships.

Theme 2: Integrating science through narrative techniques

Aside from the various ways in which students connected the different science topics, there were diverse ways in which the science content was integrated into the narratives. Three major narrative techniques were applied when incorporating science, including character dialogue, action revelation, and explaining events or plots.

Theme 3: Integrating science through multimodal design

A variety of multimodal artifacts were used in students' sci-fi narratives, including comics, diagrams, graphs, videos, music, 3D simulations, audios, and drawings. Overall, these multimodal elements helped elaborate on science ideas and served as ways for science integration. The multimodal artifacts, either found online or generated by students themselves, could help elaborate on the main science ideas insufficiently explained in text, extend and complement the relevant science concepts by adding more science information, or considerate some of the narrative techniques to integrate science as part of the narrative.

Theme 4: Proposing alternative solutions for science-related problems

A wide array of science-related problems, such as global warming, extinction of species, and earth pollution were presented in students' narratives. Addressing these problems, students proposed a wide spectrum of solutions. Some were more on the practical side (e.g., cleaning up trash and recycling to solve the problem of pollution, inventing a device to transform greenhouse gas to breathing air) whereas others fell on the more imaginative end (e.g., relying on superpowers and superheroes, leaving Earth behind and living on another planet).

Discussion

Our analysis showed that students implemented multiple approaches to integrate science in their narratives. They applied different narrative techniques and employed multimodal elements to enrich their text narratives with scientific information. Through creative storytelling, their knowledge integration become more diverse and science explanation more engaging; through digital production and organization, their science problem solutions become more concrete and tangible, and possibly more relatable to adolescents.

References (Selected)

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