

Learner-Generated Visualizations and Their Evaluation: A Generative Learning Perspective

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Abstract

According to the generative learning model, learning with understanding is a generative process. During this process, humans construct meanings by creating mental structures to store and retrieve new information and building processes to relate new information to prior knowledge. This article provides a theoretical framework of learner-generated visualizations from text through the lens of generative learning and discusses the evaluation of student-generated work, movie trailers. Once students generate their own visualizations, evaluating their products is complex. To facilitate this evaluation, we adapted Richard Mayer's SOI Model (Select, Organize, and Integrate) describing the cognitive stages involved in generative learning in multimedia development. The application of the model to the evaluation of student work and an analysis of student reflections is discussed.

Keywords: Movie Trailer, Generative Learning, SOI model

Introduction

A college professor, desiring a break from grading papers, decides to see a movie. Sitting in the theater, she waits for the movie to begin. After viewing the obligatory commercials for refreshments, the professor watches the previews of coming attractions.

As the images fly off the screen, she begins thinking about how effective these movie trailers are, how they entice moviegoers to return to see these upcoming releases. She begins to wonder about the process through which these trailers are created. The work entails several important skills, such as developing a clear understanding of the movie's plot, characters, setting, and themes. In addition, the creators must consider the trailers' purpose: to convince viewers that returning to the theater to watch this movie is a worthwhile investment of time and money. Finally, they must have the technical and creative skills necessary to translate the message into a short video. Therefore, producing a movie trailer involves a great deal of learning and applying what is learned to develop a product.

At this point, the professor begins to connect some of her classes. For example, in courses that involve significant reading, she could ask students to create digital media trailers for an imagined movie version of a book they have read. In putting together these trailers, students would go through the same process as professionals and possibly reap educational benefits.

This idea raises many questions regarding an activity like this one, including those surrounding the learning process and how students would experience that learning. Why should we expect that creating multimedia movie trailers would result in positive learning outcomes? What skills would students develop, and how would they respond to this activity.

Why Use Movie Trailers in Classroom

We adapted the generative learning model (Wittrock, 1974a, 1974b, 1989; Wittrock et al., 1975) for the movie trailer creation activity. We connected generative learning and related theoretical models with the practice of student-created movie trailers by reviewing findings in visual literacy and digital media learning.

Generative Learning

According to the generative learning model, learning with understanding is a generative process. During this process, humans construct meanings by creating mental structures to store and retrieve new information and building processes to relate new information to prior knowledge (Wittrock, 1974a, 1974b). The key to generative learning theory is that learning is an active process: “The mind, or the brain, is not a passive consumer of information. Instead, it actively constructs its own interpretations of information and draws inferences from them” (Wittrock, 1989, p. 348).

The generative learning model has applications to many knowledge domains, including mathematics (Wittrock, 1974b), science (Bobek & Tversky, 2016; Fiorella & Kuhlmann, 2020), social studies (Wang et al., 2020), and reading (Wittrock, 1989, Wittrock et al., 1975). Given our focus on applying generative learning to transform a written text into a movie trailer, we focus primarily on the connections to the act of reading.

People remember information they read when they generate relations within a text and between the text and their prior knowledge and experience (Wittrock & Alesandrini, 1990). Note that the associations between stimuli and prior knowledge are idiosyncratic, based on individuals’ prior experiences (Wittrock, 1974a, 1992). For example, when two different people read this chapter, undoubtedly, they will take away different meanings based on their backgrounds.

The generative learning model comprises four essential components: generation, motivation, attention, and memory (Wittrock, 1989). Generation involves the active construction of the organizational structures and the connections to prior knowledge. As applied to reading, this generation requires the reader to be motivated and willing to spend the time and effort needed. Attention focuses on the generation of relevant text and related stored memory. Finally, memory includes “preconceptions, metacognition, abstract knowledge, and concrete experience” (p. 348).

In one of his many works on applying generative learning theory to the process of reading, Wittrock (1989) challenged the conventional wisdom that writing is constructive, whereas reading is merely imitative. He argued that “Good reading, like effective writing, involves generative cognitive processes that create meaning by building relations (a) among parts of the text and b) between the text and what we know, believe, and experience” (p. 347).

The generative learning model is significant due to its part in the paradigm shift from behaviorism to cognitive psychology and its role as a precursor to constructivism (Tobias, 2010). Moreover, the model and its descendants have enduring significance, as we will show in establishing its relevance to the movie trailer activity.

Wittrock made clear that, although generative learning was developed to serve as a model of cognition, its *raison d’être* was to promote effective teaching and deep learning (Wittrock & Alesandrini, 1990). For example, creating summaries of written material, according to generative learning theory, should result in improved comprehension and understanding because “generative teaching activities induce learners to construct relevant representations that they would not compose spontaneously [emphasis added]” (p.369). This idea - that learners would learn more effectively by being asked to create summaries using innovative representations - provides theoretical support for creating movie trailers as a pedagogical technique.

Visual literacy and generative learning

Based on the Association of College and Research and Libraries targeted toward higher education, “Visual literacy is a set of abilities that enables an individual to effectively find, interpret, evaluate, use, and create images and visual media” (ACRL, 2011, p. 1). According to this definition, visual literacy involves both the consumption and the production of visuals.

Learner-generated visualizations have been explored in several domains (e.g., Edens & Potter, 2003; Gobert and Clement, 1999; Hall, Bailey, & Tillman, C.,1997; Van Meter, 2001). When learners translate text-based information into a visual-based format, the activity may promote deeper processing of the material and more complete and comprehensive mental models (Craik & Lockhart, 1972).

The cognitive benefits of having students create visuals to summarize readings are well documented. First, when asked to draw, learners may benefit because of the generation effect (Foos, Mora, & Tkacz, 1994). Increased mental effort in drawing and generating novel representations results in improved learning. Second, drawing involves generating a different representational form; it requires the learner to transform ideas from text into a visual. Creating a novel image often results in inferences regarding the text, resulting in deeper understanding (Chi & Wylie, 2014; Chi, 2009). Third, as the image is being created, learners externalize their mental images, which results in cognitive offloading that can be beneficial, especially with the increased cognitive load associated with complex texts (Sweller et al., 1998; Ainsworth, 2006).

How does visual creation intersect with generative learning? In a study using two types of graphic organizers in an online learning environment (Wang et al., 2020), Chinese middle school students were presented with a short reading comparing the climates of two regions in China. In one group, students were provided with the text only. In the second group, they were also given a filled-in graphic organizer containing several attributes or criteria to compare the climates in the two regions. In the third, they were provided with a blank area to create their attributes interactively and then perform the comparisons.

First, students in both graphic organizer groups outperformed the text-only group in retention and comprehension tests, and they reported more learning satisfaction and less difficulty. Second, students in the interactive group outperformed those in the filled-in group in comprehension and showed deeper processing. The second result, especially, demonstrates the value of visualization in the context of generative learning. Referring back to the four components of generative learning, the students in the interactive group generated their own attributes, were relatively more highly motivated and used the attention they paid to these aspects of the reading to integrate the new information with prior knowledge in memory more successfully.

How does visual summarization compare with other modalities? Bobek and Tversky (2016) presented students with information about ionic and covalent chemical bonding in a study of middle school students. One group summarized the information in written form and another by creating visuals. For both students with high and low spatial ability, those who created visual explanations outperformed those who produced written ones.

In the first of two experiments with university students in Germany, Schmidgall et al. (2019) presented students with a text about biomechanics. Among the treatment groups, the students who created drawings outperformed those who wrote summaries and those who merely read the passage regarding knowledge transfer. This finding supports the claim that visualization in the act of drawing supports higher-order thinking (van Meter & Firetto, 2013). In the second experiment, students who drew or observed a drawing developed outperformed those who formed mental images but did not transform them into drawings. This finding provides evidence of the critical role played by externalization as another underpinning of the value of drawing as a learning tool (Schwamborn et al., 2010).

These two studies demonstrate that visual explanations can increase learning compared to verbal explanations. Would combining visual with oral presentation, for example, be associated with improved learning? Indeed, the act of summarizing can be carried out using a combination of modalities. The authors had students read a scientific text in a study regarding college students' understanding of the respiratory system (Fiorella & Kuhlmann, 2020). One group taught the material by explaining orally, a second created drawings, a third created drawings while explaining orally, and a control group merely reread the material. In follow-up tests of retention, transfer, and drawing, all experimental groups outperformed the control group on all measures. Moreover, the group that drew while explaining orally outperformed all other groups. The authors argued that students in this group produced more detailed oral explanations and drawings, which led to their superior performance. Combining presentation and visual creation inspired the movie trailer activity.

Multimedia learning and generative learning

Richard Mayer extended generative learning strategies into multimedia learning. The SOI model (Mayer, 1996) describes the cognitive processes underlying learning strategies that result in meaningful learning, "where the goal of learning is knowledge understanding - as measured particularly by transfer tests" (p.

359). This view considers meaningful learning to be sense-making and the result of three processes: Selecting, Organizing, and Integrating. In this chapter, we focus on translating a reading into a multimedia movie trailer as a method of sense-making.

As applied to the process of making sense out of an expository passage, the first step of the SOI model, Selecting, involves deciding what is important and storing this information in short-term memory. The second step, Organizing, entails connecting the various pieces of information in short-term memory and forming a coherent whole. In the final step of sense-making, Integrating, the organized knowledge in short-term memory is related with analogous, organized knowledge in long-term memory. One can see the SOI model as an elaboration of generative learning theory with clear connections to generation, attention, and memory (Fiorella & Mayer, 2016).

Much of the early work in multimedia learning focused on the design of multimedia presentations, in which the learner is a passive recipient. For example, researchers investigated the relative effectiveness of combining different media in a study of Australian students in a trade school (Tindall-Ford et al., 1997). Students who received audio and visual instruction outperformed those who received visual instruction only on tasks requiring transfer of knowledge.

Other researchers began to consider the learner as a more active participant in multimedia learning. In a study of American university students, Mayer and Chandler (2001) found that even the most straightforward learner interactions with multimedia positively impact cognitive processes and learning outcomes. They posited that simple interactions would reduce cognitive load (Sweller, 2011; Sweller and Chandler, 1994) and thereby assist learners in constructing coherent mental models that would lead to meaningful learning outcomes. They found that students who could control the pace of a narrated animation performed better on a transfer test than those who could not. In another study at the same university (Mayer et al., 2003), students who were able to ask questions and receive answers regarding an instructional multimedia presentation outperformed those who were not able to interact with the same presentation on a transfer test.

Whether or not the learner is interacting with multimedia to develop understandings, the measures typically used are tests of their ability to transfer the knowledge by applying it to new content. In contrast, in the movie trailer activity, learners are translating their knowledge into a new medium. This process involves the construction of an external representation, like drawing, but now, using multimedia.

The differences between a learner-constructed external representation and a prefabricated one are crucially important. According to Cox (1999), the former “consists of dynamic iterations and interactions between external models and mental models as the learner constructs a personal version of the presented information” (p. 347). Therefore, we claim that the process of developing a movie trailer based on a written narrative is much more than a simple transference to a new situation; it is a unique translation to a new representation. In terms of SOI theory, according to Fiorella and Meyer (2016):

The act of translating across representations encourages learners to select the most relevant information for inclusion in the new representation, organize it into a coherent structure by building connections among the elements of information selected, and integrate it with existing knowledge by fitting the new structure with an existing structure. (p. 732)

In summary, empirical research in visual literacy and multimedia learning, along with generative learning and SOI models, supports the claim that learners who create unique movie trailers from reading will develop a deep understanding of the text. They will experience the generation effect due to the increased mental focus. By transforming the text into a novel representation, they will draw valuable inferences. Finally, externalizing their imaginings will reduce cognitive load.

Project Description

Background

This project was implemented at a comprehensive, public university in the northeastern United States. One of the authors has used a movie trailer-making activity in a general course for first-year undergraduate

students for more than five years. This course is one of many different types of first-year seminar courses, and all first-year students take one during their first year. Although each first-year seminar course is independent with different content taught by a different instructor, two of the main goals are to help first-year students gain familiarity with academic life and empower them to become independent thinkers. Each year, the university selects a recommended book across first-year seminar courses, and each instructor chooses a way to integrate the book into the course. In some years, the book is fiction and, in others, non-fiction.

In her first-year seminar course, “Introduction to Digital Literacy”, the author uses the recommended book for the first digital format project. In this assignment, students are asked to create a Hollywood-style movie trailer, based on the required reading, during the first month of the semester and present it in class. Students are encouraged to read the book as if it were a movie script and imagine what kind of movie they would make while reading.

Movie Trailer Assignment Details

To create a movie trailer, the author asks students to use PowerPoint (PPT) to create the movie trailer because most entering college students know the basics of PPT and feel comfortable with using it. PPT animated files can be saved as movie files and updated on YouTube. If they know how to use a movie editing program, such as iMovie, they can use it instead. The movie trailer must integrate visuals, narration, and music and should be 30 seconds to 1 minute long.

After reading the book, they develop a movie script. The movie script is revised and elaborated while developing the actual movie trailer. In order to have them feel they are making an authentic movie trailer, the comprehensiveness of a movie trailer from the start to the end was emphasized. For example, it should start from the green Motion Picture Association rating screen (e. g., PG 13) to the ending screen (e. g., “coming soon to a theater near you”).

After making the movie trailer, they upload the file to YouTube and present it in class. After presenting it in class, the last step is writing a reflection report about what they have learned from reading the book to watching class presentations.

As we have argued, developing a movie trailer should make students motivated and experience active learning, two of the components of generative learning (motivation and generation). From the start, students should be intrinsically motivated to read the book because they do it from a movie director’s perspective. While reading the book, they think about the genre, plot, casting, setting, props, etc. By asking students to focus on these details, these activities address the two remaining components of generative learning, attention, and memory.

Outcomes

In this section, we give a brief description of some of the products students created to explore the extent to which their constructions demonstrate the distinctiveness of their understandings of the readings. Next, we connect student processes to the SOI model. Finally, we provide a detailed report of their reflections on the activity to infer their satisfaction with the activity and provide evidence of their perceptions of the uniqueness of their work.

First, as expected, students chose different genres from the same book. For example, from the 2020 book *Binti*, the genres that students chose to vary from suspenseful thriller to romance to animated movies (see Figures 1, 2, and 3)

Figure 1.
Suspense movie trailer from Binti

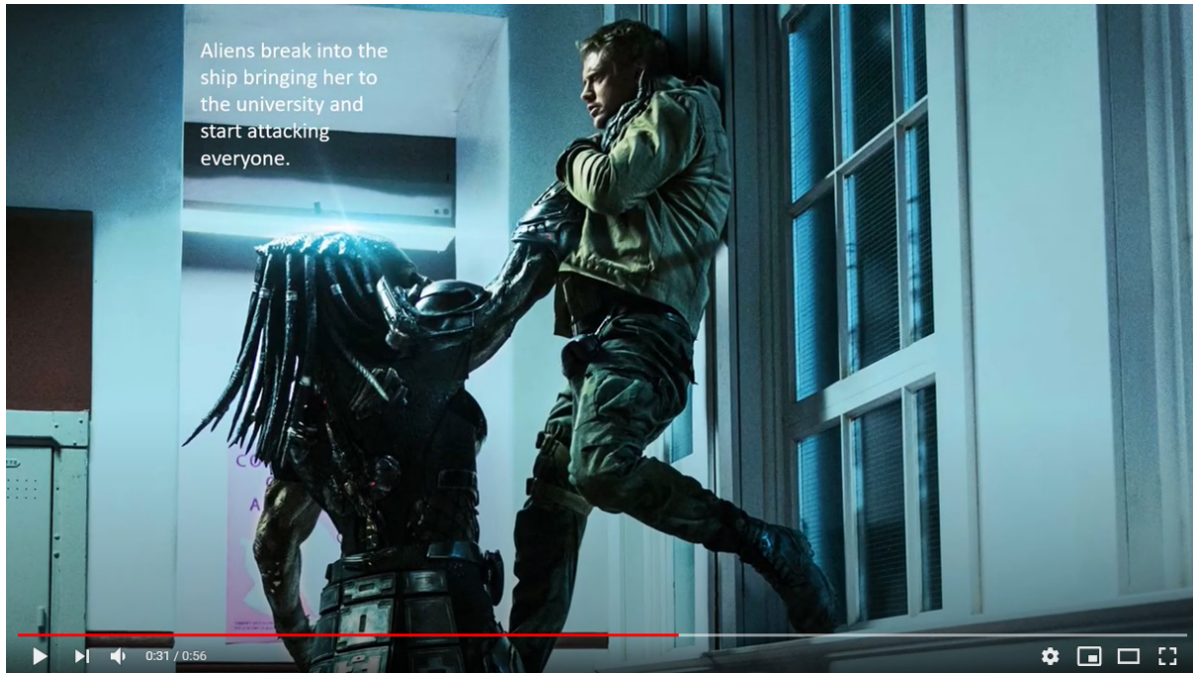


Figure 2.
Romance movie trailer from Binti



Figure 3.
Animated movie trailer from Binti



Even within the same genre, the format was varied. Mostly, the trailers were picture/video-based ones. However, some used their own animation from paper-pencil drawings, and some actually performed and videotaped their own trailer scenes (see Figures 4, 5, and 6).

Figure 4.
Picture/video with text



Figure 5.
Animation from paper-pencil drawings

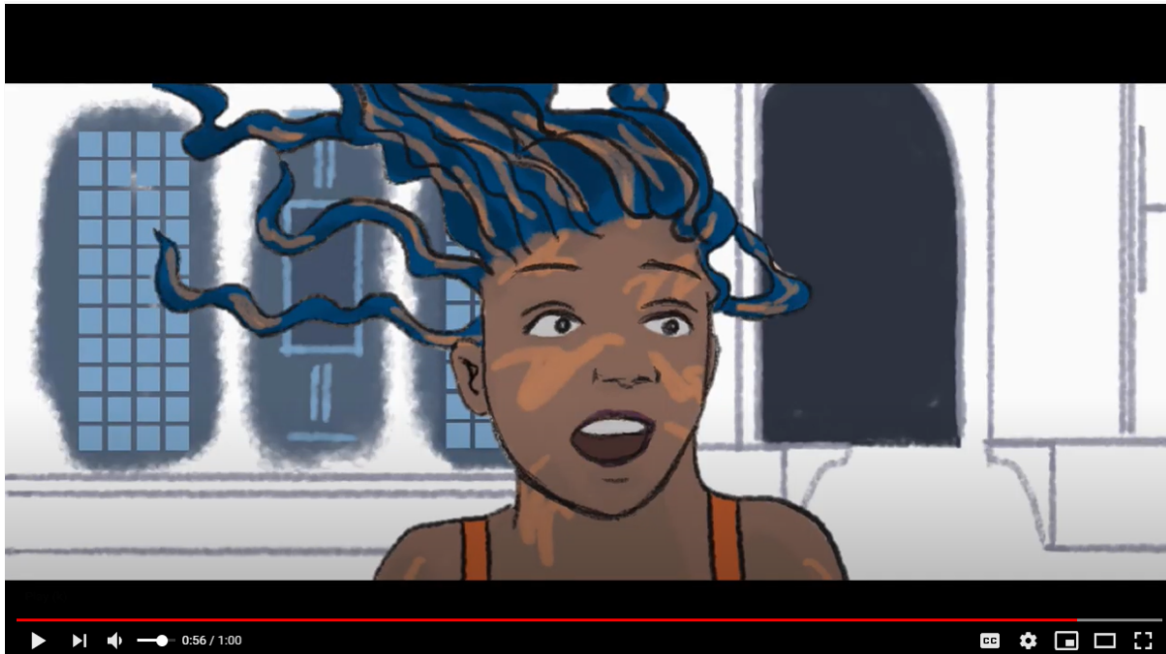


Figure 6.
Videotaped performance



Also, students selected different parts from the book to make their movie trailer. Especially when the book was fiction, each story differed and demonstrated a different interpretation. Having viewed the student-created video clips, we found clear evidence of their unique text interpretations. Although it is impossible to present the movie trailers in this chapter, the screenshots alone support this claim.

How did the students' processes relate to generative learning and, in particular, the SOI model? Table 1 contains the SOI model's three stages, and associated processes students carried out while developing, presenting, and reflecting on their movie trailers.

Table 1.

SOI model and learner processes while constructing a movie trailer from the book

	Selecting	Organizing	Integrating
SOI Stage Definition	<ul style="list-style-type: none"> Focus on the relevant pieces of information 	<ul style="list-style-type: none"> Organize the information into a coherent representation 	<ul style="list-style-type: none"> Connect new information with prior knowledge
Relevant Learner Process	<ul style="list-style-type: none"> Select their genre Decide which parts of the book would serve as the movie plot 	<ul style="list-style-type: none"> Collect all materials and put them together Develop a storyboard 	<ul style="list-style-type: none"> Refine their trailer in their own make-sense interpretation Present and reflect on the activity

Among the data acquired over several years, we selected reflections from students in two different semesters, one where the book was fiction, *Binti* (Okorafor, 2015), and the other where it was non-fiction, *Factfulness* (Rosling et al., 2019). We analyzed these reflections to identify processes related to the SOI stages: Selection, Organizing and Integration.

Selecting

Students began to visualize their interpretations by selecting the parts of the book they wanted to emphasize and production details (genre, music, cast, etc.).

First, I chose the genre of movie I wanted to create. When I settled on suspense and coming of age, I moved on to choosing my cast.

*After reading *Binti*, I knew that I wanted my trailer to be suspenseful and a little scary. Selecting this theme is when I really started to get excited about this project.*

While deciding through the many different themes I could have picked, I finally chose to go the sad route.

I was beginning to stress about the video clips I was going to choose for the trailer since there is not an actual movie for this book. I made sure I had picked the right mood for the trailer that would hook the viewer.

I had to create an outline of what I wanted in my trailer; then, I had to find the right music that fits the mood that I wanted to set..

Organizing

After making initial selections, students put together materials, organizing their interpretations.

Slide by slide, I added different pictures, figures, and text to create a stronger storyline and flow within my movie trailer.

My movie trailer was a romance trailer and a fantasy based on a non-realistic outcome. . . I was

very excited to create a trailer that was successful within my theme and my sounds.

The focus of portraying characters from my perspective is the most important.

Picking the clips was the hard part to connect with the theme. The clips were hard because I had to make sure I cut it [sic] at the right time, and it all flowed.

The final product of my trailer was my second attempt at the trailer. My first time didn't flow too good [sic] and didn't include much color [sic] to it.

I felt like I did not do the book enough justice, so I scrapped the first sketches. I started all over again, and I spent a couple of days on and off doing the sketching, base coloring, and shading. While drawing, I jotted ideas down for animating in PowerPoint... While video editing, I added transitions to fade in different parts of the music, cut a lot of the pauses in the clips, and added newer animations when I saw that some parts were lacking.

Integrating

We observed two aspects of the integration stage. First, students refined their interpretations of the text by connecting to their prior knowledge, attitudes, beliefs, and experiences. Examples follow.

It made me think thoroughly about the novel. I know I would not be able to personally do what she (Binti) did. ... I realized how much thought has to go into even just a trailer script.

I related to something that I love and show [sic] how it is also connected to what the book's topic was about.

By creating my own trailer, I felt like it gave me insight on how to take something I read and turn it into something I can put on a screen.

I thought that Factfulness wasn't a good book for making a movie trailer since it's not fiction and more of an informative book. Surprising [sic], the movie trailer project made me realize you can do anything with a book, no matter what type it is.

I was able to not only account for the plot of the novel yet was also able to reflect on what I saw from reading the novel. I was able to create an image in my mind of what I pictured this novel to be if it were to be turned into a movie.

Second, most students commented on their impression of each trailer's uniqueness. Students integrated their understanding of the book with their prior knowledge and experiences, leading to idiosyncratic movie trailers. This uniqueness provides generative learning that promotes active learning and deep thinking. In addition, their comments demonstrate widespread satisfaction with the activity. Here are some examples.

When watching my classmates' trailers, I realized that not a single person had the same or similar trailers to one another. I liked that because it showed me how we are all different and how we all took this opportunity to do whatever we wanted with the novel we read, and we all did something different with it.

Everyone took the book in a different direction for the trailer. It was cool to see how everyone else responded to the task.

I made mine into a futuristic theme, and many other people turned it into a suspenseful trailer. It was interesting to get to see everyone else's take on the book and on the project

I loved how everyone interpreted Binti in different ways.

After watching the various movie trailers by my peers, it was very interesting to see the different

aspects and points of view that they chose.

While presenting during our class, there was [sic] countless projects that blew me away. The dedication each person put into the trailer blew me away as well as the creativity of each project shock [sic] me. No trailer shared clips, music, or transitions. They all had their unique feel to it [sic].

Factfulness was not my favorite topic to make a movie about, but you can really see just how many different directions any specific subject can be taken when looking at everybody's presentations.

In summary, while working on this activity, students visualized their own movie trailer by selecting details (genre, plot, etc.), included specific content and identified the connections among content, and then developed unique representations. The following reflection from a student demonstrates the overall outcome as a generative learning activity.

I loved being able to have a blank canvas but an idea behind it (Factfulness as a guide). I loved the idea of being able to showcase my interpretation of the book to other people. When someone reads an article or a novel, or even one sentence, they can have many thoughts on what it means. I was able to show my thoughts on what Hans Rosling was trying to represent in his book. I really enjoyed the book, so creating the movie trailer was almost like turning it into real life, but I had a say in the deeper meaning. Putting your own spin on something is so fun to me because it shows the way a person thinks and how they take things.

Conclusion

Because, for young adults, an image-dominant, screen-based world is the typical environment, they are intuitive visual communicators (Felton, 2008; Mayer, 2014). However, Felten (2008) argued that leading books on pedagogy in higher education rarely cover the usage of visuals or visual technologies to promote deep learning instead of using images as mere illustrations. Zull (2002) argued that faculty should utilize visuals to help students learn. This activity facilitates learning by using various visual forms to represent what they know. "Learners are not neutral observers; rather, it is their positionality within the forest that dictates what tree they see, how they perceive these, and their ability to discern the connections among these." (List et al., 2020, p.6)

The movie trailer activity demonstrates the value of using novel representations to develop deep understandings. Our work is similar to Min's (2019) research, which explored how undergraduates represented research papers as multimodal brochures. Min's study documented undergraduate students' ability to apply visual literacy skills by transmediating text-based information into a multimodal format.

The purpose of our project was not to determine any particular cause-and-effect relationships but rather to explore the kinds of creations particular students would produce and gather some insight into their impressions of the experience. Accordingly, we did not implement any of the usual components of an experiment, such as control or randomization. So, the results of this exploratory study can not be generalized. Instead, they might be used to provoke further examination.

In this project, we studied whether the movie trailer activity would provide further evidence of the idiosyncratic nature of knowledge construction. We considered the impact of this sort of assignment on student satisfaction with their learning. As expected, students developed a wide variety of movie trailers, suggesting they each constructed a unique understanding of the reading. In addition, they reported a great deal of enjoyment in engaging with the reading in this novel way. However, we did not measure whether they developed a comprehensive, coherent understanding of the book concerning retention or knowledge transfer. It is possible that they selected only a few parts of the text that they understood or liked for inclusion in their trailers. Therefore, it would be helpful to study the possible effects of a movie trailer activity on these learning outcomes.

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