

The World is the Product of Story: Using Story to Integrate Socio-Technical Thinking into Engineering Curricula

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Brandon received his undergraduate degree in industrial engineering from the University of Toronto in 2019, before entering the food and beverage sector. Here he spent five years in industry, three of which spent managing a craft brewery during the covid-19 pandemic. In 2024, he returned to the University of Toronto to continue his studies.

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POSITIONALITY STATEMENT

My name is Brandon Lista, I am a graduate student at the University of Toronto in Industrial Engineering, specialising in Engineering Education under the supervision of Dr. Emily Moore. My research interests include socio-technical thinking, systems thinking, engineering identity, and engineering design. Born and raised in Mississauga Canada, I am a white, cis-gendered, able-bodied, straight man, born to a high-income family with Italian and Canadian heritage. I am a traditional storyteller who regularly tells folktales in my home city, hosts and curates community events, and speaks at conferences about storytelling in STEM. I believe that storytelling is an egalitarian art form; stories belong to all people, and they contain our collective wisdom. It is my love of and belief in the power of story that motivates my interest in this research, and provides the background that I draw from to speak about story. I am not without blind spots, my engagement in storytelling is predominantly through the Toronto and broader Canadian community, with limited international exposure. Therefore, the voices and oral traditions represented in this work are reflective of the traditions I spend the majority of my time in. It is important to share stories and keep them alive while respecting their origins, their respective oral traditions. I received permission to share knowledge from oral traditions in this work from those that require it.

ABSTRACT

Engineering educators continue to grapple with barriers to integrate socio-technical thinking (STT) into engineering curricula. This paper proposes story, specifically the practice of listening and working with stories, as a meaningful and currently underutilized path for integrating and developing STT. In it, I conceptualize story as cultural transmission that is embodied, relational, and co-created, drawing on literature from education, engineering education, cognitive science, and my experiences in oral storytelling traditions.

This conceptualization aligns with Gladwin and Ellis' affective-relational-cognitive (ARC) framework for systems literacy. Through this lens, stories help listeners understand and perceive the mutually constituted social and technical dimensions of engineering.

I use this conceptualization in conjunction with the ARC framework to demonstrate the alignment with two cases from the engineering education literature to illustrate this approach: an indigenous storytelling approach for knowledge transfer, and a story intervention to reduce equity gaps and increase belonging. These cases reveal that storytelling practices already support development in ways consistent with the ARC framework. I then extend the analysis by applying the framework to a story shared with me through the oral tradition, demonstrating how an individual narrative can be evaluated and selected to support STT learning outcomes.

Building on these analyses, I argue that educators need not adopt entirely new pedagogical methods, but rather become more intentional with the use of stories, particularly by centering listening and reflective dialogue. This approach enables the integration of STT without significant curricular restructuring. Ultimately, this work highlights storytelling as powerful method to shift toward more holistic, socio-technical engineering.

I. INTRODUCTION

I would like to begin with a story told to me by master storyteller Dan Yashinsky in the oral tradition.

There was once a team of engineers who went to a remote village in west Africa that was struggling with the problem of desertification. You see, every day the people of the community would go collect wood for their fire, so they could cook their dinner. However, wherever they gathered wood the desert would spread. Then they would have to go further, and the desert would spread more. So the engineers - after seeing the problem - built a solar oven for them to cook their meals. The people loved it, thought it was a brilliant solution, and the engineers left.

Some months later the engineers returned to see how the people were doing and if the solar oven was working well, yet when they returned, the solar oven was not being used! The community was using fire again! The engineers, shocked, walked up to the people and asked, "why aren't you using the solar oven, we thought it

*was great and that you loved it.” To which the people said, “Yes, it is great!”
“Then why are you not using it?” “Well...” they said, “**You can’t tell stories
around a solar oven.**” (D. Yashinsky, personal communication, June 2024)*

When I am explaining my research interests to someone, this is often the story that I tell. It is short and sweet, has a dash of humor, and ultimately, is about stories. But foremost, it conveys the importance of engineers understanding the whole context of a problem space, or at least the social dimensions beyond the technical requirements.

Within engineering education, educators are increasingly calling for more integration of socio-technical thinking (STT) in both individual courses and broader curricula. Socio-technical thinking is the ability to identify, address, and integrate the social and technical dimensions of engineering (Rodrigues & Seniuk Cicek, 2024), but also to recognize these dimensions as mutually constituted, where one cannot exist without the other (Reddy et al., 2023). Current methods to integrate STT include layering material through courses, co-instruction by differently situated educators, and dedicated courses. Despite the efforts to integrate STT into engineering curricula, educators still face many challenges including lack of support from administration, prevalence of “socio-technical dualism” within engineering culture, and the difficulty in modifying course content to create capacity for new material (Reddy et al., 2023; Rodrigues & Seniuk Cicek, 2024). STT has been further explored within broader systems thinking literature, offering possible suggestions to address these challenges. However, systems thinking has its own limitations; including abstraction and privileging certain ways of knowing (Gladwin & Ellis, 2024), which challenge the intent of integrating STT in developing holistic understanding. In response to these limitations, Gladwin and Ellis call for educating for the development of “systems beings” through systems literacy, which supports learning that is embodied, relational, and holistic rather than abstract (2024). Their ARC (affective-relational-cognitive) framework centers learning through embodied experience, co-creation, and interaction with systems, making it well suited to evaluate tools to integrate socio-technical thinking.

In this paper, I propose that story offers a meaningful and currently underutilized path for integrating and developing socio-technical thinking, specifically through the practice of listening and working with stories. I outline my conceptualization of story rooted in oral traditions, education, and psychology, then situate it within the ARC framework. This is used as a lens through which the current use of story in engineering education literature is analyzed. The literature review finds that story is already being used in methods that align with the ARC framework, suggesting that we need not reinvent the wheel. We ought rather to explore and be more intentional about using story in engineering education.

II. SEE SO WE CAN SEE: A CONCEPTUALIZATION OF STORY

The world we inhabit is the product of story; stories shape our lives and determine our behaviour. We see the world and ourselves through the stories we tell ourselves, about our world and

ourselves (Gold, 2002). Through our lives we accumulate these stories through interaction with the world, and use these stories to make our narratives of self, which are constantly being written and rewritten as we recall memories and contextualize new experiences (Bruner, 1991, 2002). These stories come from the entirety of our self-lived experiences, which are products of collective storytelling (Sfard & Prusak, 2005). As these stories make up who we are, they are funds of identity which are “historically accumulated, culturally developed, and socially distributed resources” used to make meaning (Esteban-Guitart & Moll, 2014, p. 1). In other words, they are the building blocks of who we are. Oral traditions, after all, have long been used to transmit culture – values, ways of being, communication norms, etc. – which mediate interaction with the world (Falassi & Abrahams, 2014; Vansina, 1985). Stories are therefore a fund of identity for both the storyteller and the listener. The story, its contents and how it is shared, reflects the identity of the teller, a collection of all their lived experiences. So too is how the listener interprets a story a reflection of themselves.

During this transmission, stories are embodied by both the teller and the listener. As a traditional Tanzanian story opener¹ goes, “I have been and I have seen”, to which the listeners respond “see, so we can see”, after which the storyteller starts their tale. This meaning is dual. On the surface the teller is sharing that in their travels they have heard stories which they are going to share, as this was often the only way people got their news in the time of travelling storytellers. In this framing, where the storyteller has ‘been’ also extends beyond physical locations, to the realm of story. The teller is intertwined in every dimension of the narrative; the lives, desires and dilemmas, from a talking mouse to people. The second meaning is deeper, for in my school of storytelling we say that if you see the story in your mind, if you have a rich picture of the tale, those who listen to you will see it in their mind too. So “see so we can see” is not just a call for a story to be shared, but that through the sharing of the story the listener will see in their mind’s eye what the teller sees in the telling.

This transmission is supported by recent research from the neuroscience field, where we see that when a listener and a speaker really understand each other their brain responses become coupled and synchronise to the point that they are very similar (Hasson et al., 2012; Stephens et al., 2010). Full engaging stories told to the listeners resulted in the neural entrainment spreading deep into their brains, inducing similar responses in higher order areas. Not only do these areas sync up, but in written narratives readers understand a story by simulating the events through brain regions in a process similar to recalling previous situations (Speer et al., 2009). While this makes a case for embodied theories of language comprehension, this can be pushed further through connecting it and the neuroscience work back to the Tanzanian story opener. If a storyteller shares an engaging story which they see as they recall it, so too do the listeners see the story through their mental simulations. The higher functioning of their brain is activated and

¹ A story opener is a phrase that a storyteller says before they begin sharing a story, to situate the listeners in the world of story. They can be many in many forms such as a call and response such as the Tanzanian opener, or an opening phrase such as “once upon a time...”.

entrained with the storyteller and each other, as if they were the one recalling the story. The story then becomes embodied by all who are coupled together in the exchange.

As stories are shared, we are also transmitting identity through culture. To illustrate this, I draw upon the words of Omushkego Elder Louis Bird. He is one of the last knowledge keepers of his people who knows thousands of traditional stories. When asked how he remembers so many stories, he said he remembered them in the voices of those who told them to him (Elder Louis Bird, personal communication, n.d.). When he said this, he did not mean just voices of the elders who told him the stories when he was a young boy, but the voices of all who have ever told the story. It is the responsibility of the teller to retain the grounding “in voice, memory, ancestry, community; the voice of his grandmother and the voice of thousands who came before her” (D. Yashinsky, personal communication, February 2026). Something more than just words and teachings are transmitted in the passing of a story, something that may support STT development in engineering curricula.

III. THE ARC FRAMEWORK FOR SYSTEMS LITERACY

This conceptualization of story as culture transmission is aligned with the ARC framework, as both center learning through embodiment, co-creation, and interaction.

The ARC framework, developed by Gladwin and Ellis, calls for education to extend beyond systems thinking into education that develops systems beings, which is the “the ontology for living within in learning about systems” (Gladwin & Ellis, 2024, p. 8). They describe the development of systems beings as an action-oriented practice that invites engagement with world, other perspectives, and balance other ways of knowing around a topic. The development of systems beings can be achieved through a systems literacy pedagogy, where systems literacy is “theory and practice to identify, interpret, co-create, relate to, and communicate about systems” (Gladwin & Ellis, 2024, p. 8). Systems literacy supports learning about the multidimensional relationships within a system and how both the system and the learner is shaped by interaction with it. This approach echoes the call by Stroh to develop an orientation to systems (2011). Since systems thinking requires seeing us as a part of the system we are trying to understand, to think in systems we are required to learn new methodologies and ways of looking at the world. By doing so, we develop an orientation to systems. This systems orientation, “is ultimately a way of being that points to alternative ways of thinking and acting” (Stroh, 2011, p. 2).

This approach works to address some of the limitations in systems thinking, as Western approaches tend to focus on abstraction instead of lived experience (Goodchild, 2021). The calls for a focus on lived experience are what Gladwin and Ellis respond to in their framework. But this not to say that systems thinking is ineffective at developing and integrating STT; systems thinking can be used to increase STT (Moresoli & Mikhail, 2024). It has also been a useful tool to pair with stories, as stories when combined with systems thinking have been shown to create

an empathetic method of problem formulation (Ollove & Lteif, 2017). It is important to note that in this combination of systems thinking and story, the stories were ‘worked with’ as it aligns with the idea of co-creation. After the stories were generated and integrated into the systems maps, they were taken back to the interest holders to be discussed and revised, co-created iteratively. Combining a systematic approach with a focus on lived experience of those who live within the system.

To be with/in the systems, Gladwin and Ellis advocate for a systems literacy pedagogy using an affective-relational-cognitive (ARC) framework for learning (Gladwin & Ellis, 2024). Through a focus on embodiment across the three dimensions, affect means to look at feelings and sensations mediated by the body in interactions with the system. Relation is through the interconnection with other learners and listening to them. Finally, cognition is through holistic means of acquiring knowledge that focus on decentring the individual as the creator of knowledge. Instead, knowledge is co-created through negotiation and interaction with the system and other learners. Alternatively, “feeling as affective, thinking as cognitive, and listening as relating” (Gladwin & Ellis, 2024, p. 9). The three dimensions of the framework applied in a pedagogy demonstrate embodiment, co-creation, and “being within systems”; developing systems literacy while incorporating alternative ways of knowing.

IV. STORY AND THE ARC FRAMEWORK

The conceptualization of story as cultural transmission, when compared with the ARC framework, aligns with a systems literacy pedagogy, allowing students to develop their understandings of systems and their relationships with them. Developing these skills improves students’ ability to see and integrate the social and technical dimensions of engineering. Our conceptualization’s alignment with the ARC framework involves all three dimensions (affective-relational-cognitive), with each dimension facilitating learning that is embodied, co-created, and interactive. Each dimension connects to story on two levels; in listening to a story, and within a story. The latter will be explored in a subsequent section.

Stories affect the listener, connecting with their emotions and eliciting responses in the body, just as watching movies, theatre, and listening to music have affective and physiological responses (Codispoti et al., 2008; Evans, 2022; Gomez & Danuser, 2004; Lundqvist et al., 2009). As listeners feel the emotional beats of a story and imagine the story in their mind, the story becomes embodied, internalizing feelings and reactions.

Story is relational in multiple dimensions and grounded in listening, the first being between the teller and the listener. People become coupled together as the story is shared and co-created. As more listeners engage in the story, they join the chorus of people working to create the tale. Listeners can see how other listeners respond to the story, as emotions and reactions play across their face, or the occasional uncontrolled outburst in response to a dramatic twist. This is the second dimension of relation within the practice of story, listener to listener. In cultural contexts

or at a storytelling event, after the story is shared there is then space for the listeners to engage with each other and the teller, discussing the story and listening to how each other understood it.

This bridges into cognition, as the cognitive dimension emerges because story creates space where knowledge is co-created rather than delivered. Listeners negotiate meaning with the teller, other listeners, and the system/context from which the story comes. The act of interpreting a story is a cognitive process shaped by lived experience, bringing forward different interpretations and understanding that could only be arrived at through discussion with others. In this way, story centers cognition towards collective meaning making, an expansive way of knowing and being with systems, decentering the individual as the creator of knowledge.

As story works to develop systems literacy, learners are situated within the interconnections. They engage affectively, relationally, and cognitively with the story through feeling, listening, and thinking. Through this engagement, they begin to perceive engineering not as isolated technical problems, but as technical and social dimensions intertwined and unable to exist independently. This shift supports improved socio-technical thinking.

V. THE STORY ARC FRAMEWORK IN THE ENGINEERING EDUCATION LITERATURE

Now that story has been situated within the ARC framework, let's turn to the engineering education literature. Currently story is used within the literature on engineering education pedagogy in a variety of ways. Educators present problems as case studies with a framing story (e.g. (Bonab et al., 2023)), design course curricula with a storyline (e.g. (Reiser et al., 2021)), work with fiction to teach ethics (e.g. (Berne & Schummer, 2005)), tell anecdotes to establish rapport (e.g. (Daniel, 2009)), or create children's books to build communication skills in engineering (e.g. (Bosman, 2021)). While these are all great uses of story, to examine story with the ARC framework we will draw on two case studies; an indigenous storytelling approach for knowledge transfer, and a story intervention to reduce equity gaps and increase belonging.

A use of story in the cultural context of the oral tradition is exemplified by Spaulding (Spaulding, 2010), who developed and tested an alternative knowledge transfer model using an indigenous storytelling approach. In the context of the microprocessor industry, they selected an expert engineer who developed three stories using indigenous approaches to storytelling with researchers.

The technical stories had four integrated morals, which the expert engineer observed knowledge transfer in the three morals on ways of being or ways of working with others, how to be an engineer, and professional responsibility; but not but the technical subject matter moral. After the activities, interviews with the listeners revealed that this approach provided cultural and environmental awareness through experience, uncovered tacit knowledge in the listener, and the storytelling was transformational and emerged from personal experience. The stories elicited affective responses in the listeners, prompting them to desire sharing their own stories to contextualize what they heard. In reflection, one listener noted that "Our interpretation of the

stories is different and the shared learning was helpful to see different perspectives” (Spaulding, 2010, p. 93). When reflecting on the activities, the expert engineer storyteller noted,

This approach would be most suited for (a) recent college graduates to acquire the right attitude, (b) safety training, (c) a good way to transfer cultural behaviors as part of new hire orientation training, and (d) using story characters to illustrate relationships between chemical reactions or material properties. (Spaulding, 2010, p. 105)

The impacts on the listeners and the reflections from the storyteller show that the stories impacted learning in the social dimensions of engineering work, within a technical context, impacting culture and ways of being. This occurred through feeling the stories, thinking about them, and co-creating understanding through listening.

In the classroom context, Godwin et al. (Godwin et al., 2024) used a story intervention to reduce academic equity gaps and increase belonging for Black, Latinx, and Indigenous (BLI) engineering students. Extending the work of Binning et al. (Binning et al., 2020) into an engineering context, Godwin et al. had first year engineering students in a computer programming course write stories about a struggle they were currently experiencing and how they might overcome it in the future. After this exercise, carefully designed and selected stories of struggle and perseverance of students who previously completed the course were shared with the students, which were then discussed in small breakout groups. The intervention worked as a preventative measure against the degradation of belonging that was typically experienced by BLI students, and appeared to almost completely close the academic equity gap in individual programming assignment grades. The stories shifted student framing of their struggle. In the context of the ARC framework, the stories from previous students became embodied as students read and worked with them. Students thought about the stories of others, and worked with their understandings as they listened to classmates share their understandings. Meaning was co-created, and the personal stories of struggle from previous students provided a vehicle for them to see themselves in context, in relation to the system.

In both Spaulding and Godwin’s interventions the learners engaged in dialogue with their peers to listen to other interpretations of the story, co-creating meaning with each other. The stories shared by the tellers touched on themes of identity, either as professional engineers or as engineering students. Mediated by the lived experiences of the listeners, or the stories that made up their own identities, resulted in differences in interpretation of the stories. Through listening to the stories and in discussion with each other after; their bodies mediated feelings, they interacted and listened with others, and knowledge was co-creation, decentred from the individual.

VI. DISCUSSING WITH A STORY

The ARC framework has been discussed on the level of the activity, through the listening and working with stories. However, a story can be holistically evaluated for connection to the three

dimensions to get an idea of how listeners will engage with it. In the solar oven story all three dimensions of the ARC framework are present, which is why it makes it so effective when engaging engineers about the importance of STT. It is more of a folk story than the personal stories used by Spaulding and Godwin, yet the themes are likely similar between the folk and personal stories despite not having the personal stories as a point of comparison. In terms of affect, reactions and emotions are elicited throughout the framing of the story. There are engineers to be related to, people experiencing an issue to be empathized with, the confusion as to why the design was ultimately abandoned, and the humor in the twist at the end. In the interactions between the engineers and the villagers we see the relations between the people, between the fire and the need to cook food, but also the social need of the fire as a point of gathering, something to tell stories around. Finally, the cognitive, thinking about social elements of engineering along with the technical does not unfold until the final sentence. While the solar oven technically solved the problem of cooking food without fire, it did not address the broader context of what the fire was for the people, the social need of the fire to tell stories. There are components of all three dimensions interplayed throughout the story, which provide anchors for the three dimensions to connect to at the activity level. This is not to say that every story will have all three dimensions in this way, or that they need to in order for students to listen and work with a story. But a story may have additional axis in which listeners can connect with the story, that are relevant to them.

The activities in both Spaulding and Godwin mirror my own experiences from traditional storytelling. People listen to a story, and then the listeners discuss it. When we look at the solar oven story from the activity perspective, in the sharing of the story, it can function similarly to any other story shared. In the sharing of the story the audience listens to the teller, they feel and embody the story, and they think about their understanding of the concepts shared, mediated through their perception of the world. Through discussions after the story has been shared, the listeners do this again but by listening to the feelings and understanding of other listeners. As the various interpretations are mediated by each listeners perception of the world, they provide a gateway into the sum of all of the stories that have they accumulated. For students, this means that they play an active role in the co-creation of understanding, drawing from their own lived experiences. They develop systems literacy through identifying, interpreting, co-creating, relating to, and communicating about the story, which reflects the system. In doing so they engage with the world, other perspectives, and balance ways of being; developing as systems beings who have the ability to see the mutually constituted social and technical dimensions of engineering.

Educators do not need to reinvent the wheel to use story to develop STT or other metacognitive skills. Story is already being used in engineering education in similar ways, and story has been used since it has first existed. Instead, we can focus on intentionally using story, with the ARC framework as a guide as we select and/or build stories. Stories require work, especially if they are to be used intentionally, but the preparation is worth it to increase the impact of existing

methods of STT integration. As a story is modular and can be self-contained it is relatively easy to layer into an existing course that is being taught, Godwin et al. referring to their intervention as “low-effort” (Godwin et al., 2024, p. 62). If a course is co-instructed, then stories shared by the instructor predominantly trained in the “social” can help contextualize those dimensions of engineering more readily. While story may not help address the lack of support from administration and the prevalence of “socio-technical dualism” (unless you tell a great story, in which case I am sure many would be interested to hear it), stories are content dense and therefore easy to integrate without needing to significantly modify course content to create capacity for the new material.

The act of storytelling can be difficult; it is hard to get people to listen and engage with a story. As storyteller Ruth Sawyer said in her book *The Way of the Storyteller*, “...it is the easiest thing in the world to tell a story – and the hardest to be a fine storyteller” (Ruth Sawyer, 1944). But just as in the ARC framework, it can be made easier by focusing on listening. If you want the listeners to feel connection with the story, to have affective responses, the storyteller needs to feel connection to the story. If you see, the listeners will see. If you feel, they will feel. So spend time carefully selecting the story you wish to share, and the right storyteller if you are bringing someone in. Think about what you want the listeners to take away from the story, while acknowledging the listeners takeaways will not all be the same. Then build connection with the takeaway, holding in your mind why it is important, and your listeners will feel it too.

Once we focus on listening, we need to be intentional as we think about the stories we invite students to hear. We need to be intentional about the stories that we choose to share, which stories we invite them to feel connection to. Every story that is listened to, contributes a new building block to the listener’s perception of the world. Elder Louis Bird remembers and transmits stories in the voice and context of his people, the stories are identity and culture (D. Yashinsky, personal communication, February 2026). In Spaulding’s work, there was a shift in how listeners understood how to be an engineer (Spaulding, 2010). In Godwin’s (Godwin et al., 2024), students learned that struggle was a part of being an engineering student, using the stories of others to shape how they see themselves in the role. The stories we tell shape the culture and the culture shapes the stories we tell; they are mutually constituted just as the social and technical dimensions of engineering are. By changing the stories or introducing new ones, we can shape the oral culture to further integrate STT. Changing how students perceive engineering and their relation to it, through being intentional about the stories available to them to acquire their holistic knowledge. The stories that they listen to, the stories that others share their interpretations, the stories that become embodied.

But we must be careful. It is not novel to say that stories can be dangerous, they have been used as weapons and vehicles of control throughout history. The intent behind the story matters. And if more is transmitted in the sharing of a story than just the words, than even a story that is problematic, heavily edited, still has the potential to be problematic. Fortunately just as stories

can control, the reverse is true, as Chinua Achebe said, “storytellers threaten all champions of control” (Achebe, 2010).

It is not my intent to say which stories should be told, and which should not. Instead, I want to highlight that we shape our oral culture, and with it, how engineering is perceived. If we want to develop STT in engineering, we need to be intentional and select that support the identity of an integrated socio-technical engineer. Bring the stories into the classroom where students can reflect, engage, but above all else, listen.

VII. CONCLUSION

The practice of listening and working with stories offers a meaningful and currently underutilized path for integrating and developing socio-technical thinking in engineering curricula. Story aligns naturally with the ARC framework for systems literacy; stories are embodied, co-created through listening, and decenter the individual in knowledge creation, making them inherently affective, relational, and cognitive. When learners listen to a story they are engaging their bodies, negotiating meaning, and locating themselves within a broader system of relationships, identities, and experiences.

Because of this, story supports the shift in perception STT requires. Through story, students begin to see engineering work as not just a set of isolated technical tasks, but mutually constituted with social dimensions. They learn that to understand a problem space, a system, requires listening to the people that live within it. This is the development of systems beings; learners who engage with the world, other perspectives, and balance ways of knowing.

Stories are not a new educational intervention, and no new methods are required to use them; they already circulate our classrooms and professional practices. What is required is intentionality, selecting relevant stories and focusing on facilitating discussion in a way that foreground embodiment, co-creation, and interaction.

If we want engineers who can truly see the broader dimensions of their work, we should start by asking them to listen to stories.

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REFERENCES

- Achebe, C. (2010). *Anthills of the savannah* (Anchor Canada ed). Anchor Canada.
- Berne, R. W., & Schummer, J. (2005). Teaching Societal and Ethical Implications of Nanotechnology to Engineering Students Through Science Fiction. *Bulletin of Science, Technology & Society*, 25(6), 459–468. <https://doi.org/10.1177/0270467605283048>
- Binning, K. R., Kaufmann, N., McGreevy, E. M., Fotuhi, O., Chen, S., Marshman, E., Kalender, Z. Y., Limeri, L., Betancur, L., & Singh, C. (2020). Changing Social Contexts to Foster Equity in College Science Courses: An Ecological-Belonging Intervention. *Psychological Science*, 31(9), 1059–1070. <https://doi.org/10.1177/0956797620929984>
- Bonab, M. S., Ghasemzadeh, M., Alishahian, R., & Amirfazli, A. (2023). A STORY TELLING APPROACH FOR TEACHING ENGINEERING COURSES: A MINI-CASE METHOD. *Conference Proceedings*.
- Bosman, K., Lisa;Chelberg. (2021). Creating Children's Books to Promote Exposure and Build Communication Skills in Engineering. *Scholarship and Practice of Undergraduate Research.*, 5(2).
- Bruner, J. (1991). The Narrative Construction of Reality. *Critical Inquiry*, 18(1).

- Bruner, J. (2002). *Making Stories: Law, literature, life*.
- Codispoti, M., Surcinelli, P., & Baldaro, B. (2008). Watching emotional movies: Affective reactions and gender differences. *International Journal of Psychophysiology*, 69(2), 90–95. <https://doi.org/10.1016/j.ijpsycho.2008.03.004>
- Daniel, A. (2009). Story Time. *ASEE Prism*, 18(5), 44–47.
- Esteban-Guitart, M., & Moll, L. C. (2014). Funds of Identity: A new concept based on the Funds of Knowledge approach. *Culture & Psychology*, 20(1), 31–48. <https://doi.org/10.1177/1354067X13515934>
- Evans, R. (2022). *Catching Feelings: Measurement of Theatre Audience Emotional Response Through Performance* [UCLan]. <https://knowledge.lancashire.ac.uk/id/eprint/46180/>
- Falassi, A., & Abrahams, R. D. (2014). *Folklore by the Fireside: Text and Context of the Tuscan Veglia*. University of Texas Press.
- Gladwin, D., & Ellis, N. (2024). Systems beings: Educating for a complex world. *Educational Philosophy and Theory*, 56(7), 683–695. <https://doi.org/10.1080/00131857.2024.2320185>
- Godwin, A., Perkins, H., DeAngelo, L., McChesney, E., Kaufman-Ortiz, K., Dorvé-Lewis, G., & Conrique, B. (2024). Belonging in Engineering for Black, Latinx, and Indigenous Students: Promising Results From an Educational Intervention in an Introductory Programming Course. *IEEE Transactions on Education*, 67(1), 56–64. <https://doi.org/10.1109/TE.2023.3312628>
- Gold, J. (2002). *The Story Species: Our Life-Literature Connection*. Fitzhenry & Whiteside.
- Gomez, P., & Danuser, B. (2004). Affective and physiological responses to environmental noises and music. *International Journal of Psychophysiology*, 53(2), 91–103. <https://doi.org/10.1016/j.ijpsycho.2004.02.002>

- Goodchild, M. (2021). Relational Systems Thinking: That's How Change is Going to Come, From Our Earth Mother. *Journal of Awareness-Based Systems Change*, 1(1), 75–103.
<https://doi.org/10.47061/jabsc.v1i1.577>
- Hasson, U., Ghazanfar, A. A., Galantucci, B., Garrod, S., & Keysers, C. (2012). Brain-to-brain coupling: A mechanism for creating and sharing a social world. *Trends in Cognitive Sciences*, 16(2), 114–121. <https://doi.org/10.1016/j.tics.2011.12.007>
- Lundqvist, L.-O., Carlsson, F., Hilmersson, P., & Juslin, P. N. (2009). Emotional responses to music: Experience, expression, and physiology. *Psychology of Music*, 37(1), 61–90.
<https://doi.org/10.1177/0305735607086048>
- Moresoli, C., & Mikhail, M. (2024). THE ROLE OF EMPATHY AND SYSTEM THINKING IN CREATING SOCIO-TECHNICAL AWARENESS: THE CASE OF THE PANDEMIC. *Conference Proceedings*.
- Ollove, M., & Lteif, D. (2017). Integrating Systems Thinking and Storytelling. *FormAkademisk - Forskningstidsskrift for Design Og Designdidaktikk*, 10(1).
<https://doi.org/10.7577/formakademisk.874>
- Reddy, E., Kleine, M. S., Parsons, M., & Nieusma, D. (2023). Sociotechnical Integration: What Is It? Why Do We Need It? How Do We Do It? *2023 ASEE Annual Conference & Exposition Proceedings*, 44239. <https://doi.org/10.18260/1-2--44239>
- Reiser, B. J., Novak, M., McGill, T. A. W., & Penuel, W. R. (2021). Storyline Units: An Instructional Model to Support Coherence from the Students' Perspective. *Journal of Science Teacher Education*, 32(7), 805–829.
<https://doi.org/10.1080/1046560X.2021.1884784>

- Rodrigues, R. B., & Seniuk Cicek, J. (2024). A scoping literature review of sociotechnical thinking in engineering education. *European Journal of Engineering Education*, 49(5), 807–833. <https://doi.org/10.1080/03043797.2024.2346344>
- Ruth Sawyer. (1944). *The Way of the Storyteller* (First Ed.). George G. Harrap & Co. Ltd.
- Sfard, A., & Prusak, A. (2005). Telling Identities: In Search of an Analytic Tool for Investigating Learning as a Culturally Shaped Activity. *Educational Researcher*, 34(4), 14–22. <https://doi.org/10.3102/0013189X034004014>
- Spaulding, R. J. (2010). An Alternative Expert Knowledge Transfer Model. *ProQuest LLC*.
- Speer, N. K., Reynolds, J. R., Swallow, K. M., & Zacks, J. M. (2009). Reading Stories Activates Neural Representations of Visual and Motor Experiences. *Psychological Science*, 20(8), 989–999. <https://doi.org/10.1111/j.1467-9280.2009.02397.x>
- Stephens, G. J., Silbert, L. J., & Hasson, U. (2010). Speaker–listener neural coupling underlies successful communication. *Proceedings of the National Academy of Sciences*, 107(32), 14425–14430. <https://doi.org/10.1073/pnas.1008662107>
- Stroh, D. P. (2011). The Systems Thinker. *Systems Thinker*, 21(8).
- Vansina, J. (1985). *Oral tradition as history*. University of Wisconsin press.