Journal of Agricultural Education, 66(4), Article 27
https://doi.org/10.5032/jae.v66i4.3244

Storytelling and Narrative Transportation as a Catalyst for Self-Efficacy and Action in the Face of Climate Change

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Abstract

Climate change, characterized by intricate scientific foundations and far-reaching implications, presents significant societal and individual challenges. We examined how storytelling and narrative transportation can enhance climate change education by influencing self-efficacy, content interest, and climate change anxiety. Narrative transportation is the imaginary journey readers take while focusing their attention on a story. Using a Taguchi design, we constructed eight versions of a climate change story, manipulating story ending, fictionality, collective identity, and verisimilitude. University students read one of the stories and completed a questionnaire. Reading the story increased self-efficacy expectancies by 28% ($p < .001$). Narrative transportation significantly increased content interest and was positively correlated with climate change anxiety. Fictionality moderated the relationship between narrative transportation and self-efficacy. The relation between narrative transportation and self-efficacy was stronger for nonfiction stories. Verisimilitude increased narrative transportation and improved learning outcomes. Self-involvement increased narrative transportation. Self-relevant stories yielded narrative transportation. Realistic, personally relevant stories enhance climate change education by increasing narrative transportation and learning outcomes.

Introduction

Climate change, characterized by intricate scientific foundations and far-reaching implications, presents significant societal and individual challenges. Environmental and social impacts are increasingly evident. Recent years have witnessed world-wide increases in the frequency of heatwaves, hurricanes, flooding, wildfire, and drought (Clayton, 2020). Climate change is spreading water-borne and vector-borne diseases, increasing malnutrition, and diminishing physical and mental health. *Climate anxiety* has emerged as an international phenomenon, particularly among young people of high-school and college age and has become a topic of behavioral science research (Clayton, 2020; Watts et al., 2019). In a recent study of 16- to 25-year-old Canadian youth, 78% reported impacts of climate change on their mental health, 73% reported finding the future to be "frightening," and 39% reported reservations about having children due to climate change (Galway & Field, 2023). In the United States, the percentage of Gallup survey respondents reporting they "worry a great deal" about climate change increased from 37% to 45% between 2016 and 2017 (Haltinner & Sarathchandra, 2018, p. 2). Worldwide, climate change and concerns about climate

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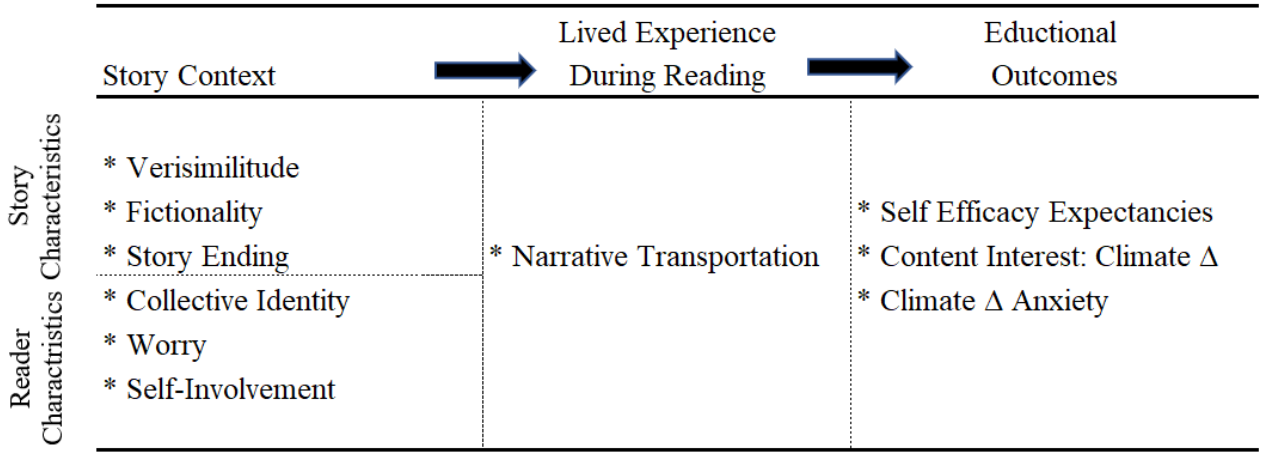
change are leading to mass migration and conflicts among people occupying different geographical regions (Clayton, 2020; Watts et al., 2019).

Despite the growing urgency to address this issue, many individuals, including university students, feel disconnected from understanding its presumed causes and potential solutions (Clayton et al., 2015; 2020; Jones & Davison, 2021). In some countries, including the United States, climate change beliefs and attitudes are keenly divided along political party lines. This sense of detachment and lack of personal efficacy highlights the need for strategies that not only educate but also empower individuals to take meaningful action. Our study was directed at how university professors can design and use stories to connect students with climate change content and empower students to act. Specifically, we examined how the story characteristics and student characteristics shape university students' narrative transportation—the lived experience of being absorbed in a story about climate change—and three key educational outcomes: content interest in climate change, climate change anxiety, and self-efficacy expectancies in demonstrating learning about climate change (Fig. 1). Story characteristics and student characteristics about which we formulated hypotheses were ending valence, fictionality, verisimilitude, collective identity, and self-relevance.

Figure 1

Conceptual model of story experiences and educational outcomes



We treat climate anxiety not as an endpoint but as a signal that can be redirected from helplessness to action. Cross-national evidence shows many young people report feeling "powerless" and "helpless" about climate change, "more than 50% reported each of the following emotions: sad, anxious, angry, powerless, helpless, and guilty" (Hickman et al., 2021). To counter these feelings, Bandura's efficacy framework may be helpful. Stories can provide vicarious mastery experiences and model specific, controllable steps, thereby cultivate self-efficacy and outcome expectancies while reducing paralyzing distress (Bandura, 1997, 2000). Seligman's attributional analysis of learned helplessness also suggests strategies useful to educators. Well-designed narratives shift explanations from global/stable/uncontrollable causes to specific/unstable/controllable ones, which prevents generalized helplessness and supports agency (Abramson et al., 1978; Seligman, 1975). In agricultural education, educator-told and community stories can illustrate feasible, local solutions (e.g., water, soil, or herd-health interventions) and collective problem-solving, thereby demonstrating empowerment rather than despair and aligning with long-standing extension practice.

Related Literature

Educational Outcomes

In this section, we describe the model's three outcomes. Content interest indexes motivational engagement with climate material, climate-change anxiety captures affective responses that can hinder or propel action, and self-efficacy expectancies reflect students' confidence in demonstrating what they have learned. Together, these outcomes describe how stories may inform, move, and empower learners.

Content Interest in Climate Change

We define content interest as the motivation to engage with climate information—how much students care, think, and lean in (Høgheim et al., 2022). Four indicators are: perceived value of time spent reading, anticipated impact of the reading, meaningfulness of the content, and likelihood of recommending the story to others (Ellis et al., 2024). Perceived value captures whether the reading felt worth the time investment Anticipated impact reflects the expectation that the story will change understanding or behavior. Meaningfulness grows when narratives connect with one's values or lived experience and, in turn, pull readers deeper into the topic (Moser, 2016). Likelihood of recommending signals that the story mattered enough to share—an impulse that can amplify influence through social networks and seed collective engagement (Hart et al., 2024). Consistent with this logic, Ellis et al. (2024) found a .58 correlation between anticipated impact and meaningfulness.

Narrative transportation should heighten all four indicators. When a story engages receivers, they tend to value the time, expect meaningful consequences from the encounter, and want others to read it. We therefore treated content interest as an important educational outcome of the story experience. Content interest may link story experiences to subsequent inquiry and action. Heightened content interest for any subject drives attention and information seeking; if that exposure is threat-heavy and agency-light, interest can co-occur with increased anxiety in the short term. When narratives pair compelling content with credible, controllable actions interest tends to channel worry into constructive engagement (Bandura, 1997, 2000; Ojala, 2012).

Climate Change Anxiety

In contrast to content interest, which is a cognitive outcome, climate-change anxiety may be an important affective consequence of narrative engagement. Climate-change anxiety can either disrupt learning or propel it—depending on whether students perceive efficacious paths forward (Bandura, 1997, 2000). Anxiety is "an emotion characterized by apprehension and somatic symptoms of tension in which an individual anticipates impending danger, catastrophe, or misfortune" (Dictionary of Psychology, n.d). Emotions are transitory experiences, yet their frequency and intensity depend on dispositional and environmental contingencies. Individuals with a stable tendency to worry about global issues, such as climate change, are more likely to experience persistent anxiety, which is described as chronic worry or distress associated with anticipated impacts on individuals, communities, and future generations (Clayton, 2020). Some researchers (e.g., Clayton & Karazsia, 2020) have conceptualized climate change anxiety as a complex construct that includes cognitive and functional impairments that result from repeated bouts of anxiety. Young people who frequently encounter messages about the severe consequences of climate change report higher levels of climate anxiety, which can manifest as feelings of helplessness, frustration, or even betrayal by government inaction (Hickman et al., 2021).

The same emotions that can immobilize can also mobilize when paired with efficacy and meaning-focused coping (Hickman et al., 2021). Relations among emotions, coping, efficacy, and mobilization point to the need to reframe climate problems toward specific, controllable actions and proximal goals via

vicarious modeling (Bandura, 1997, 2000; Ojala, 2012). In line with the attributional reformulation of learned helplessness (Abramson et al., 1978), narratives that highlight specific, unstable, and controllable causes should reduce paralyzing distress while increasing self-efficacy and outcome expectancies (Bandura, 1997, 2000). In brief, anxiety is productive when paired with efficacy and controllable attributions, and counterproductive when framed as global, stable, and uncontrollable. Narrative design can make that difference: by modeling specific, attainable steps and near-term successes, stories convert arousal into approach motivation, action, and perseverance.

Self-Efficacy

Self-efficacy is a potentially potent agent in determining whether climate-related anxiety energizes or undermines action. Self-efficacy refers to individuals' beliefs in their ability to perform actions required to achieve specific goals (Bandura, 1977). Self-efficacy influences how people think, feel, and behave. It determines effort, persistence, and resilience when faced with challenges (Bandura, 1997). Individuals with high self-efficacy toward a specific task are more likely to set ambitious goals, approach challenges confidently, and recover from setbacks effectively. Students who believe in their ability to make a difference are more likely to engage in pro-environmental behaviors (Ojala, 2012). Sources of self-efficacy are mastery experiences, vicarious experiences, verbal persuasion, and physiological arousal (Bandura, 1994). These sources shape peoples' beliefs in their capacity to perform specific tasks. Self-efficacy is a powerful determinant of motivation, performance, and persistence.

Self-efficacy theory distinguishes between self-efficacy expectancies and outcome expectancies. Self-efficacy expectancies are "the conviction that one can successfully execute the behavior required to produce the outcomes" (Bandura, 1977, p. 193). Self-efficacy beliefs determine how much effort individuals will invest in a task and their resilience in the face of obstacles. In contrast, outcome expectancies are beliefs that a particular behavior will lead to a desired outcome (Bandura, 1982). An outcome expectancy is present, for example, when a teacher believes that a certain learning activity will be successful (self-efficacy expectancy) and will lead to students acting based on their learning (outcome expectancy).

Several studies have explored the interplay between self-efficacy and outcome expectancies, often through the lens of Bandura's four mechanisms: mastery experiences, vicarious experiences, verbal persuasion, and physiological/emotional arousal. Schunk and Pajares (2002) investigated how mastery experiences, such as successfully solving mathematical problems, influenced self-efficacy and outcome expectancies. Mastery directly enhanced students' confidence in their abilities and reinforced their beliefs that their efforts would lead to success. Lent et al. (2017) examined the sources of self-efficacy and outcome expectations for career exploration and decision-making. They highlighted that vicarious learning, through observation of models, serves as a primary source of self-efficacy beliefs, influencing individuals' career-related behaviors. Toggerson et al. (2020) assessed the impact of team-based learning pedagogy on student self-efficacy. Managing physiological states such as reducing anxiety through collaborative learning environments positively influenced students' self-efficacy and outcome expectancies. Stories are vicarious experiences and thus are potentially impactful in changing self-efficacy expectancies. Engaging stories enrich the vicarious experience by transporting readers into imaginary worlds of stories (e.g., Gerrig, 2018). Engaging story experiences increase knowledge about the subject matter that is the content of the story (Gerrig, 2018; Green, 2021). Research on the relationship between climate-change knowledge and anxiety is limited (e.g., Baykara Mat & Yılmaz, 2024; Ramírez-López et al., 2023; Thomson & Roach, 2023; Zacher & Rudolph, 2023). Some research has shown that instruction about climate change increases climate change anxiety (Ramírez-López et al., 2023; Verlie, 2022), yet other studies show a negative relation (Zacher & Rudolph, 2023).

Narrative Transportation: The Lived Experience of Reading a Story

Stories, both fiction and nonfiction, can be powerful mechanisms for establishing beliefs, influencing attitudes and intentions, and alleviating anxiety (Green & Brock, 2000; Hollis, 2023). Meta-analysis results show that story experiences "exert a causal influence on the four most common indices of persuasion" (Braddock & Dillard, 2016, p. 461), yet "…work is needed to isolate message features that enhance or inhibit narrative potency" (p. 463). In brief, we know that stories can be impactful, but we do not know what story *features* make some stories more impactful than others.

One area of inquiry relevant to a quest for identifying impactful story features focuses on *narrative transportation* (Gerrig, 2018). Narrative transportation refers to the imaginary journeys experienced by story receivers as their attention is transported to the places, times, and sets of circumstances described in a story. Through a story, one may vicariously visit a dazzling imaginary land with a bold and dashing hero and a cadre of despicable villains or a future world in which a once prosperous land was laid to waste due to climate change. A story may also carry a receiver to a future circumstance in which government leaders made catastrophic decisions to address a climate change problem that proved to be nonexistent. When the reader's attention returns from imaginary worlds, that person is changed in some way. Readers return to their real worlds with new knowledge, beliefs, attitudes, intentions, values, and perspectives. Facts travelers encounter during visits to imaginary worlds are often assumed to also be true in the real world to which the traveler returns (Gerrig, 2018).

Facts that are true only in fictional stories can change beliefs about their truth in the real world (Gerrig, 2018). In one demonstration, participants read a short passage stating the U.S. national speed limit was 70 mph (fictional at the time). Moments later, they verified general-knowledge statements; those who had just read "70 mph" were ~78 milliseconds slower to judge the true statement "The speed limit is 55 miles per hour," indicating interference from the story world (i.e., narrative propositions took priority in retrieval) (Gerrig, 2018). This mechanism helps explain how climate stories can reorganize what comes to mind first—making controllable, specific actions more cognitively available and, when designed well, nudging judgments away from helplessness toward efficacy.

Stories are instructional strategies used by many teachers, professors, and agriculture and engineering extension educators (e.g., Hollis, 2023; Moon, 2010; Peters & Franz, 2012). Narrative transportation fosters engagement and yields downstream effects on beliefs, attitudes, intentions, and behaviors (Braddock & Dillard, 2016; Gerrig, 2018; Green, 2021; Janes et al., 2025). Using meta-analysis, Braddock and Dillard (2016) tested three hypotheses about narrative transportation. The first proposed that exposure to narrative yields story-consistent changes in beliefs, attitudes, intentions, and behaviors. The second hypothesis was that fictionality moderates the effect of narrative on the same outcomes, and the third hypothesis proposed that the medium of presentation of the story moderates the effect of narrative on the set of outcomes. Results showed significant effects of exposure to stories on beliefs, attitudes, intentions, and behaviors. The test of fictionality yielded mixed results, and the medium through which stories were told had no significant effect. We tested the following hypotheses about narrative transportation and educational outcomes from reading a story about climate change:

H_1: Story experiences increase self-efficacy expectancies.
H_2: As narrative transportation increases, self-efficacy expectancies increase.
H_3: As narrative transportation increases, content interest in climate change increases.
H_4: As narrative transportation increases, climate change anxiety changes.

Story Context

Story Ending: Optimistic vs. Pessimistic

Story ending is a potentially important story feature. Positive story endings, where challenges are met with successful solutions, may foster a sense of hope and motivation to engage in climate action (Ojala, 2012). Conversely, stories with negative endings can heighten awareness of the severity of climate change impacts, potentially increasing climate anxiety and urgency for action (Clayton, 2020; Hinkel et al., 2020). In climate change education, it may be important to strike a balance between presenting the dire realities of climate impacts and offering hopeful narratives that empower students to believe in their capacity to contribute to solutions. Stories illustrating successful community adaptation and mitigation efforts can enhance students' self-efficacy and willingness to participate in climate action (Baldwin et al., 2023; Ojala, 2012). Incorporating elements of resilience and innovation in story endings can help students envision practical steps they can take to combat climate change (Baldwin et al., 2023; Muroi & Bertone, 2019). Using different story endings may yield different educational outcomes. Haltinner and Sarathchandra (2018) point out that motivating emotions such as hope and pride tend to be more effective in facilitating action than paralyzing emotions such as fear and anxiety. Thus, a story promoting hope by ending in successful climate action may be more effective in motivating activism and stimulating behavior change than a story ending without hope; a story highlighting the catastrophic consequences of inaction. In the context of our conceptual framework (Fig. 1), it is reasonable to assume that stories with hopeful outcomes about climate change will yield positive emotions and motivation which, in turn, will lead to positive educational outcomes. Thus,

H_5: Story ending affects self-efficacy expectancies.
H_6: Story ending affects content interest in climate change.
H_7: Story ending affects climate change anxiety.

Fictionality

Fictionality may affect narrative transportation across different media (Barthes, 1974; Davies, 2015). Through fictional stories, authors may weave elements that, while not necessarily factual, offer deeper insights into the human condition and broaden the scope of narrative expression. Fictionality serves semiotic functions within narratives, using signs and symbols to convey layers of meaning beyond the surface text. This semiotic dimension enhances the interpretative richness of narratives and encourages readers to engage in deeper analytical processes (Barthes, 1974). Thus,

H_8: Fictionality increases narrative transportation

Nonfiction stories, though, may also impact narrative transportation. If readers believe a story describes actual conditions, it is reasonable to assume that they will be more inclined to act in accordance with learning resulting from story experiences:

H_9: Fictionality moderates the effect of narrative transportation on self-efficacy expectancies. For nonfiction stories, but not fictional stories, self-efficacy expectancies increase as narrative transportation increases.

Verisimilitude

Verisimilitude refers to the quality of making a narrative's elements—characters, dialogue, and settings—believable and lifelike. Rich descriptions of sensory details such as colors, aromas, emotions, and experiences like terror, joy, or despair, can heighten realism. Realism facilitates the receiver's construction

of personal narratives by reducing cognitive gaps, allowing them to focus on the story's germane features. Consequently, verisimilitude enhances engagement, fosters narrative transportation, and promotes deep experience (Green & Brock, 2000). Through meticulous attention to detail, stories can make even fantastical elements plausible and immerse readers in a narrative world that feels authentic and relatable. Although verisimilitude is widely acknowledged for its role in enhancing narrative transportation, its effects on contentious topics such as climate change remain underexplored. Stories incorporating imaginative elements while maintaining factual plausibility may influence perceptions of urgency and severity, potentially motivating pro-environmental behavior (Salama & Aboukoura, 2018). Balancing realism with creativity in such narratives can help storytellers connect with audiences, fostering both understanding and action, thus,

H_{10}: Verisimilitude increases narrative transportation.

Reader Characteristics

Self-Relevance and Self-Involvement

Stories relevant to personal experiences add depth and richness to storytelling, fostering a profound sense of connection and emotional involvement. Self-relevance is among the most longstanding topics of study in psychology, originating with the work of William James (1890). Self-relevance refers to the extent to which an individual perceives a topic, narrative, or message as genuinely and meaningful and important to their beliefs, values, commitments, and aspirations. Self-relevance plays a key role in determining how deeply individuals engage with activities (Csikszentmihalyi, 1988). Deeply engaging activities create *self-expansion*; changes or affirmations of deeply valued beliefs, attitudes, intentions, and behaviors (Bian et al., 2019; Csikszentmihalyi, 1988; Green & Brock, 2000). Self-relevance may be influenced by several interconnected factors, including collective identity, personal interests, and levels of worry or concern about the subject (Tajfel & Turner, 1979; Vansteenkiste et al., 2018). Worry draws attention to issues perceived to be threatening to a valued component of the self. Worry acts as a motivational force, increasing the likelihood that individuals will engage with information they perceive as relevant to their well-being or future (Loewenstein et al., 2001). Worry about such potential consequences as rising sea levels, extreme weather, or biodiversity loss heightens the self-relevance of climate change narratives (Ojala, 2012).

While self-relevance asks, "Is this about me?", self-involvement asks, "Am I in this social group?" Self-involvement embraces both self-relevance and worry, referring to the degree to which individuals are personally invested in an issue, experience, or narrative. In education, self-involvement fosters engagement with the issue (Cents-Boonstra et al., 2020). When people see climate change as directly affecting their lives or communities, their interest and willingness to act increase significantly (Whitmarsh, 2008). Self-involvement also plays a critical role in storytelling. Stories featuring relatable characters, situations, or challenges can enhance self-involvement by allowing individuals to see themselves in the narrative, thereby increasing their emotional connection and the likelihood of adopting the intended message (Green & Brock, 2000). Thus,

H_{11}: Self-involvement in a story increases narrative transportation.

Collective Identity

Collective identity represents the part of an individual's self that is derived from their membership in one or more distinct social groups (Cheek & Cheek, 2018; Tajfel & Turner, 1979). Individuals who endorse collective identity orientation place great importance on the values and characteristics of members of their group. Groups may be based on affiliation with a certain organization (e.g., a student at a particular university), ethnicity, religion, nationality, profession, or other affiliations. The groups that are the basis for

collective identity shape how individuals perceive themselves and interact with others. Collective identity involves three key processes: categorization, identification, and comparison (Tajfel & Turner, 1979; Tajfel, 1981). Through categorization, individuals organize their social environment by assigning themselves and others to groups, thereby simplifying complex social dynamics. Identification occurs when individuals adopt the values, norms, and behaviors of their in-groups, strengthening emotional connections to the group. Comparison entails evaluating one's group against others, which can enhance self-esteem when the in-group is positively perceived, or lead to prejudice and conflict in cases of negative comparisons.

Collective identity plays a significant role in self-relevance, as individuals find meaning and personal connection through their affiliations. Narratives, educational content, or media representations that resonate with an individual's collective identity are more engaging and more likely to influence beliefs and behaviors (Ashmore et al., 2004; Green & Brock, 2000). Storytelling that frames climate change as a shared challenge for farmers, coastal communities, or indigenous groups fosters a sense of collective responsibility and urgency (Adger et al., 2013; Clayton et al., 2015). When climate action is tied to group norms, individuals are more likely to adopt behaviors consistent with their group's identity, such as supporting clean energy initiatives or sustainable practices (Bamberg & Möser, 2007). Thus, incorporating collective identity into climate change storytelling can be expected to enhance engagement and strengthen the credibility of a story's message. The presence of group values and norms reflected in a narrative fosters trust and emotional resonance, thereby increasing the likelihood of behavioral change.

H_{12}: Collective identity of readers reflected in a story increases narrative transportation.

Methods and Materials

Materials: A Story about a Debate on Climate Change

We constructed eight versions of a story about a debate about climate change to create experimental treatment conditions in a fractional factorial (Taguchi) experimental design (Maxwell et al., 2017). Participants read the version of the story to which they were randomly assigned and completed a paper questionnaire immediately after their reading of the story. The stories varied systematically according to four features: story ending (optimistic ending vs. pessimistic ending), fictionality (fiction implied vs. nonfiction implied), collective identity (high vs. low), and verisimilitude (rich description vs. less rich description).

All eight versions described a debate occurring on a university campus. The debate addressed the causes of climate change. The debate did not focus on possible solutions, a sensitive topic that might elicit responses founded in dogmatism instead of reasoning. All versions of the story ended with a brief presentation by an atmospheric science professor who commented briefly on several possible solutions. In four stories, the debate occurred on the campus of Texas A&M University in the United States, where the experiment was conducted (*collective identity-high*). The setting for the *collective identity-low* condition was a university in Mashhad, Iran, a location about which the students had no knowledge or affiliation. Cues were added to four stories to suggest that they were *nonfiction*. These cues included explicit mention of the time, date, and location of the debate, presented at the beginning of the nonfiction treatment condition stories. For the *fictional* stories, the second line of the introduction read, "The story is fictional,*"* in boldface and underlined characters.

Verisimilitude was manipulated through the *presence or absence of rich descriptions* throughout the stories. As an example, stories high in verisimilitude described the entrance to the auditorium in which the debate was to occur as "a pair of enormous walnut doors framing the entrance to the auditorium." For the low verisimilitude condition, the corresponding description was simply, "the entrance to the auditorium." Four stories ended with an *optimistic* message delivered by an atmospheric science professor.

In four other stories, the message provided by the atmospheric science professor was pessimistic. In the optimistic stories, the distinguished professor began remarks with, "I am optimistic, we have excellent reason for hope. Climate change requires our immediate and collective action. Massive wind farms line many of our highways, replacing fossil fuels with wind energy…." In the *pessimistic* stories, the professor began remarks with, "I must confess a deep sense of despair. For decades, we have been aware of the impending crisis, yet meaningful action has been scant…our world continues to warm, seas rise, and ecosystems collapse while debates rage on without tangible progress." Table 1 shows the word count and features of each of the eight stories. Despite the differences in verisimilitude, fictionality, and story ending, all stories were presented in approximately 6.5 single-spaced pages in 12-point Times New Roman font and 1" margins. Results of linear mixed model analysis revealed no significant variation by the random variable, story ($Z = .69$, $p = .25$, $R^2_{PRE} = .03$).

Table 1

Story profiles: Fractional factorial/Taguchi design

Story	*N* Words	Identity	Fictionality	Verisimilitude	Story ending
1	*4,028*	*Related*	*Fictional*	*High*	*Optimistic/Hopeful*
2	*3,473*	*Related*	*Fictional*	*Low*	*Pessimistic/Hopeless*
3	*3,959*	*Related*	*Not Fictional*	*High*	*Pessimistic/Hopeless*
4	*3,467*	*Related*	*Not Fictional*	*Low*	*Optimistic/Hopeful*
5	*3,847*	*Not Related*	*Fictional*	*High*	*Pessimistic/Hopeless*
6	*3,388*	*Not Related*	*Fictional*	*Low*	*Optimistic/Hopeful*
7	*3,819*	*Not Related*	*Not Fictional*	*High*	*Optimistic/Hopeful*
8	*3,307*	*Not Related*	*Not Fictional*	*Low*	*Pessimistic/Hopeless*

The pattern of the presence or absence of attributes of each of the four factors was determined empirically, through an orthogonal array (Table 1). If the design had remained completely balanced (i.e., equal numbers of participants read each story), the factors would have been uncorrelated empirically; no confounding (collinearity) would have existed among vectors representing the effects of the four treatment conditions. Interpretation of each of the main effects would have been totally free of confounding from the remaining three factors. In our study, however, negligible correlations did occur due to small variations in the sample sizes across the eight stories. Correlations (phi coefficients) between dummy coded vectors representing the four factors ranged from 0 to .04.

Participants

Participants were 146 undergraduate and graduate students majoring in one of the academic programs offered by the College of Agriculture and Life Sciences at Texas A&M University. Procedures for selecting the sample and conducting the study were approved by the Texas A&M University Institutional Review Board.

Measurement

Self-Efficacy Expectancy Change

Consistent with the retrospective pretest method (e.g., Moore et al., 2009), we measured self-efficacy change with questions requesting two responses to each of six self-efficacy expectancies. Our questionnaire preceded these self-efficacy expectancy statements with, "Imagine that an atmospheric science professor asked you each of the questions below. Also imagine that the professor asked you those questions twice:

before and after you read the story. Please tell us how confident you would be that you could provide an acceptable answer, both before and after the story." The following statements were:

1. Describe the presumed cause of climate change in enough detail to convince an atmospheric science professor that you have a correct understanding.
2. List five impacts climate change is having on the earth.
3. Describe three human behaviors that are assumed to cause climate change.
4. Describe three actions humans are taking to try to mitigate climate change.
5. Explain the reasons some people believe climate change is human caused.
6. Explain the reasons some people believe climate change is a naturally occurring phenomenon, not significantly impacted by human activity.

Participants provided responses along a 101 continuum, ranging from 0 ("I am 100% sure I could not do this) to 100 ("I am 100% sure I could do this). The intermediate point, 50, was described as "I don't know. Maybe yes, maybe no." They provided two responses for each question. The first was their judgement of their ability to complete the task before reading the story and the second response was their judgement of their ability to complete the task after reading the story. We calculated a total score by subtracting each "before" response from its corresponding "after" response and summing the differences across the six items. Cronbach's alpha was .90 for the six-item scale, and item-to-total correlations ranged from .61 to .81.

Climate Change Anxiety

We measured climate change anxiety with a single item. As Allen et al. (2022) argue, "[s]ingle-item measures are acceptable when constructs are unidimensional, clearly defined, and narrow in scope" (p. 3). Our item explained that anxiety is present when we "…feel uneasy, apprehensive, or fearful about the thing (e.g., climate change) that is causing us to worry so much…At the highest levels of anxiety, our heart rates may increase and we may experience panic attacks." We then asked participants to report "how much anxiety about climate change do you feel in your day-to-day life?" Students responded along a 101-point scale, anchored with 0 (no climate change anxiety) and 100 (the greatest possible climate change anxiety." Although climate change anxiety has been conceptualized as a complex, multidimensional construct (Clayton, 2020), we treated it in a manner consistent with the definition in the American Psychological Association *Dictionary of Psychology* (https://dictionary.apa.org/): a transient emotional state. A bivariate correlation of .60 between our measure of climate change anxiety and Stewart's (2021) measure of climate change worry provided criterion-related evidence of validity of our approach.

Self-Involvement

Self-involvement was a linear combination of two indictors: climate change worry and climate change self-relevance. For climate change worry, we used the 10-item scale developed by Stewart (2021). Sample items are "I worry about climate change more than other people" and "I worry that outbreaks of severe weather may be the result of a changing climate." Stewart conducted three studies to develop and evaluate the validity of inferences that can be made from scale scores, collectively involving 1,071 undergraduate and graduate students. Results supported a unitary factor model, strong internal consistency from both the classical test theory ($\alpha = .95$) and congeneric measurement model perspectives ($\Omega = .95$), stability over time ($r = .91$) and invariance of the factor structure across students indicating their gender was male vs. female. In our study the alpha reliability coefficient was .93, and item-to-total correlations ranged from .60 to .81.

Climate change self-relevance was a single item measure. Our questionnaire explained that "self-relevance of a story refers to whether the story has anything to do with your interests, values, beliefs, or attitudes. A story about rugby, for example, will likely be more self-relevant to an athlete who plays that

sport than to someone who has never played rugby and does not know the rules…Please mark an X anywhere on the line below to show your response." The question was followed by a horizontal line with 0 to 100 as end-points and separated into 20 incremental segments (i.e., 0, 5, 10, 15…100). "Not at all" was printed below "0" and "Totally, as much as possible" was presented below "100." Two additional descriptors were positioned at locations determined empirically through previous research on the intensity of meaning of modifiers (Ellis et al., 2023). "Very" was indicated at 29 units and "Greatly" was indicated at 44 units. Self-Involvement in climate change was the sum of *z* scores for climate change worry and climate change self-relevance. The alpha reliability coefficient for this two-item measure was .66.

Narrative Transportation

We used the Appel et al. (2015) narrative transportation short form to measure narrative transportation. The scale comprises six items, examples of which are "I could picture myself in the scene of the events described in the narrative," "I was mentally involved in the narrative while reading it," "I wanted to learn how the narrative ended," and "The narrative affected me emotionally." Following van Laer et al. (2014) and Gerrig (2018), the word "narrative" was changed to "story." That change made the measure consistent with the literature in narrative transportation defining narrative as the performance of the story receiver in creating images of the story, feeling the emotions of the story, and filling in story details left unaddressed by the storyteller. We also added the phrase "in my mind" to items referring to imagery, for the purpose of increasing clarity. Following Janes et al. (2025), we added the item, "I felt like I was in a story" as an indicator of global narrative transportation. We also used the Janes et al. response format, ranging from 1 (*not at all*) to 100 (*very much/totally*). Item scores were summed to create a total score for each participant. Alpha reliability coefficients ranging from .77 to .88 have been reported (Appel et al., 2015; Janes et al., 2025). Our seven-item scale produced an alpha reliability coefficient of .93. Item-to-total correlations ranged from .60 to .87 and the item-to-total correlation for the item we added ("I felt like I was in a story") was .76.

Content Interest

Content interest refers to an affinity for specific subject matter with the likelihood of sustained interest and engagement over time. Our measure of content interest was a principal component score comprising weighted sums of scores on four indicators: meaningfulness of the reading experience, anticipated impact of the reading experience, perceived value of time spent reading the story, and proclivity to recommend the story to others. Meaningfulness was measured with a single item, "I am still thinking about something I learned." A 101-point response scale (0-100) was used, anchored by *not at all* and *very much.* Significant correlations with (a) mindfulness (Ellis et al., 2020), (b) value during use (Eck, 2021), (c) perceived value of time spent (Ellis et al., 2017), and (d) engagement (Ellis et al., 2017) have been reported using this approach. Proclivity to recommend was a single-item measure based on the popular *net promoter score* (Reichheld, 2003). Introduced in 2003 as "one number" companies need to know to succeed, the net promoter approach asks customers to indicate how likely it is that a consumer would recommend a product, service, or company to a friend. An 11-point response format is provided, ranging from 0-11. Our application used a 101-point response scale (0-101, anchored with "I am 100% sure I would *not* recommend the story" to "I am 100% sure I *would* recommend the story") and asked readers to indicate "how likely it is that you would recommend the story you read?" Variations of the net promoter scale approach have been broadly used in such diverse disciplines and industries as marketing (e.g., Fisher & Kordupleski, 2019), health care administration (e.g., Adams et al., 2022), tourism (e.g., Nguyen et al., 2023), and higher education administration (Kara et al., 2022).

We measured participants' anticipated impact of reading using a labeled magnitude scale (Ellis et al., 2024). Participants were presented a description of a target outcome and asked to indicate their judgement of the impact they expect the training will have. We used a 101-point response scale, ranging

from "negligible" (scored 0) to "transformative" (scored 100). Adverbial modifiers were positioned along the continuum at empirically determined intervals: substantial (17), significant (25), profound (47). Criterion-related evidence of validity was evident from correlations in our data set with meaningfulness of the reading experience ($r = .59$, $p < .01$), perceived value of time spent reading the story ($r = .49$, $p < .01$), and proclivity to recommend the reading experience to peers ($r = .52$, $p < .01$). Perceived value of time spent was a summative, four-item scale. Items were "I chose wisely when I decided to read this story," "Reading this story was worth the time I invested in it," "I am glad I chose to read this story," and "reading this story was an excellent use of my time." The scale yielded an alpha reliability coefficient of .93. Results of several studies support reliability and criterion-related evidence of validity in samples of youth and adults. In a recent study of university students, Freeman et al. (2024) reported an alpha reliability coefficient of .93 and a loading of .87 on a factor comprised of the memorability of an experience ($\lambda = .79$), proclivity to recommend ($\lambda = .86$), and meaningfulness ($\lambda = .70$).

The content interest score was calculated through principal components analysis. The single component extracted explained 72% of the variance. Loadings for meaningfulness, anticipated impact of the experience, perceived value of time spent, and proclivity to recommend the story to others were strong: .86, .75, .89, and .88, respectively. The reliability coefficient (omega) for this four-item, weighted sum scale was .91.

Procedure

Seven professors volunteered their classes for participation in the study. A member of the research team visited classes for which instructors had volunteered. The researcher explained procedures and responded to questions. At least two days prior to the experimental session, we administered the climate-change worry questionnaire to participants. We conducted the experiment during a subsequent class meeting. Students who volunteered to participate were given a booklet containing the randomly assigned story and the questionnaire measuring all other variables. Participants received two documents. Students who chose not to participate were given a list of websites about climate change and were invited to review their choice of those while their peers completed the study. Participants completed the worry questionnaire, read the story to which they had been assigned, and then completed the second questionnaire. The researcher gathered all materials, debriefed the class on study details, thanked the class, and departed. The entire experiment, including reading the stories and collecting the data, required approximately 30 minutes. These procedures were approved by the Institutional Review Board.

Method of Data Analysis

We scrutinized the data for outliers and calculated descriptive statistics to summarize central tendencies, variability, and distributions of the data. For hypothesis testing, we used Minitab's Mixed Modeling procedure. For H_1, the test was a single sample *t* test. The null hypothesis was that the mean reported change in self-efficacy expectancies did not include 0, which would indicate no learning. All other hypotheses were tested using the general linear model.

Results

Central Tendency, Dispersion, and Shape

Descriptive statistics, including means, standard deviations, minimum and maximum values, skewness, and kurtosis, are presented in Table 2. The distribution of narrative transportation ($M = 42.47$, $SD = 23.88$) was relatively normal, with a slight positive skew (.22) and mild negative kurtosis (-.95). Self-efficacy expectancy change had a mean of 28.15 ($SD = 17.81$), with a moderate positive skew (.57) and slightly platykurtic distribution (-0.43). Climate change anxiety exhibited high variability ($M = 11.11$, SD

= 15.22) and a strong positive skew (3.11) with high kurtosis (12.04), indicating that while many participants reported low anxiety, a subset exhibited extreme levels of concern. Self-involvement, computed as an average *z*-score of two items (*M* = .00, *SD* = .87), showed a moderate positive skew (.76) and slight leptokurtic distribution (.76). Within the content interest principal component (*M* = 1.00, SD = 2.12), anticipated impact (*M* = 26.17, *SD* = 21.02) and meaning (*M* = 4.17, *SD* = 2.05) were normally distributed, whereas perceived value of time spent (*M* = 5.28, *SD* = 1.87) and proclivity to recommend (*M* = 43.78, *SD* = 25.66) showed slight negative skewness values (-.36 and -.17, respectively).

Table 2

Descriptive statistics for key study variables

Variable	Items	E(ρ)*	N	Mean	StDev	Min	Max	Skew	Kurt
Self-Efficacy Expectancy Change	6	.90	138	28.15	17.81	.00	75.67	.57	-.43
Climate Change Anxiety	1	--	137	11.11	15.22	.00	90.00	3.11	12.04
Self-Involvement (avg. *z* scores)	2	.66	148	.00	.87	-1.37	2.92	.76	.76
Climate Δ Worry	10	.93	147	2.57	1.20	1.00	6.30	.54	.06
Climate Δ Self-Relevance	1	--	134	29.22	20.49	.00	90.00	.81	.22
Narrative Transportation	7	.93	142	42.47	23.88	.00	94.29	.22	-.95
Content Interest (P. Component)	4	.91	135	.00	1.00	-2.12	2.10	-.13	-.66
Meaningfulness	1	--	141	4.17	2.05	.00	8.00	-.39	-.36
Anticipated Impact	1	--	135	26.17	21.02	.00	80.00	.80	-.30
Perceived Value of Time Spent	4	.93	141	5.28	1.87	1.00	9.00	-.36	-.25
Proclivity to Recommend	1	--	137	43.78	25.66	.00	100.00	.17	-.70

Treatment Group Comparisons

Table 3 presents group means associated with hypotheses 5,6,7,8,10, and 12. The narrative transportation means for the high vs. low verisimilitude stories differed by 9.29 units on the 101-point scale. Differences in narrative transportation were negligible for collective identity (high vs. low) and fictionality (fictional cues vs. no fictional cues). Self-efficacy expectancies, topic interest, and climate change anxiety were higher for the stories with pessimistic vs. optimistic endings.

Table 3

*Treatment group means**

	Collective Identity		*Fictionality*		*Verisimilitude*		*Story Ending*	
	High	*Low*	*Fiction*	*Non-Fiction*	*High*	*Low*	*Optimistic*	*Pessimistic*
Narr Trans.	41.99	42.94	41.95	42.96	*47.18*	*37.89*		
Self-Eff. Expect.							26.51	29.85
Content Interest							-.02	0.20
Climate Δ Anxiety							11.03	11.19

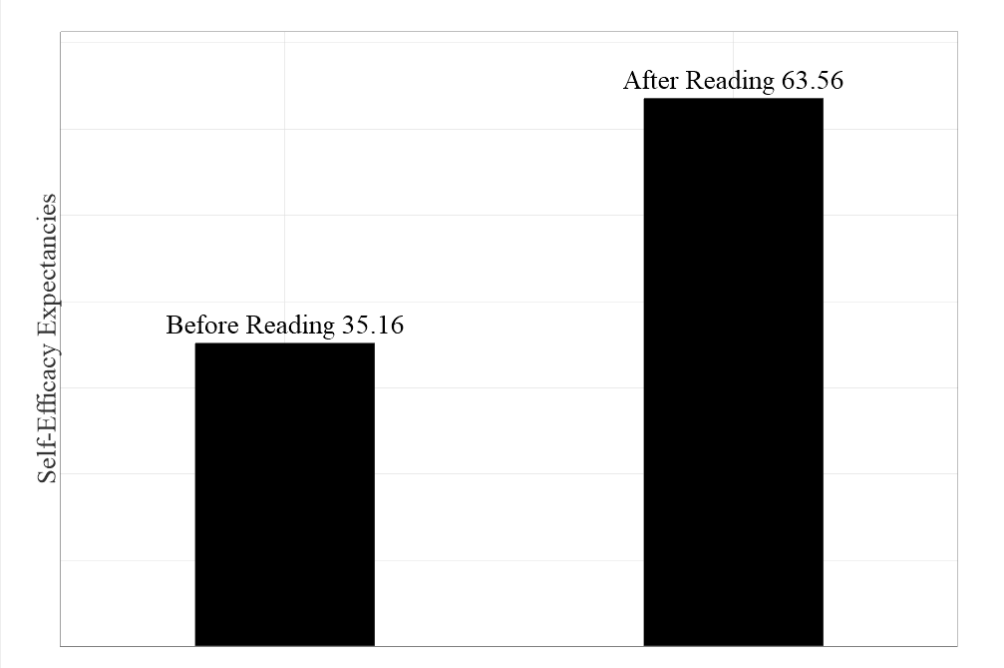
Tests of Hypotheses

Hypothesis 1 proposed that reading any version of the story would increase self-efficacy expectancies. A one-sample *t-test* was performed to test the statistical hypothesis that the mean of the reported change in self-efficacy expectancies from before to after reading was greater than zero. Students

reported an average increase of 28.15% (*SD* = 17.81; Range = 0 -100). The hypothesis was supported (t_{137} = 18.57, $p < .001$), and the confidence interval indicated that the parameter most likely lies between 25.16 and 31.15. The magnitude of the difference between self-efficacy expectancies before vs. after reading the story is illustrated graphically in Fig. 2. Thus, the sample reported substantial increases (Cohen's *d* = 1.58) in self-efficacy expectancies as a result of reading the story to which they were assigned.

Figure 2

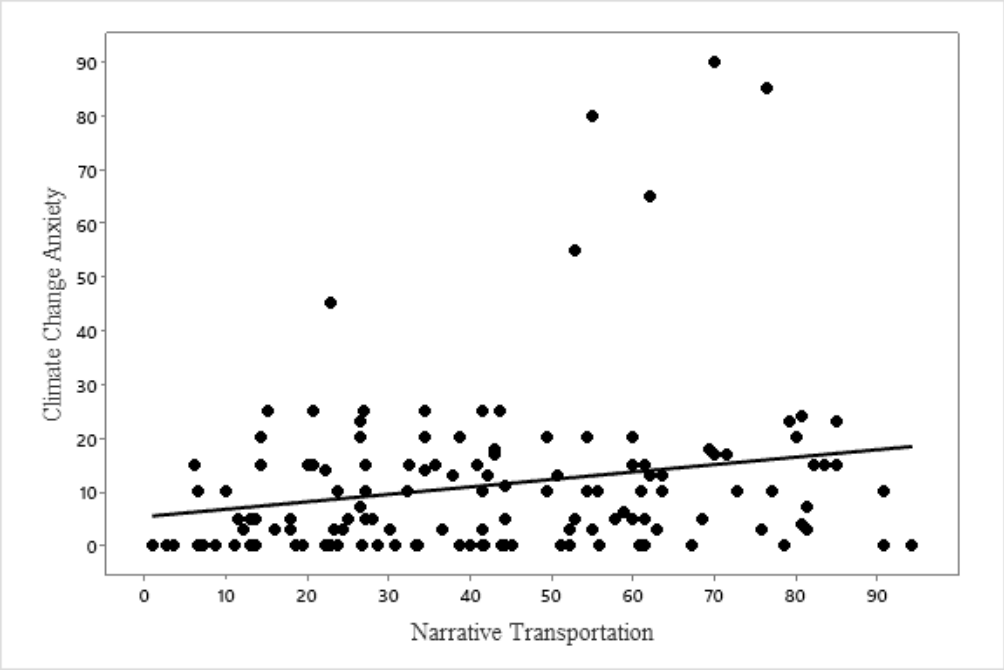
Self-efficacy expectancies before and after reading the story



Hypotheses 2-4 proposed positive relations between narrative transportation and the three educational outcomes: self-efficacy expectancies (H_2), content interest (H_3), and climate change anxiety (H_4). The relation between narrative transportation and self-efficacy expectations was not significant (n = 138, r = .124, p =.148). Significant ($p < .05$) relations were found between narrative transportation and both content interest (n = 135; r = .61, p <.001) and climate change anxiety (n = 136, r =.22, p =.012). We visually examined the scatterplots associated with these three hypotheses. The scatterplot of the relation between narrative transportation and climate change anxiety revealed an unusual pattern (Fig. 3). A steep linear regression line is implied by approximately 15 data points, six of which are unusually high climate change anxiety scores. The other two scatterplots revealed no unusual patterns.

Figure 3

Climate change anxiety by narrative transportation



Hypotheses 5-7 were nondirectional hypotheses proposing that the educational outcomes change as a function of optimistic vs. pessimistic story endings. Point-biserial correlations between dummy variables (optimistic outcome = 1, pessimistic outcome = 0) representing story ending and the educational outcomes were negligible and not significant. Coefficients were -.09, -.01. and -.02 for self-efficacy expectancies, climate change anxiety, and content interest, respectively. Hypothesis 9 proposed an interaction effect: fictionality of the story moderates the effect of narrative transportation on self-efficacy expectancies. Results of the regression of self-efficacy expectancies on narrative transportation, fictionality, and a product vector representing their interaction are presented in Table 4. The significant interaction term (t_{137} = -2.89, p < .05) supports the hypothesis. We evaluated simple main effects by regressing self-efficacy expectancies on narrative transportation for each of the fictionality groups. As that figure shows, self-efficacy expectancies increased with narrative transportation if stories were presented as non-fiction, and they decreased for stories containing cues suggesting the story was fictional.

Table 4

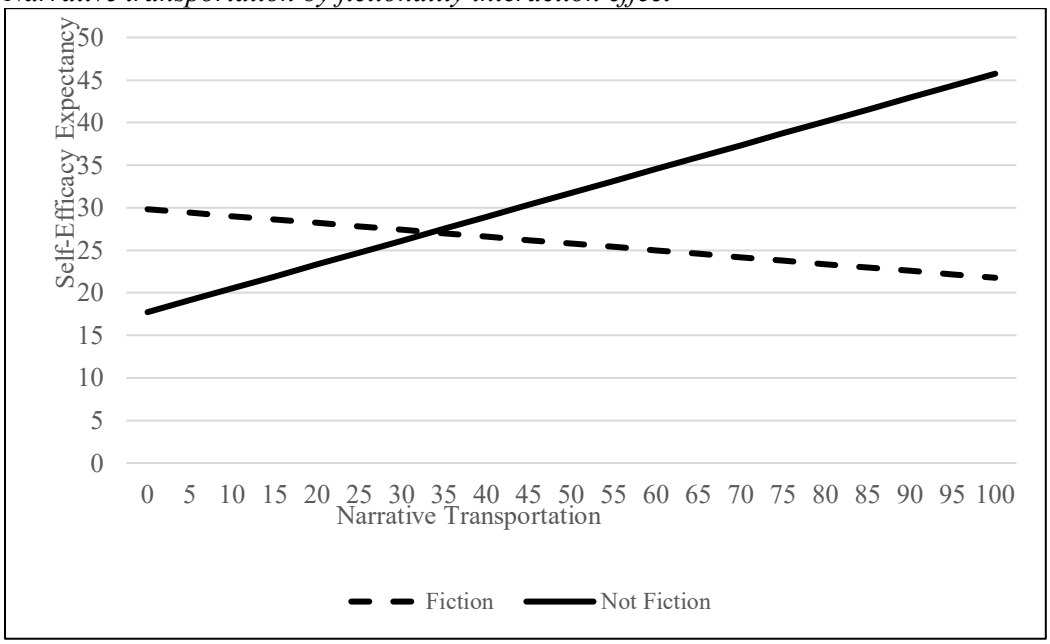
Regression of self-efficacy expectancies on narrative transportation and fictionality

Term	*B*	*SE*	*t*	VIF
Constant	17.73	4.39	4.03*	
Narrative Transportation (NT)	.28	.09	3.11*	2.08
Fictionality (F)	12.10	6.12	1.98*	4.33
NT by F	-.36	.13	-2.89*	5.38

* $p < .05$; R^2=.08

Figure 4

Narrative transportation by fictionality interaction effect



Hypotheses 8 and 10 were the basis for testing the effects of story characteristics (fictionality and verisimilitude) on narrative transportation. Hypotheses 11 and 12 proposed effects of reader characteristics (collective identity and self-involvement) on narrative transportation. Results of the regression of narrative transportation on these two sets of variables are presented in Table 5.

Table 5

Regression of narrative transportation on story characteristics and reader characteristics

Term	Coef	SE	95% CI	*t*	VIF
Constant	37.79	3.63	(30.60, 44.97)	10.40*	
Fictionality (H_8)	-2.23	3.68	(-9.52, 5.05)	-.61	1.01
Verisimilitude (H_{10})	12.83	3.74	(5.43, 20.23)	3.43*	1.04
Self-Involvement (H_{11})	10.48	2.12	(6.29, 14.67)	4.94*	1.04
Collective Identity (H_{12})	-.94	3.67	(-8.20, 6.33)	-.25	1.00

** $p < .05$; $R^2 = .19$*

Discussion

We tested 12 hypotheses. Six were supported and six were not. Hypotheses supported indicate that stories can be very impactful in elevating self-efficacy expectancies related to content learning, that narrative transportation into stories increases content interest and anxiety, and that self-relevant stories with rich description and lifelike qualities (high verisimilitude) increase narrative transportation. Stories that are presumed to be nonfiction may yield greater narrative transportation, leading to stronger self-efficacy expectancies. Hypotheses not supported suggest that story ending (optimistic vs. pessimistic) does not impact educational outcomes, narrative transportation does not increase self-efficacy, and collective identity does not increase narrative transportation.

The finding that reading the story produced notable gains in self-efficacy is consistent with Bandura's (1994, 1997) social cognitive theory. Vicarious experience increases self-efficacy. Results also support the literature on how story features and receiver features increase narrative transportation (Green & Brock, 2000; van Laer et al., 2014). Verisimilitude and self-involvement increase narrative transportation. Support for the relation between narrative transportation and educational outcomes is consistent with results reported by Liu (2023). Story ending had no effect on the educational outcomes. Learning outcomes seem to emerge *during* reading rather than being determined by the end moment (Heath & Heath, 2017) of the experience. Perhaps the finding of no effect may also be due to the nature of the debate-style stories. Perhaps the arguments presented by the debaters in the story engaged participants in cognitive processing rather than emotional immersion.

Self-efficacy did not increase with narrative transportation. Situational anxiety is known to affect self-efficacy and outcome judgments (Bandura, 1977). Situational anxiety spikes when the value of the outcome is high, but controllability is minimal, yielding the belief, "I can't do this." To preserve self-efficacy, the controllability of the task at hand must be reframed (Pekrun, 2006; Bandura, 1977; Pfitzner-Eden et al., 2016). Thus, stories should add credible, actionable steps and near-term wins so arousal reads as readiness, not incapacity (Bandura, 1977; Pekrun, 2006).

The immersive quality of narrative transportation may have shifted readers' attention from the factual content of the climate change story. While narrative transportation enhances motivational engagement, self-efficacy is a cognitive judgement. Rich, vivid descriptions may have captivated readers, focusing their attention on the story's experiential aspects rather than cognitive judgements. Additionally, because narrative transportation is a deep emotional journey the experience might not directly translate to stronger beliefs in ability to perform tasks, which is critical for self-efficacy. The debate format of the story may have also required analytical thinking that was not fully consistent with the immersive experience of narrative transportation. Furthermore, the moderation effect of fictionality showed that only nonfiction stories led to increased self-efficacy with higher narrative transportation, suggesting that readers might not take fictional stories seriously enough to influence their confidence in learning and applying new information.

Verisimilitude increased narrative transportation by bringing the debate story to life through rich descriptions of characters, emotions, settings, and circumstances. These vivid details allowed readers to construct personal narratives, fostering a deeper cognitive and emotional engagement with the story. By creating a realistic and relatable story world, verisimilitude enabled readers to immerse themselves more fully, promoting stronger narrative transportation. While the story's facts, data, and argument validity seemed to contribute to self-efficacy expectancies, they did not serve as the primary agents of rich description. Instead, verisimilitude enhanced the experiential aspect of the story, allowing readers to mentally simulate the narrative. However, results also suggest that while this heightened engagement increased important learning outcomes, it may have shifted attention away from critical analysis of the factual content, highlighting a nuanced balance between storytelling and cognitive learning.

Fictionality and collective identity were also not significant predictors of narrative transportation. Despite its potential, the impact of fictive elements, fictionality, and cross-fictionality on contentious issues like climate change remains underexplored. The unusual pattern of paired scores in the scatterplot of NT and CC anxiety warrants future inquiry. This pattern may reflect individual differences in transportability (Gerrig, 2018; Green & Brock, 2000; Thompson et al., 2018).

Limitations and Future Research

Limitations must be noted. Although we aspire to identify story and reader characteristics that impact narrative transportation in any university student population and through any story, resource constraints do not permit massive projects that address all possible limitations. Our sample included 146 agriculture students from only one university, an insignificant fraction of all agriculture students worldwide. We authored the story about the climate change debate. Methodologically, our story must be interpreted as being a randomly selected story from a hypothetical population of possible stories about climate change. Perhaps unknown features of other stories would affect outcomes. Our Taguchi design allowed us to test the main effects of four theoretically relevant factors, but did not allow us to explore interaction effects among those factors.

Several directions for future research are indicated. A deeper understanding of the moderating effects of fictionality in the relation between narrative transportation and self-efficacy is warranted. When cues suggesting that stories were nonfiction were present, self-efficacy expectancies increased with narrative transportation. Perhaps readers consider facts in stories to be more germane to their learning from a story only when those facts are presumed to be true. Future research should also explore how individual differences shape narrative transportation and educational outcomes. Beyond self-involvement and collective identity, other relevant receiver characteristics may include receiver attention, education, sex, age, familiarity, and transportability. Many of these questions might be addressed through evaluation of the data using artificial intelligence (AI) and machine learning (ML) to analyze storytelling in climate change education and identify which narrative elements most effectively enhance self-efficacy, content interest, and climate change anxiety. A machine learning analysis could provide deeper insights beyond our findings, as additional data would be required to improve predictive accuracy and generalizability.

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