

Understanding Learner Engagement and Persistence in AI-Assisted Interactive Climate Fiction Learning

Charlotte Briggs

Xi'an Jiaotong Liverpool University, China

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ABSTRACT

Advances in generative artificial intelligence (AI) have enabled educators to create increasingly sophisticated interactive learning materials, yet relatively little research has examined how learners engage with and persist in such interventions over time. This exploratory case study investigated learner engagement and persistence within a five-stage AI-assisted interactive climate fiction (cli-fi) intervention delivered through H5P activities embedded within the Moodle learning management system as part of an extracurricular sustainability initiative at an English-medium university in China. Participation, activity scores, completion data, and time-on-task measures were analysed descriptively across a five-week intervention. While learners who engaged with the intervention demonstrated high levels of engagement, reflected in strong activity scores and substantial interaction with the materials, participation declined markedly across successive stages, falling from 25 learners in Story 1 to six learners by Story 5. Descriptive improvements were observed in environmental knowledge scores among the small number of learners completing both pre- and post-tests, although these findings were inconclusive. The findings highlight a clear distinction between engagement and persistence, suggesting that engaging digital learning experiences do not necessarily translate into sustained participation. The study contributes to emerging research on AI-assisted learning design by emphasising the importance of considering persistence as a distinct outcome when designing and evaluating multi-stage digital learning environments.

1. Introduction

The rapid progress of generative artificial intelligence (GenAI) is increasingly reshaping educational practice, providing educators with new opportunities to create interactive, multimodal, and personalised learning experiences. Within higher education, AI-assisted tools are being used to generate textual, visual, and multimedia content, reducing development time while expanding the range and complexity of learning materials available to students (Crompton et al., 2024; Grassini, 2023; Zirar, 2023). These developments are particularly significant in areas requiring interdisciplinary approaches, such as sustainability education,

* Corresponding author's E-mail address: charlotte.briggs@xjtlu.edu.cn

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where complex global challenges must be communicated in ways that are both accessible and engaging.

Higher education institutions are increasingly recognised as key sites for advancing the United Nations Sustainable Development Goals (SDGs) and developing students' understanding of environmental issues (Žalėniene & Pereira, 2021). Within higher education, including English as a medium of instruction (EMI) institutions, researchers have argued that classrooms provide important spaces for engaging learners with ecological sustainability, climate change, and environmental justice (Goulah & Katunich, 2020; Micalay-Hurtado & Poole, 2022). However, climate-related issues often suffer from what Lorenzoni et al. (2007) describe as psychological distance, whereby environmental problems are perceived as geographically, socially, or temporally remote from learners' everyday experiences. Consequently, there is growing interest in pedagogical approaches capable of making such issues more immediate, relatable, and personally meaningful.

One approach receiving increasing attention is climate fiction (cli-fi). Through narrative representations of environmental challenges and their consequences, cli-fi can bridge the gap between scientific knowledge and lived experience, encouraging both cognitive and emotional engagement with sustainability issues (Dahlstrom, 2014; Hulme, 2015; Roig, 2024). Narrative approaches have been shown to facilitate understanding by combining analytical and experiential forms of cognition, enabling learners to explore complex problems through characters, settings, and decision-making processes (Bruner, 1991; Dahlstrom, 2014). Recent advances in generative AI have further expanded the potential of such approaches by enabling the rapid creation of contextually rich stories, images, interactive activities, and multimedia learning environments.

The increasing availability of platforms such as H5P has also enabled educators to embed interactive tasks, feedback mechanisms, and learner-controlled progression within digital learning materials (Homanová & Havlásková, 2019; Li & Reis, 2023). As a result, interactive narrative learning environments incorporating AI-generated content are increasingly viewed as promising tools for promoting engagement through interactivity, immersion, and personal relevance. Existing research has largely focused on the affordances of such technologies, including their capacity to support motivation, participation, and active learning (Choppin & Borys, 2017; Doran & Briggs, 2024).

However, while digital storytelling and interactive learning environments are often associated with increased engagement, less attention has been paid to the issue of sustained participation over time. Research in digital learning contexts has consistently demonstrated that learners may engage readily with initial activities while failing to continue through extended learning pathways (Kizilcec et al., 2013; Jordan, 2014). This distinction highlights the importance of differentiating between engagement, which reflects learners' interaction with a task, and persistence, which refers to continued participation across a sequence of learning activities. Understanding this relationship is particularly important in multi-stage digital interventions where educational value depends not only on initial participation but also on sustained involvement over time.

Despite growing interest in AI-assisted educational content generation and interactive digital learning, relatively little research has examined how learners engage with and persist in extended, multi-stage interventions once they are implemented in authentic educational settings. Much of the existing literature focuses on design affordances or perceived benefits, while patterns of participation, progression, and attrition remain comparatively underexplored.

This study addresses this issue through an exploratory case study of an AI-assisted interactive climate fiction intervention implemented at an EMI Sino-British university in China. The intervention combined narrative-driven sustainability content, multimedia resources, and embedded interactive activities delivered through a digital platform. Rather than focusing solely on learning outcomes, the study examines patterns of learner engagement and persistence across the intervention, seeking to understand how students interacted with and progressed through a multi-stage digital learning environment.

The study is guided by the following research questions:

- **RQ1:** How do learners engage with AI-assisted interactive climate fiction materials?
- **RQ2:** What patterns of participation and persistence emerge across stages of the intervention?
- **RQ3:** What factors may influence learner persistence in multi-stage digital learning environments?

2. Literature Review

2.1. Sustainability, Climate Fiction and Narrative Learning

The integration of sustainability into higher education has become an increasingly important priority as universities seek to support the United Nations Sustainable Development Goals (SDGs) and prepare students to engage with complex environmental challenges (Žalėnienė & Pereira, 2021). Within international education systems through which English is the medium of study, scholars have argued that environmental issues provide authentic and meaningful contexts through which learners can simultaneously develop linguistic competence and engage with broader social and ecological concerns (Goulah & Katunich, 2020; Micalay-Hurtado & Poole, 2022).

Despite growing awareness of environmental issues, climate change and sustainability remain difficult topics to teach effectively. Research suggests that many environmental problems are perceived as psychologically distant, occurring in places, times, or contexts removed from learners' everyday experiences (Lorenzoni et al., 2007; Milfont, 2010; Weber, 2010). This distance can reduce personal relevance and limit meaningful engagement with environmental issues.

Climate fiction has emerged as one response to this challenge. By presenting environmental issues through narrative forms, cli-fi enables learners to encounter climate-related challenges through characters, settings, and storylines that make abstract issues more tangible and relatable (Hulme, 2015; Schneider-Mayerson, 2018). Rather than presenting sustainability solely through scientific facts and statistics, cli-fi situates environmental issues within human experiences and consequences, allowing learners to explore both the causes and impacts of environmental change.

The educational value of narrative is well established. Bruner (1991) argues that narrative represents a distinct mode of human thought through which individuals construct meaning and interpret experience. Similarly, Dahlstrom (2014) suggests that storytelling can facilitate understanding of complex scientific issues by connecting information to familiar narrative structures and emotional experiences. Narrative approaches may therefore support both cognitive and affective engagement by encouraging learners to connect new knowledge with existing experiences and perspectives.

Recent work has highlighted the potential of digitally mediated cli-fi to support environmental learning (Schneider-Mayerson, 2018; Milner, 2025; Doran & Briggs, 2026). Interactive narratives can provide opportunities for learners to explore consequences, make decisions, and engage actively with sustainability issues rather than consuming information passively (Roig, 2024). These affordances make cli-fi a particularly suitable context for investigating how learners engage with and progress through interactive digital learning environments.

While previous research has examined the potential of climate fiction to support environmental awareness and engagement, less attention has been paid to how learners participate in extended, multi-stage narrative interventions over time. Consequently, cli-fi provides a useful context within which to explore broader questions of learner engagement and persistence in digitally mediated learning environments.

2.2. Generative AI and Interactive Digital Learning

The rapid development of generative AI has created new opportunities for the design and delivery of educational materials. Recent advances in large language models and AI-assisted content generation have enabled educators to produce textual, visual, and multimedia resources with greater efficiency than traditional development processes (Crompton et al., 2024; Grassini, 2023; Zirar, 2023). Within educational contexts, these technologies have been used to support lesson planning, content creation, assessment design, and the development of personalised learning experiences (Bannister et al., 2023; Yan et al., 2023).

One of the most significant educational affordances of GenAI lies in its capacity to generate authentic and contextually relevant learning materials. Rather than relying exclusively on commercially produced resources, educators can create customised content aligned with specific learning objectives, learner needs, and disciplinary contexts (Aktay, 2022). This capability is particularly valuable in interdisciplinary domains such as sustainability education, where authentic scenarios and locally relevant examples may enhance learner engagement.

At the same time, digital learning platforms have increasingly enabled educators to move beyond static content towards more interactive learning experiences. Interactive learning environments typically incorporate multimedia resources, learner-controlled navigation, embedded activities, and immediate feedback mechanisms that encourage active participation (Homanová & Havlásková, 2019; Li & Reis, 2023). Research suggests that such features can positively influence learner motivation and engagement by promoting active rather than passive interaction with learning materials (Choppin & Borys, 2017).

Platforms such as H5P have further expanded opportunities for the creation of interactive digital learning activities. Through the integration of quizzes, branching scenarios, interactive videos, and gamified elements, H5P enables educators to develop learning experiences that support exploration, decision-making, and formative feedback (Li & Reis, 2023; Doran & Briggs, 2024). These affordances are particularly relevant for narrative-based learning environments, where learners can progress through stories while interacting with content in multiple ways.

The combination of GenAI and interactive learning platforms has therefore created new possibilities for the rapid development of immersive educational experiences. AI-assisted tools can generate narratives, characters, scenarios, and supporting resources, while interactive platforms can structure these materials into coherent learning sequences. Together, these technologies enable the creation of complex learning environments that would previously have required substantial time and technical expertise to develop.

However, much of the existing literature has focused on the pedagogical potential and technological affordances of AI-generated learning materials, including their capacity to support content creation, personalisation, interactivity, and learner engagement (Crompton et al., 2024; Grassini, 2023; Bannister et al., 2023; Yan et al., 2023). Comparatively less attention has been paid to how learners interact with such environments once implemented in authentic educational settings. In particular, questions remain regarding whether the engagement supported by AI-generated and interactive learning experiences translates into sustained participation across extended learning sequences.

This issue is especially relevant in multi-stage interventions where educational value depends not only on learners' initial engagement with individual activities, but also on their continued participation over time. Consequently, examining patterns of engagement and persistence within AI-generated interactive learning environments represents an important area for further research.

2.3. Engagement and Persistence in Digital Learning Environments

Student engagement has long been recognised as a critical factor influencing learning outcomes in both traditional and digital educational settings. Although definitions vary, engagement is generally understood as a multidimensional construct encompassing behavioural, cognitive, and emotional dimensions of learner participation (Fredricks et al., 2004; Bond et al., 2020). More recent work has further highlighted the contextual and dynamic nature of engagement within technology-mediated learning environments, emphasising the interaction between learners, learning activities, and digital technologies (Bond, 2020). Behavioural engagement refers to observable participation in learning activities, cognitive engagement concerns investment in learning and strategic thinking, while emotional engagement relates to learners' affective responses, interest, and sense of connection to learning tasks.

The development of digital learning environments has generated considerable interest in how technology can enhance engagement. Interactive multimedia, gamified activities, learner control, and immediate feedback have all been associated with increased participation and motivation (Choppin & Borys, 2017; Homanová & Havlásková, 2019; Li & Reis, 2023). Similarly, narrative-based approaches have been found to support engagement by situating learning within meaningful contexts and encouraging emotional investment through story, character, and scenario development (Bruner, 1991; Dahlstrom, 2014). These affordances have led to growing optimism regarding the capacity of digital learning environments to capture and sustain learner interest.

However, engagement alone does not necessarily guarantee continued participation. Research in online and digitally mediated learning environments has consistently identified a distinction between initial engagement and longer-term participation. Learners may actively engage with individual tasks while discontinuing participation before completing an entire learning sequence (Kizilcec et al., 2013; Jordan, 2014). Consequently, engagement should not be assumed to equate to persistence.

While engagement and persistence are closely related, they represent distinct dimensions of learner participation. Where engagement generally refers to learners' behavioural, cognitive, and emotional involvement in learning activities (Fredricks et al., 2004; Bond et al., 2020), persistence concerns the continuation of participation over time and across successive learning stages. Within digital learning environments, learner persistence is commonly understood as sustained progression through a learning programme or sequence of activities, particularly where participation is voluntary or self-directed (Lee & Choi, 2011; Joksimović et al., 2018). Persistence is often operationalised through indicators such as progression, retention, and

completion behaviours (Kizilcec et al., 2013; Joksimović et al., 2018). Although engagement is frequently associated with continued participation, research has demonstrated that initial engagement does not necessarily translate into persistence, particularly within online and digitally mediated learning environments (Jordan, 2014; Kizilcec et al., 2013). Contemporary scholarship therefore conceptualises persistence as a complex phenomenon shaped by interactions among learner characteristics, instructional design, motivation, and contextual factors (Lee & Choi, 2011; Hew & Cheung, 2014; Broadbent & Poon, 2015).

Accordingly, although engagement and persistence are closely related, they should not be treated as synonymous. Learners may demonstrate high levels of engagement with individual activities while exhibiting limited persistence across an extended learning sequence. Understanding the relationship between these constructs is therefore particularly important in multi-stage digital interventions where educational value depends upon continued participation over time.

A substantial body of research has identified factors associated with persistence in digital learning environments. These include motivational variables such as self-efficacy and perceived task value, learner characteristics such as self-regulation and time management, and environmental factors including social support, instructional guidance, and curriculum integration (Lee & Choi, 2011; Broadbent & Poon, 2015). More recent reviews have similarly emphasised the interaction of cognitive, behavioural, and contextual influences in shaping sustained participation within online learning environments (Bond et al., 2020; Doran & Briggs, 2024).

The design of learning tasks may also influence persistence. Cognitive Load Theory suggests that learners possess limited cognitive resources, and that increasing complexity may reduce capacity for sustained engagement when instructional demands exceed available resources (Sweller, 2011). In multi-stage digital learning environments, cognitive demands may accumulate over time as learners are required to process content, navigate interfaces, complete activities, and maintain motivation across multiple stages. While such environments can offer rich learning opportunities, they may simultaneously introduce barriers to continued participation.

These issues are particularly relevant in AI-assisted learning environments. GenAI can significantly expand the volume, diversity, and sophistication of educational content, enabling the creation of interactive multimedia experiences that would previously have required substantial development resources (Crompton et al., 2024; Grassini, 2023). Nevertheless, while much of the literature has focused on the pedagogical affordances of AI-generated materials, less attention has been paid to how learners interact with these environments over extended periods. Questions therefore remain regarding whether the engagement afforded by interactive and AI-supported learning experiences translates into sustained participation across multi-stage learning sequences.

Taken together, the literature suggests that engagement and persistence represent related but distinct constructs. While engagement may facilitate initial participation, persistence reflects learners' ability or willingness to continue participation over time. Understanding this relationship is particularly important in interventions that rely upon sequential progression through multiple learning stages. Consequently, the present study examines both engagement and persistence within an AI-assisted interactive climate fiction intervention, with particular attention to patterns of participation across the learning sequence.

3. Methodology

3.1. Research Design

This study adopted an exploratory case study design (Stake, 1995; Yin, 2018) to investigate learner engagement and persistence within an AI-assisted interactive climate fiction intervention. Case study methodology was considered appropriate because the research sought to examine patterns of learner participation within an authentic educational setting rather than evaluate the intervention under controlled experimental conditions.

The study formed the second phase of a broader research project examining the use of AI-assisted climate fiction materials for sustainability education. Whereas the first phase focused on the design and development of the materials (Doran & Briggs, 2026), the present study examined learner engagement, participation, and persistence following implementation.

3.2. Context and Participants

The intervention was implemented at an EMI Sino-British university in China as part of an extracurricular Sustainability Challenge designed to promote awareness of environmental issues. Participation was voluntary and was not linked to assessment, course credit, or compulsory teaching activities.

The interactive stories were made available to all students across the university and promoted through the Sustainability Challenge. The initial participant group comprised 25 students who completed the first story, from all 11 Schools and Departments within the university. Students ranging from ages 18 to 23 years old took part in the study, representing ten students from Year 1 and fifteen from Year 2 of their studies.

Because the research focused on engagement and persistence within the climate fiction intervention, analysis was based on learner interaction data generated through participation in the stories and associated activities.

3.3. Intervention Design

The intervention consisted of a five-stage sequence of interactive cli-fi stories delivered over a five-week period during Semester 2, with one story released each week.

The stories were developed to introduce learners to a range of environmental issues through narrative-driven scenarios situated in diverse geographical and cultural contexts. Generative AI tools were used to support the creation of story outlines, narrative content, characters, and multimedia resources. All AI-generated materials were subsequently reviewed, edited, and adapted by the researchers prior to implementation. The general workflow process for each story is outlined in Figure 1.

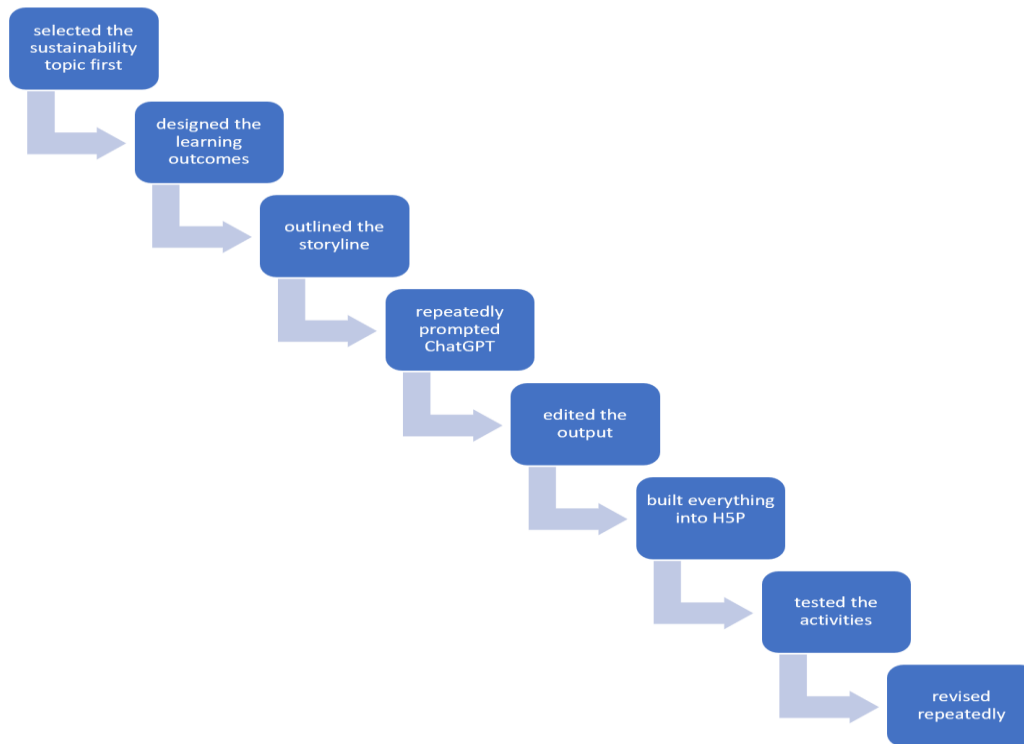


Figure 1. General workflow process for each story

Each climate fiction story was developed using an iterative human–AI design process. Once the story topics were decided, ChatGPT was used to generate initial story concepts, narrative content, image generation, dialogue, interactive activities, and assessment ideas based on researcher-developed prompts. Prompts specified the sustainability topic, intended learning outcomes, target language level, narrative style, and the types of interactive H5P activities to be incorporated.

AI-generated outputs were not used without substantial human review and revision. All materials were reviewed and edited to ensure factual accuracy, pedagogical suitability, coherence, language appropriateness, and alignment with the intended learning outcomes. Sustainability content was checked against authoritative sources, and all narratives and activities were refined iteratively before implementation within H5P.

Throughout the development process, outputs were reviewed for potentially inaccurate, misleading, or culturally inappropriate content. Additionally, the researchers utilised the 4A Framework (Rice & Ortiz, 2021; Doran & Briggs, 2026) which covers Accessibility, Active Engagement, Advocacy for Inclusion and Accountability, addressing both technical (engagement) and ethical aspects (inclusion, accessibility) of materials design aligned with the sustainability goals of the materials. Where necessary, prompts were refined and materials revised until they met the required pedagogical and disciplinary standards. Generative AI functioned as a design support tool rather than an autonomous content creator, with all final pedagogical decisions made by the researchers.

The intervention was delivered through the university's Moodle learning management system using H5P interactive learning activities. Learners progressed through narrative-driven stories incorporating multimedia content, embedded comprehension tasks, reflective activities, and decision-making exercises designed to promote engagement with sustainability issues.

Each story focused on a different environmental challenge, including fast fashion, ecosystems, water resilience, air pollution, and plastic waste. To enhance authenticity and contextual relevance, stories featured diverse settings and protagonists, including an Indian social media influencer in Mumbai, a wolf in North America, a First Nations Australian child, a Thai university student in Chiang Mai, and a young Chinese professional confronting issues associated with global plastic pollution.

The intervention was designed to combine narrative engagement with sustainability learning by situating environmental issues within the lived experiences of characters affected by ecological challenges. While stories were released sequentially, participation remained entirely voluntary and learners were free to engage with as many or as few stages of the intervention as they wished. This provided an opportunity to examine both initial engagement and persistence across a multi-stage digital learning sequence.

Although all five H5P stories followed the same overall instructional structure, they differed in their narrative themes, sustainability focus, and embedded activities. Story length, reading load, and the number of interactive tasks varied slightly between stories according to the pedagogical requirements of each topic. These differences may have influenced participation and completion times and should therefore be considered when interpreting persistence across the intervention.

3.4. Data Collection

Multiple sources of quantitative data were collected to examine learner engagement, participation, persistence, and sustainability knowledge development throughout the intervention.

3.4.1 H5P Data

First, participation and completion data were obtained from the H5P platform for each climate fiction story. These data included the number of learners completing each story, completion scores, number of attempts, and time spent engaging with each activity. These measures provided indicators of behavioural engagement with individual stories and enabled the tracking of participation across successive stages of the intervention.

Although learners were permitted to repeat activities, analyses were based on each learner's first successfully completed attempt to provide a consistent measure of behavioural engagement across participants. Only completed activities were included in the analysis. Participants who did not complete a story were treated as non-completers for that stage of the intervention and no attempt was made to impute missing data, as participation was entirely voluntary and missing data therefore reflected natural attrition rather than technical failure. While H5P provides robust behavioural analytics relating to completion, performance, and time spent on task, it does not capture learners' motivations for continuing or discontinuing participation, nor does it record engagement with learning activities outside the platform.

3.4.2 Pre- and Post-intervention Environmental Knowledge Questionnaires

Second, learners were invited to complete pre- and post-intervention environmental knowledge questionnaires developed specifically for this exploratory case study (see Appendix 1). The questionnaire comprised five sections: demographic information (Questions 1–4), environmental knowledge (Questions 5–15), attitudes and perceptions towards sustainability (Questions 16–17), self-reported sustainable behaviours and behavioural intentions (Questions

18–19), and an open-ended reflection exploring learners' emotional engagement with the climate fiction stories (Question 20; post-test only).

The environmental knowledge section consisted of eleven researcher-developed multiple-choice questions designed to assess learners' understanding of the key sustainability concepts addressed throughout the intervention. Questionnaire development was informed by established sustainability literacy and Education for Sustainable Development (ESD) assessment frameworks, including Sulitest and the EDINSOST project (Muñoz-Rodríguez et al., 2020). Rather than adopting an existing instrument directly, items were developed and contextualised for the present study using a blueprinting approach to ensure alignment between the instructional materials, intended learning outcomes, and assessment content.

As the questionnaire was developed specifically for this exploratory case study, it was intended to provide an indicative measure of changes in sustainability knowledge, attitudes, and behavioural intentions rather than function as a standardised psychometric instrument. The matched pre- and post-test data were collected from the subset of learners who completed both questionnaires. Given the small number of matched responses, these data were analysed descriptively to identify potential trends in environmental knowledge development rather than to support inferential statistical analysis. Formal psychometric evaluation of the questionnaire (e.g., internal consistency reliability using Cronbach's alpha and construct validity analyses) was beyond the scope of this exploratory case study. Future studies using larger samples should establish the instrument's psychometric properties.

3.5. Data Analysis

Data analysis focused on patterns of learner engagement and persistence across the intervention. Consistent with the literature reviewed earlier, engagement, specifically behavioural engagement, was operationalised through participation in individual stories and interaction with story activities, while persistence was operationalised as continued progression through successive stages of the intervention (Kizilcec et al., 2013; Jordan, 2014).

Descriptive statistics were used to analyse participation rates, completion patterns, activity scores, and time-on-task measures generated through the H5P platform. Particular attention was paid to changes in participation across stories in order to identify patterns of persistence throughout the intervention.

Pre- and post-test scores were analysed descriptively for learners who completed both assessments. Given the small number of matched responses, inferential statistical procedures were not considered appropriate. Instead, individual score trajectories and overall trends were examined to provide exploratory insights into potential changes in environmental knowledge among completers.

The analysis therefore prioritised understanding patterns of engagement, participation, and persistence within the intervention, while treating learning outcome data as supplementary evidence rather than the primary focus of investigation.

3.6. Operational Definitions

As engagement and persistence are conceptually distinct constructs, operational definitions were established for the purposes of this exploratory study. Engagement was operationalised as behavioural engagement with an individual learning activity, indicated by voluntary completion of each H5P climate fiction story. Persistence was operationalised as sustained voluntary participation across the five-stage intervention and associated questionnaires,

measured by participants' continued return to successive learning activities over time. Because participation was entirely voluntary and independent of course assessment, these measures reflect behavioural participation rather than cognitive, emotional, or motivational engagement.

3.7. Ethical Considerations

Ethical approval for the study was obtained from the University's Ethics Committee. Participation in the intervention and associated data collection activities was voluntary. Participants were provided with information regarding the purpose of the study and informed consent was obtained prior to participation. All data were anonymised prior to analysis and no personally identifiable information is reported in this paper. Data were stored securely and accessed only by the research team in accordance with institutional research ethics guidelines.

4. Results

4.1. Behavioural Engagement with the Learning Activities

Consistent with the operational definitions described above, behavioural engagement was examined through learners' completion of individual H5P stories and the associated interactive activities. Story 1 provided the initial participant group for the study, with twenty-five learners voluntarily completing the first climate fiction story.

Completion records indicated generally high levels of task engagement. Participants achieved a mean activity score of 91.54% (SD = 18.45), where scores reflected the proportion of embedded interactive activities completed correctly within the H5P story. Most learners achieved scores above 80%, and many obtained full marks on the embedded activities.

Completion times varied considerably, ranging from 2.28 minutes to 70.08 minutes (M = 25.18, SD = 17.98), suggesting substantial variation in learner interaction patterns and approaches to task completion. While some learners progressed rapidly through the materials, others spent over an hour engaging with the story and associated activities.

Table 1. Behavioural engagement across the intervention

Story	Participants (n)	Mean Activity Score (%)	Mean Duration (mins)
Story 1	25	91.54	25.18
Story 2	10	88.90	15.12
Story 3	4	100.00	20.29
Story 4	4	100.00	8.22
Story 5	6	100.00	5.66

Despite variation in completion times, learners who completed the activities demonstrated consistently high levels of behavioural engagement throughout the intervention. Mean activity scores remained above 88% across all five stories and reached 100% among learners completing Stories 3–5. Taken together, these findings suggest that learners who voluntarily participated in the intervention successfully engaged with the AI-assisted climate fiction materials and completed the embedded learning tasks to a consistently high standard.

4.2. Persistence Across the Five-Stage Intervention

Persistence was examined through continued participation across successive stages of the intervention. As shown in Figure 2, participation declined substantially across the five-story

sequence. Twenty-five learners completed Story 1, decreasing to ten learners in Story 2, four learners in Stories 3 and 4, and six learners in Story 5.

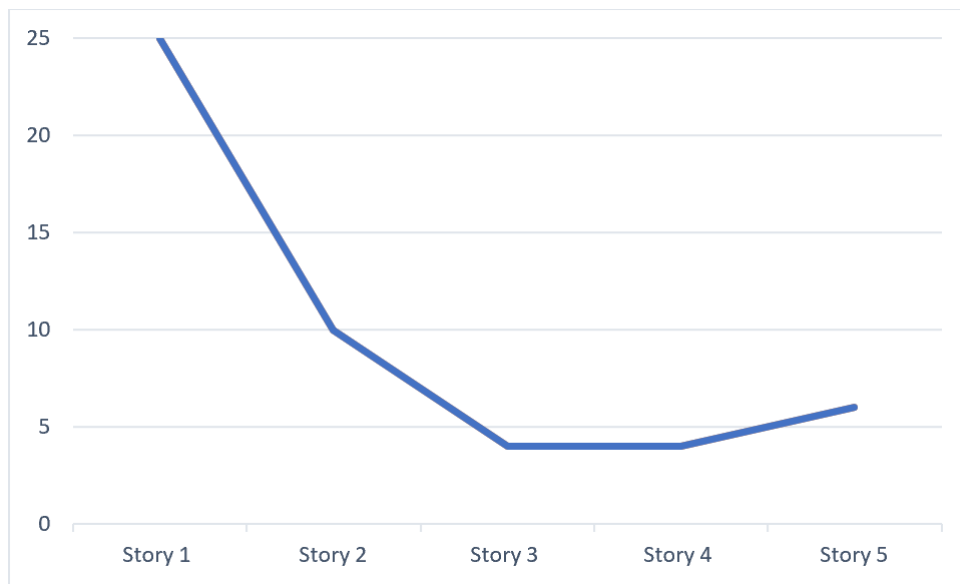


Figure 2. Participation numbers across stories

Although participation declined across successive stories, the pattern was not strictly linear. Table 2 illustrates participant completion trajectories across the intervention. Four learners completed all five stories, four completed Stories 1 and 2 only, and fifteen completed only Story 1. Two participants who did not complete Stories 3 and 4 subsequently returned to complete Story 5, indicating that persistence was more dynamic than a simple pattern of progressive attrition.

Table 2. Participation matrix showing completion patterns of each H5P story across the five-week intervention

Participation pattern	n	Story 1	Story 2	Story 3	Story 4	Story 5
Completed all stories	4	■	■	■	■	■
Returned for Story 5	2	■	■	□	□	■
Completed Stories 1–2 only	4	■	■	□	□	□
Completed Story 1 only	15	■	□	□	□	□

Key: Completed = ■ / Not Completed = □

The largest reduction in participation occurred between Stories 1 and 2, where participant numbers declined by 60%. Participation decreased further between Stories 2 and 3 before stabilising. Although participation increased slightly during Story 5, overall persistence remained substantially lower than initial engagement.

These findings demonstrate a clear distinction between behavioural engagement and persistence. While learners who completed the stories consistently achieved high activity scores and successfully engaged with the learning activities, relatively few continued participating throughout the complete five-stage intervention. Initial engagement with individual activities therefore did not necessarily translate into sustained participation over time.

4.3. Knowledge Development Among Completers

Matched environmental knowledge data were available for five learners who completed both the pre-intervention and post-intervention knowledge questionnaires, as well as the 5 stories. Given the small number of matched responses, the data were analysed descriptively rather than statistically.

Four of the five learners demonstrated improvements in environmental knowledge scores between the pre- and post-test assessments. Improvements ranged from 19 to 55 percentage points, with two learners achieving post-test scores of 100%. One learner's score remained unchanged at 91%.

Although these descriptive results suggest the possibility of increased environmental knowledge among some participants, the very small number of matched responses prevents broader conclusions regarding learning effectiveness. Given the absence of a comparison group and the potential influence of test familiarity, motivation effects, and random variation, these changes cannot be attributed directly to the intervention and should be interpreted as exploratory rather than conclusive.

5. Discussion

5.1. Engagement Does Not Necessarily Lead to Persistence

One of the most notable findings of the study was the distinction between initial engagement and sustained participation. Although 25 learners completed the first climate fiction story, participation declined substantially across subsequent stages of the intervention. This finding supports previous research suggesting that engagement and persistence should not be treated as synonymous constructs in digital learning environments (Kizilcec et al., 2013; Jordan, 2014).

The high completion rates and generally strong performance among learners who participated in Story 1 indicate that the intervention was capable of attracting and sustaining attention at the task level. This finding is consistent with previous research suggesting that narrative-based learning experiences can promote learner engagement by situating complex issues within personally meaningful and emotionally resonant contexts (Bruner, 1991; Dahlstrom, 2014; Schneider-Mayerson, 2018). The strong engagement observed among initial participants may therefore reflect the affordances of climate fiction as a pedagogical approach, particularly its capacity to make abstract sustainability challenges more relatable and meaningful through narrative experiences (Milner, 2025).

However, this initial engagement did not consistently translate into continued participation across the full intervention sequence. These findings contribute to a growing body of literature highlighting the importance of distinguishing between engagement as a measure of interaction with individual learning activities and persistence as a measure of continued participation over time (Bond et al., 2020). The distinction is important because learner engagement is frequently used as an indicator of intervention success within digital learning research. The present findings suggest that engagement alone may provide only a partial picture of learner participation. Learners may engage deeply with individual learning activities while still choosing not to continue participation in subsequent stages. In voluntary digital learning environments, persistence therefore represents a complementary dimension of participation that warrants separate consideration (Lee & Choi, 2011; Kizilcec et al., 2013). While digital learning interventions frequently report evidence of learner engagement, less attention has been paid to the challenge of sustaining participation across extended learning sequences.

5.2. Factors Potentially Influencing Persistence

In exploring factors that may influence learner persistence within multi-stage digital learning environments, the exploratory design of the study does not permit causal explanations. However, the participation patterns observed suggest several factors that may have influenced continued participation.

First, participation in the intervention was entirely voluntary and was not linked to assessment, course credit, or formal classroom activities. Previous research has shown that persistence in digital learning environments is influenced by a combination of motivational, contextual, and environmental factors, including perceived value, competing demands, and learner self-regulation (Lee & Choi, 2011; Hew & Cheung, 2014; Broadbent & Poon, 2015). This interpretation is also consistent with Self-Determination Theory (Deci & Ryan, 1985; Ryan & Deci, 2020), which proposes that sustained engagement is influenced by learners' experiences of autonomy, competence, and relatedness. Although learners demonstrated high levels of behavioural engagement while participating, the voluntary nature of the intervention and absence of external incentives or structured accountability may have reduced motivation to continue across successive stages. In such contexts, learners may find activities engaging yet still choose not to continue participation due to competing academic commitments or changing priorities.

Second, participation declined progressively across the five-story sequence. Research in online learning environments has consistently demonstrated that persistence often decreases as learners progress through extended learning pathways, even when individual activities are perceived positively (Jordan, 2014; Kizilcec et al., 2013). The participation patterns observed in the present study are broadly consistent with these findings and suggest that sustaining participation across multiple stages may represent a challenge distinct from generating initial engagement.

The findings may also be considered in relation to Tinto's (1993) model of student persistence, which emphasises the importance of ongoing academic and social integration in sustaining participation. Although originally developed to explain persistence in higher education programmes rather than voluntary extracurricular interventions, the model highlights that continued participation is shaped by more than initial interest alone. In the present study, participation occurred outside formal programme requirements and carried no academic consequences, potentially reducing the structural supports that encourage continued engagement over time.

Third, the intervention required learners to engage with narrative content, multimedia resources, and embedded activities across successive stages. Although cognitive load was not measured directly, Cognitive Load Theory suggests that increasing instructional demands may influence learners' willingness to continue participation when effort accumulates over time (Sweller, 2011). It is therefore possible that the cumulative demands associated with progressing through successive stories and embedded activities contributed to declining participation, although this remains speculative.

Finally, the results suggest the possibility of self-selection effects. While a relatively large group engaged with the first story, a much smaller core group persisted through the later stages of the intervention. Learners who continued participation may have possessed higher levels of intrinsic motivation, interest in sustainability issues, or willingness to engage in extracurricular learning activities. However, these characteristics were not examined directly and therefore remain speculative.

Taken together, the findings suggest that persistence within multi-stage digital learning environments is likely shaped by an interaction of motivational, contextual, instructional, and design-related factors rather than by engagement alone. The present findings therefore reinforce the importance of evaluating persistence as a distinct construct and suggest that future AI-assisted learning interventions should consider motivational support alongside content design.

5.3. Implications for AI-Assisted Learning Design

The findings also have implications for the design of AI-assisted learning environments.

As generative AI becomes more widely integrated into educational design processes, attention has increasingly shifted from content production toward understanding how learners interact with AI-supported learning experiences over time (Crompton et al., 2024; Grassini, 2023). However, the present study suggests that the successful creation of engaging materials does not necessarily guarantee sustained participation. While AI-assisted approaches may reduce barriers to content development, challenges relating to learner persistence remain. Although previous research has highlighted the potential of generative AI to support the rapid development of personalised and interactive educational content (Grassini, 2023; Crompton et al., 2024), the present findings suggest that content quality alone may be insufficient to sustain participation across extended learning sequences.

This finding has implications for how the success of AI-assisted educational interventions is evaluated. Much of the emerging literature surrounding generative AI in education has focused on content generation capabilities, personalisation, and instructional efficiency (Grassini, 2023; Crompton et al., 2024). The present findings suggest that the ability to create engaging learning materials does not necessarily address challenges associated with sustained learner participation. Consequently, future research may need to move beyond evaluating the quality of AI-assisted content and consider how such interventions can be designed to support persistence across extended learning experiences.

One implication is that persistence should be considered during the design process rather than evaluated solely after implementation. Designers of AI-assisted learning interventions may benefit from incorporating mechanisms intended to support continued participation, such as shorter learning sequences, staged progression pathways, structured reminders, or greater integration with formal learning activities.

The findings also suggest that the effectiveness of AI-assisted learning environments should be evaluated using a broader range of indicators than engagement alone. Measures such as progression, completion, and persistence may provide valuable insights into how learners interact with extended learning experiences and whether educational benefits are likely to be realised over time. The findings may be particularly relevant for extracurricular sustainability initiatives, where participation is often voluntary and sustained engagement cannot be assumed even when learners express positive attitudes towards environmental issues (Weber, 2010; Milfont, 2010).

6. Limitations and Future Research

Several limitations should be acknowledged.

Firstly, participation declined substantially across the intervention, resulting in a relatively small number of learners completing the later stages of the intervention and associated questionnaires. Consequently, the study is unable to make strong claims regarding learning

outcomes or knowledge development. While several participants demonstrated improvements in post-test environmental knowledge scores, the small number of matched responses and absence of a comparison group mean that these findings should be interpreted as exploratory rather than conclusive.

Secondly, the study was conducted within a single institutional context and focused on a voluntary extracurricular intervention. Patterns of engagement and persistence may differ in other educational settings, particularly where participation is compulsory, integrated into the curriculum, or linked to assessment.

Another factor to consider is that the study did not collect qualitative data regarding learners' participation decisions. While the findings identified clear patterns of engagement and persistence, no follow-up interviews, surveys, or reflective accounts were collected from learners who discontinued participation. Consequently, the factors discussed in relation to persistence should be interpreted as potential influences informed by existing literature rather than empirically verified explanations.

Future research could build on these findings by examining learner persistence across larger samples and multiple institutional contexts. Studies incorporating interviews, surveys, or learner reflections could provide greater insight into the motivations, barriers, and contextual factors influencing continued participation. In addition, comparative and longitudinal research may help determine how different forms of scaffolding, curriculum integration, motivational support, and intervention design influence both persistence and learning outcomes within AI-assisted digital learning environments.

7. Conclusion

This study examined learner engagement and persistence within an AI-assisted interactive climate fiction intervention implemented in a higher education context. Although generative AI technologies have increasingly been used to create immersive and interactive educational experiences, limited research has explored how learners engage with these interventions and maintain participation when they are deployed in real-world educational environments. Through an exploratory case study of a five-stage climate fiction learning sequence, the study sought to address this gap by examining patterns of participation over time.

The findings revealed a clear distinction between engagement and persistence. Learners who participated in the intervention generally demonstrated strong engagement with the climate fiction stories, as reflected in high activity scores and meaningful interaction with the materials. These findings provide further support for the potential of climate fiction as an engaging approach to sustainability education, capable of situating environmental issues within personally meaningful narrative experiences. However, participation declined substantially across successive stages of the intervention, indicating that initial engagement did not necessarily translate into sustained participation over time.

These findings contribute to emerging discussions surrounding both climate fiction pedagogy and AI-assisted learning design. While climate fiction has been increasingly promoted as a means of fostering environmental awareness and engagement, the present study suggests that greater attention should be paid to how learners participate in extended sustainability-focused educational interventions over time. Similarly, while generative AI may facilitate the rapid creation of engaging and interactive educational experiences, sustaining participation remains a distinct challenge. Consequently, engagement and persistence should be considered complementary rather than interchangeable indicators of intervention success, particularly within voluntary and multi-stage digital learning environments.

Although the small number of learners completing the full intervention limits conclusions regarding learning outcomes, the study demonstrates the value of examining participation patterns within authentic educational contexts. By foregrounding the relationship between engagement and persistence, the findings provide a more nuanced understanding of how learners interact with AI-assisted climate fiction interventions and suggest directions for future research exploring how sustained participation can be supported in extended sustainability-focused digital learning experiences.

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Appendices

Appendix 1.

Pre-/Post-Test Survey: Student Engagement with Climate Fiction & Sustainability Awareness

Section 1: Demographic Information

1. **Name:** _____
2. **Age:** _____
3. **Degree Subject:** _____
4. **Year of Study:**
 - a. ☐ First Year
 - b. ☐ Second Year
 - c. ☐ Third Year
 - d. ☐ Fourth Year or beyond

Section 2: Concept/Knowledge Questions

5. Which of the following is the best definition of sustainable development?
 - a) Creating a government welfare system that ensures universal access to education, healthcare, and social services
 - b) Meeting the needs of the present without compromising the ability of future generations to meet their own needs
 - c) Setting aside resources for preservation, never to be used
 - d) Building a neighborhood that is both socio-demographically and economically diverse. Don't know
6. What role do wetlands play in mitigating climate change?
 - a) They primarily provide recreation areas
 - b) They make the water flow faster
 - c) They capture and hold a lot of carbon from the atmosphere
7. What is the primary reason for adopting municipal water recycling, reuse, and desalination?
 - a) To eliminate the need for natural water sources entirely
 - b) To address water scarcity and reduce reliance on freshwater supplies
 - c) To decrease wastewater discharge into natural water bodies
 - d) To reduce energy consumption in urban areas

8. Which of the following is an example of sustainable forest management?
 - a) Setting aside forests to be off limits to the public
 - b) Never harvesting more than what the forest produces in new growth
 - c) Producing lumber for nearby communities to build affordable housing
 - d) Putting the local communities in charge of forest resources
9. What are the potential effects of global climate change?
 - a. Loss of habitats
 - b. Less severe weather
 - c. Loss of ozone layer
 - d. Decrease in sea level
10. In China, we often hear about the importance of protecting the Yangtze River and its ecosystem. Which of the following is the greatest pressure leading to the degradation of the Yangtze River's ecosystem?"
 - a) Industrial pollution from factories along the river
 - b) Plastic waste and litter flowing from cities into the river
 - c) Excessive fertilizer use in agriculture leading to water pollution
 - d) Overfishing and habitat destruction affecting biodiversity
11. The most significant driver in the loss of species and ecosystems around the world is...
 - a. Overhunting/overharvesting
 - b. Conversion of natural spaces into human developments (farmland, cities, etc.)
 - c. Acid rain
 - d. Breeding of animals in zoos
12. Of the following, which would be considered living in the most environmentally sustainable way?
 - a. Recycling all recyclable packaging
 - b. Reducing consumption of all products
 - c. Buying products labeled "eco" or "green"
 - d. Buying the newest products available
13. What factors influence the human population's impact on Earth?
 - A. Size of the population
 - B. Amount of materials used per person
 - C. Use of technology that lessens our impact
 - a. A, B, and C
 - b. A and B, but not C
 - c. B and C, but not A
 - d. A, but not B or C

14. Imagine that we had to pay for all the costs associated with the goods we use every day. What would go into calculating the true costs of a product?

- a. The cost of raw materials to make the product
- b. The cost of environmental damage caused by production
- c. The cost of health care for employees who manufacture the product
- d. All of the above
- e. Don't know

15. Put the following list in order of the activities with the largest environmental impact to those with the smallest environmental impact:

- A. Keeping a cell phone charger plugged into an electrical outlet for 12 hours
 - B. Producing one McDonald's quarter-pound hamburger
 - C. Producing one McDonald's chicken sandwich
 - D. Flying in a commercial airplane from Washington D.C. to China
- a. A, C, B, D
 - b. D, A, B, C
 - c. D, C, B, A
 - d. D, B, C, A
 - e. Don't know

Section 3: Attitude and Perception Scale

16. On a scale from 1 to 5, how much do you agree with the following statement? (*1 = Strongly Disagree, 5 = Strongly Agree*)

I understand how my daily choices (e.g., food, transport, energy use) affect the environment.

17. On a scale from 1 to 5, how much do you agree with the following statement? (*1 = Strongly Disagree, 5 = Strongly Agree*)

Stories and narratives can influence how I think and feel about climate change and sustainability.

Section 4: Sustainability Awareness & behaviour

18. How often do you engage in sustainable actions like recycling, using less plastic, or conserving energy? (*Likert Scale*)

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often

- ☐ Always

19. Which of these sustainable actions do you try to do? (*Select all that apply.*)

Post - Which of these sustainable actions would you be willing to try more regularly?

- ☐ Reducing energy and water consumption
- ☐ Using sustainable transport (walking, biking, public transport)
- ☐ Eating less meat or choosing sustainable food sources
- ☐ Buying second-hand or repairing items instead of replacing them
- ☐ Advocating for climate action (e.g., spreading awareness)

Section 5: Emotional Engagement with the Story (*Post-Test Only*)

20. How did the cli-fi story and its characters affect your feelings or perspective on climate change and sustainability? (*Open-ended*)

Appendix 2.

Full participant matrix showing completion patterns of each H5P story across the five-week intervention

Participant	Story 1	Story 2	Story 3	Story 4	Story 5
P01	■	■	■	■	■
P02	■	■	■	■	■
P03	■	■	■	■	■
P04	■	■	■	■	■
P05	■	■	□	□	■
P06	■	■	□	□	■
P07	■	■	□	□	□
P08	■	■	□	□	□
P09	■	■	□	□	□
P10	■	■	□	□	□
P11	■	□	□	□	□
P12	■	□	□	□	□
P13	■	□	□	□	□
P14	■	□	□	□	□
P15	■	□	□	□	□
P16	■	□	□	□	□

Participant	Story 1	Story 2	Story 3	Story 4	Story 5
P17	■	□	□	□	□
P18	■	□	□	□	□
P19	■	□	□	□	□
P20	■	□	□	□	□
P21	■	□	□	□	□
P22	■	□	□	□	□
P23	■	□	□	□	□
P24	■	□	□	□	□
P25	■	□	□	□	□

Key: Completed = ■ / Not Completed = □