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Enhancing literacy education with narrative richness in the metaverse

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ABSTRACT

Through an education-centric metaverse learning application, this research aims to assess the use of narrative richness to deliver media, language, and sustainability literacy education. The 21st-century learning needs require teaching and learning resources to be shared and managed more effectively across institutions. The use of metaverse features can help to manage varying narrative richness to boost learning reflection and attitude. Despite its potential, it is unclear how narrative richness in the metaverse can enhance teaching and learning. The study proposed in this research, which includes institutions from four Asian countries, is driven by this knowledge and evidence gap. Module leaders conceptualize and evaluate a purpose-built metaverse-learning application to produce rich and realistic learning experiences. We utilize narratives to enhance the realism of learning experiences and will assess the effects of narrative richness on learning reflection and attitude.

Keywords

Metaverse, narrative richness, narrative transportation, robot-assisted learning, sustainability literacy, media literacy, language literacy.

INTRODUCTION

Digital pedagogies, such as digital storytelling in the metaverse, can enhance education delivery through narrative transportation to create customized virtual environments. Despite several studies examining the use of the metaverse for education (e.g., Kye et al., 2021; Hwang & Chien, 2022), empirical evidence on the efficacy of using the metaverse in an educational context is sparse. In this research, we will evaluate the application of robot-assisted learning in a metaverse environment to improve teaching and learning.

The use of metaverse, which often leverages authoring tools to customize experiences, has garnered increasing attention in recent years. The metaverse is a created environment where people "live" under the rules defined by the creator (Hwang and Chien, 2022). The technology in which the metaverse resides could be a virtual reality (VR) system, an augmented reality (AR) system, or a mobile game system. People can discuss issues, collaborate on projects, or play games in a metaverse. In contrast to previous systems, the metaverse supports avatars, allows the creation of many scenes, offers user authoring capabilities, and supports open-world explorations (Kye et al., 2021). The metaverse can also be manifested in an educational context to extend and expand teaching content:

- Learners can use the metaverse to experience situations or locations challenging to replicate in a classroom.
- Virtual worlds often use virtual agents to automate the delivery of teaching content.
- Metaverses can use user-generated content created by classroom-authoring tools.

It is important to examine the use of narratives for digital storytelling in the metaverse. According to Naul and Liu (2020), a distributed and personalized narrative, empathetic characters, and virtual agents are required for powerful storytelling. These properties are generally complex to implement and require significant planning and implementation. However, the affordances provided by a metaverse make the implementation more feasible and straightforward. A better understanding of digital storytelling, specifically through narrative transportation in a metaverse, is an important area of research for enhancing motivation in learning while assisting in the generation of new knowledge (Wu & Chen, 2020).

THEORETICAL FOUNDATION

Narrative Transportation

While stories can be powerful, it is important to evaluate their formation and implementation in the form of narratives. Narratives work best when they 'show and not tell' (Green, 2021). Narratives are often used interchangeably with stories, and in the context of this research, they are used in the virtual world to offer a realistic and authentic experience termed presence (Cao et al., 2021). One important aspect of presence in the virtual world is spatial presence, which refers to a mental representation of the environment after viewing a mediated environment (Wirth et al., 2007). Studies have linked spatial presence to narrative transportation, which immerses viewers in a make-believe situation while eliciting powerful emotions and active mental pictures (Pianzola et al., 2021). Narrative transportation helps combine attention, emotions, and visuals to transport someone into a story (Green, 2021; Green & Brock, 2000).

A rich narrative has powerful thoughts, ideas, or plot components (Boukes & LaMarre, 2021). Narrative richness can influence whether a story is persuasive and can be accepted by others, also known as narrative absorption (Nell, 1988). Narrative richness can be generated by narrative characters through "identification" described by Hui et al. (2021) as "the ability to experience characters' feelings, to adopt characters' points of view, to internalize characters' goals, and potentially to have the sensation of becoming the character" (p. 3). Dahlstrom (2012) refers to the persuasive power of narratives as a "covert mode of persuasion, where information is generally accepted first and only analyzed later" (p. 502). Studies based on narrative transportation have demonstrated improvements in the formation of connections, sense-making, and deep cognitive learning (Paliadelis et al., 2015).

Metaverse Affordance Actualization

A technology affordance is a property of technology that provides clues to how artifacts can be used (Anderson & Robey, 2017). The metaverse uses perceived utility to link instrumental affordances such as non-player characters to affective affordances such as embodiment and empathy (Shin, 2022). Perceived utility, in the context of education, can be defined as how technology helps students learn the curriculum (Marín-Díaz et al., 2019).

Narrative transportation and metaverse authoring tools let teachers build individualized stories. Teachers can create different stories that meet multiple learning objectives using metaverse-enabled authoring tools. Cross-scene integration and virtual agents in a metaverse are studied (Kye et al., 2021; Hwang & Chien 2022), but less is known about teacher-created environments.

Embodied Cognition and Reflective Learning

Alberto et al. (2022) defined embodied cognition as the process through which humans think through and with their bodies. This can be done by recognizing, altering, and refining solutions when learning activities (like cutting wood) by repetition. Reflective learning is described as "the process of internally examining and exploring an issue of concern, triggered by an experience, which creates and clarifies meaning in terms of self, and which results in a changed conceptual perspective" (Boyd & Fales, 1983, p. 100). Le Pertel et al. (2020) claimed that reflection-in-action helps learners obtain information by redesigning and adjusting their behavior to accomplish their learning goals.

In a virtual environment like the metaverse, embodiment can be supplemented by agency, the ability to direct a virtual body's behaviors (Makransky & Petersen, 2021). John-Glenberg (2018) argues that virtual body movement is important for high embodiment in learning. Completing tasks through movement or physical action is also consistent with constructivist learning theory. Constructivism involves creating complicated, realistic environments to generate knowledge, frequently with others. To create a constructivist learning environment in an educational metaverse, cognition and reflection learning can be supplied through the student's avatar. Students can learn via virtual conversational bots but the ability to use virtual chatbots well is fairly limited. One study found that educational chatbots have limited content, not enough AI bot training, and not enough user-centered design (Kuhail et al., 2022).

Another option is to use the metaverse to create vast amounts of scene content, where the student's avatar can interact with numerous non-player characters' scripted dialogues to maintain high engagement in learning. The identification of students through their avatars can create an emotional bond which can lead to positive behavior development (Kim & Kim, 2016). Narrative transportation has been frequently linked to emotional engagement (Chung-Fat-Yim et al., 2019; de Regt et al., 2021; Pianzola et al., 2021).

Narrative Richness

Making stories that are either high or low in narrative richness depends on whether the storytelling is active or passive. Rich stories are used in dialogic teaching to encourage critical thinking and reflective learning (Teo, 2019). According to Cui and Teo (2019), dialogically

structured training "puts a premium on queries" (p. 5). It encourages discussion by considering the viewpoints of the students. Digital games can also be used to enhance students' interest (Herrewijn et al., 2021).

According to narrative discourse theory, a story can be told in the first or third person, or "point of view" (Diasamidze, 2014). In the third-person perspective, the reader interprets the story rather than becoming a character. The first-person perspective makes the reader a character and adds immediacy, credibility, and psychological reality. A first-person perspective will have higher narrative richness compared to a third-person perspective. When you watch a movie and listen to its narration, you do not participate in the story or have an impact on it; rather, you observe from a distance. As an alternative, putting a student in a situation in Rome to study Roman history gives a more active learning experience than reading or watching videos in class. Additionally, virtual field trips can simulate a narrative-rich educational experience (Wong et al., 2019). In-class discussions can improve learning from virtual field trips when combined with pedagogies like the flipped classroom.

Learning Attitude

Hogg and Cooper (2007) assert that processes such as affect, cognition, and action have an impact on attitudes. In the metaverse setting, a learner's ability to connect their narrative transportation experience to meaningful problems through embodied cognition and reflective learning can influence their attitude toward learning. A learner is anticipated to evoke various levels of emotion and cognitive reasoning depending on the richness of the narrative. Reflection in particular has been linked to an increase in learning attitude (Farrell, 2020; Wong et al., 2022).

Concept Development

"Agency" affects narrative transmission (Pianzola et al., 2021) and refers to the ability to "manage content, medium, and naturalness/fluency of media use." Metaverse flexibility allows for multi-scene administration and learning facilitation. Metaverse can create learning circumstances that are hard to duplicate in a typical classroom, making it useful for presenting literacy scenarios (Hwang & Chien, 2022). Metaverse can provide authentic experiences to increase narrative transportation (Farrell, 2020). Along with aesthetic aspects, it can include psychological elements such as performance feedback and reflection. We propose designing the metaverse in such a way that participants can openly browse and view scenes, i.e., created through teacher-authoring tools, to access learning content across varying levels of narratives supported by learning management features. Hence, we propose the following research questions to facilitate learning in the metaverse.

Research Question 1 (RQ1). How do the elements of a metaverse employ narrative transportation to foster learning reflection in an educational setting?

Social presence impacts spatial presence (Pianzola et al., 2021). In the context of the metaverse, social presence refers to "the awareness of being present with others in a mediated environment combined with a certain degree of attention to the other's intentional, cognitive, or affective states" (van der Land et al., 2011, p. 5). Hence, the actions and intentions of other agents also enhance social presence. The use of virtual agents can help deliver personalized learning and engagement (Xu et al., 2014; Lin et al., 2022). Robots can serve as intelligent agents that pose as human-driven avatars or objects to converse in a natural manner. In the context of this research, robots and non-player characters or objects are used interchangeably. Robots can deliver issues, gaps, missions, and inquiries in ecosystems to boost active learning and critical thinking (Kim et al., 2022; Luna-Nemecio et al., 2020). Robot-assisted storytelling helps promote visualization of learning using multi-sensory data, which can help boost narrative absorption. Hence, we are interested in using virtual-agent robots to create narrative richness for narrative transportation experiences.

Research Question 2 (RQ2). How do learners perceive a metaverse environment that uses virtual-agent robots to offer various levels of narrative richness to promote narrative transportation?

The development of young people's literacy skills is ranked as a crucial 21st century ability by the Organization for Economic Co-operation and Development (OECD) (2018). Young people may not always be equipped to determine if information is authentic and fact-based on the Internet, and this ability is typically referred to as media literacy (Hill, 2022). The narrative persuasiveness of using a metaverse to deliver knowledge may be beneficial for media literacy (Dahlstrom, 2012). While media literacy in the virtual world and digital-games has previously demonstrated an increase in learning attitude and motivation (Herrewijn et al., 2021), its adoption in varying narrative richness and robot-assisted VR has not been studied. Therefore, we propose the following research question for media literacy:

Research Question 3 (RQ3). Does the narrative richness in a metaverse learning environment affect learning reflection and attitudes toward media literacy?

According to Chung-Fat-Yim et al. (2019), the use of a foreign language may reduce mental imagery and increase cognitive load, thus impacting the narrative experience. As the main goal in second language learning and development is to reduce speaking anxiety through repetitive practice, it is unclear if narratives may distract learners. Therefore, the impact of narrative richness on second language learning needs to be studied. While VR has been used to increase attitudes toward learning languages (Lan, 2020; Lin et al., 2022), the adoption of narratives in robot-assisted environments is unclear. Thus, we propose the following research question for media literacy.

Research Question 4 (RQ4). Does the narrative richness in a metaverse learning environment affect learning reflection and attitude for language literacy?

Understanding sustainability requires complex thinking that involves many stakeholders (Luna-Nemecio et al., 2020). These problems can be challenging to understand from multiple perspectives. Although studies have attempted to use VR to improve environmental education, little research has studied narratives and robot-assisted virtual environments (Matovu et al., 2022). Hence, we are interested in studying if high narrative richness can provide better support for sustainability literacy.

Research Question 5 (RQ5). Does the narrative richness in a metaverse learning environment affect learning reflection and attitude toward sustainability literacy?

Hypothesis Development

The affordances provided by an education-centric metaverse for the creation and management of narratives with varying levels of richness can support student learning, particularly in learning reflection and attitude. This is in light of the connections between the theoretical foundations of narrative transportation, embodied cognition, and reflective learning.

The use of narrative transportation, particularly through varying degrees of narrative richness, can help transform how learners receive, process, and reflect on information (Boukes & LaMarre, 2021; Nell, 1988). Narrative transportation helps learners reflect on what they learn. Embodied learning theory suggests that letting learners directly manipulate objects and perceive embodiment of themselves within a story can lead to increased absorption and reflection of their learning, e.g., on how their actions have affected outcomes in the subject domain (Makransky & Petersen, 2021). Thus, we hypothesize the following:

Hypothesis 1. The richness of narratives in the metaverse has a positive effect on reflective learning.

Several studies have shown that an increase in reflection led to increased learning performance and attitude (Farrell, 2020). The depth of a dialogue can be managed through the introduction of conversations that drive cognitive thinking (Cui & Teo, 2019), supported by virtual agents in the metaverse. By facilitating and increasing reflective thinking, a learner is able to better relate to and assimilate the subject matter, which increases the attitude toward learning the subject (Hogg and Cooper, 2007). Therefore, we hypothesize the following:

Hypothesis 2. Reflective learning has a positive effect on attitude toward learning.

Figure 1 shows the research model.

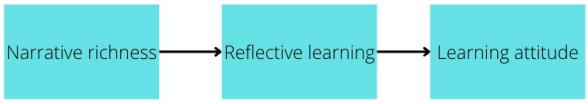

Figure 1. Research Model

RESEARCH METHOD

An experimental study will be carried out to assess the effect of narrative richness of storytelling in the metaverse environment on reflective learning and attitude toward learning. This study takes an adaptation of narrative richness and narrative persuasion based on reflection (Hamby et al., 2017; Boukes & LaMarre, 2021).

Based on narrative discourse theory (Diasamidze, 2014), the narrative richness of storytelling in the metaverse is expected to have an effect on attitude toward learning. Compared to a third-person perspective, a first-person perspective adds richness to the narrative in the metaverse as learners are able to exert direct influence over decisions and the surroundings. The third-person point of view will require the learner to analyze materials presented through interactions with people or items in the environment to better understand the materials.

The narrative richness of the scenes in the metaverse is the independent variable, which is operationalized as high and low levels of richness (see Table 2). A teacher administrator can edit the dialogues of non-player characters like robots and objects. The mediating variable is reflective learning and the dependent variable is learning attitude. They will be assessed using a learning reflection scale (Kember et al., 2000) and a learning attitude scale (Pierce et al., 2007).

#	Type	Description
1	Content used in the metaverse	• Media literacy: Fact check / Research (RQ3) • Language Literacy: Presentation skills (RQ4) • Sustainability Literacy: Environmental issues (RQ5)
2	Independent variable (RQ2)	Variation 1: High narrative richness: Metaverse scenes with robots (RQ1) using first-person dialogue Variation 2: Low narrative richness: Metaverse scenes with robots (RQ1) using third-person dialogue
3	Mediating & dependent variables	Learning reflection (Kember et al., 2000) and attitude (Pierce et al., 2007)
4	Control	Same duration. Same content.

Table 2. Scenarios and Operationalization of Study

Subjects will be randomly assigned to either the high or low narrative richness condition. Pre/post questionnaires will be used to assess changes in learning reflection and attitude after which the effects across both levels of narrative richness (i.e., high versus low) will be statistically compared and analyzed. Narrative richness is expected to influence students to adopt fresh and internalized perspectives and increase their learning. Some key points on how the metaverse supports narrative transportation and richness are highlighted below.

- The metaverse learning platform, Soqqle Classlet (https://soqqle.com) will be used. Besides learning management like multiple choice questions, the platform supports metaverse characteristics like multi-scene setup, avatars, and authoring.
- Narratives are arranged into scenes and tailored to different degrees of narrative richness. Participants accomplish learning activities in 20-minute sessions.
- The teacher administrator uses authoring features to add dialogues and feedback for assessment. Teachers can access learning metrics via a web dashboard. The teacher can use learning metrics in a face-to-face classroom to discuss challenges and problems with students.

The scenarios for this study are fact check / research methods for media literacy (RQ3), presentation skills for language literacy (RQ4), and environmental issues for sustainability literacy (RQ5). These modules are chosen due to the potential of narrative persuasion to affect change (Nell, 1988). Narratives will be written in English. As part of robot-assisted learning, non-player characters or objects can be tapped to start a dialogue (Figure 2). The dialogues begin a discussion in which different questions can be chosen and answers can be supplied. When activities are completed, students receive points, which show whether or not decisions have been made appropriately. Sample scenes from the metaverse are presented in Figure 3.

Participants

Students from higher education institutions in Hong Kong, Malaysia, Thailand, and Indonesia will be invited to participate in this study. Three different categories of literacy will be used to divide the modules: Media literacy, language literacy, and sustainability literacy.

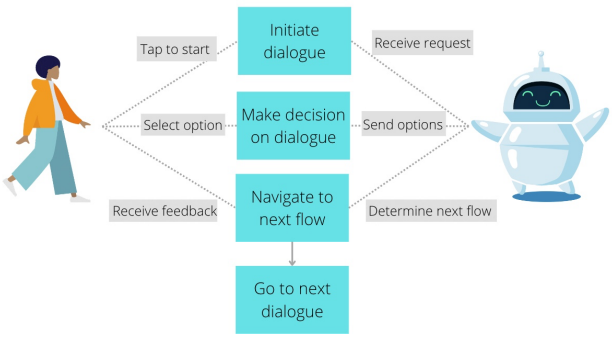

Figure 2. Robot-Assisted Interaction

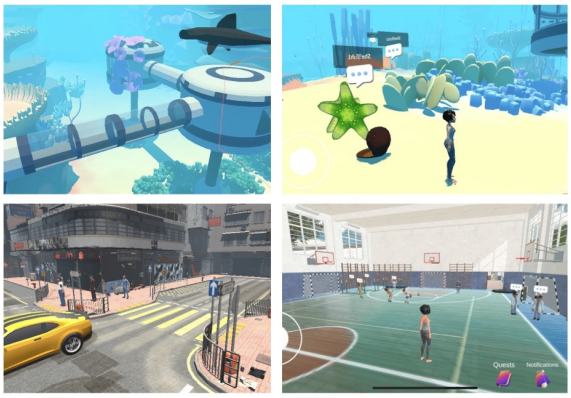

Figure 3. Screenshots of Conceptualized Environments

Data Analysis

The study employs a qualitative-quantitative mixed-method approach. More information is provided below.

Qualitative data: Each of the countries involved will host focus groups related to authentic learning assessment (Farrell, 2020) to gain a better understanding of the efficacy of using narratives and narrative richness in the metaverse to facilitate and enhance literacy education.

Quantitative data: Correlational analysis and parametric statistics will be used for data analysis.

EXPECTED CONTRIBUTIONS

Gamification, game-based learning, and VR are not new (Eschenbrenner et al., 2008; Nah et al., 2013; Chen et al., 2022; Krouska et al., 2022), especially given that teachers must adopt online learning during the COVID-19 era. Despite studies showing that immersive games might be helpful, they present many limitations. This study will examine the efficacy of using the metaverse for learning.

This study uses digital storytelling and metaverse-supported narrative transportation to examine student learning reflection and attitude. The metaverse's multi-scene infrastructure provides a collaborative, integrated learning environment. Teacher authoring tools can help put up content and construct instructional scenarios. Scenes can be updated and new information supplied by reloading a web browser. This metaverse infrastructure allows teachers to adapt content into storytelling dialogues and integrate them with pedagogies. The metaverse can give different pre-class field experiences as well as facilitate the use of flipped classrooms to enhance pedagogies (Wong et al., 2019; Humrickhouse, 2021). It can also offer a variety of robot-assisted functionalities to enhance teaching-learning activities involving sustainability literacy, language literacy, and media literacy (Farrell, 2020).

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