Journal of Sociocybernetics

Journal of Sociocybernetics ISSN 1607-8667

ORIGINAL ARTICLE

Using text-to-image generative AI to create storyboards: Insights from a college psychology classroom

Shantanu Tilak, Blake Bagley, Jadalynn Cantu, Mya Cosby, Grace Engelbert, Ja'Kaysiah Hammonds, Gabrielle Hickman, Aaron Jackson, Bryce Jones, Kadie Kennedy, Stephanie Kennedy, Austin King, Ryan Kozlej, Allyssa Mortenson, Sebastien Muller, Julia Najjar, Sydney Queen, Milo Schuehle, Nolan Schulte, Emily Schwarz, Joshua Shearn, Kalyse Williams, Malik Williams

Virginia Wesleyan University, Virginia Beach, VA, United States of America

This participatory study, conducted in an introductory psychology class, recounts self-reflections of 22 undergraduate students and their instructor engaging in an GenAI-mediated storyboard generation process. It relies on Gordon Pask's conversation theory, structuring out the nature of interactions between students, instructor, and GenAI, and then uses a qualitative narrative to describe these conversational feedback loops constituting the creation of draft and final storyboards. Results suggest students engaged in cyclical feedback driven processes to master their creations, used elements of photography related to the relationships between objects in frame, image processing, and cultural objects/themes to generate narratives. Issues were faced with generating text on images, and the consistency and style of generated frames as they interacted with GenAI tools. This study provides guidelines to university teaching professionals to design effective activities mediated by text-to-image GenAI.

url: 10.26754/ojs_jos/jos.2024110822

1. Introduction

In a digitized society, complexity has been added to online contexts with the deployment of generative artificial intelligence (GenAI) with multimodal capabilities. While AI can increase efficiency in tasks like editing, proofreading and generating images, it may not always

produce coherent output. Educational settings affording individual and collaborative learning become a context where the mechanisms of human interaction with GenAI can be reflected upon to understand how to create meaningful outcomes. Biases inherent to algorithms, issues of equity in access, and implications for student privacy raise questions; but warrant exploration of the "how" and "why" of using tools. While technologies like Microsoft's Copilot allow schools to protect their data, larger concerns related to misinformation in Internet contexts calls for careful evaluation of GenAI output by groups of users (Mishra & Oster, 2023).

Effectively governing AI-mediated education becomes possible by analyzing students' interactions with GenAI for classwork, and by understanding processes that teachers use to shepherd these interactions. This first step that informs curriculum design should precede studies investigating the cognitive and social mechanisms of using GenAI. Rather than one-to-one interactions where fewer perspectives are considered, this paper considers a social paradigm of human-AI interaction to inform curriculum design. Information produced in one-to-one human-AI interaction is brought to a group to build upon it in a many-to-many computer mediated setting (Sharples, 2023).

This study is a participatory project; it qualitatively elaborates self-reflections of 22 students and an instructor (all co-authors) in an introductory college psychology classroom using text-to-image GenAI to create storyboards. Rather than understanding topics students explore and changes in their thinking, it decodes the processes followed to craft assignments in interaction with AI, applying Gordon Pask's conversation theory to expose effective mechanisms of human-computer interaction (Pangaro, 2008) that practitioners may rely on.

2. Storyboards and text-to-image GenAI

Multiliteracy involves understanding how to blend modes of expression in creating artifacts. Students must exercise intertextuality (skill in orchestrating relationships between visual, aural, verbal, spatial, and contextual facets of communication). A challenge in engaging with intertextuality is the distance perceived between modes (Balzotti, 2016). While students may face challenges with creating intertextual work, feedback and formative instruction can allow them to bring out cogent relationships in multimodal information (Bickmore & Christiansen, 2010). When students and teachers experience new ways of interpreting artifacts, students may journey towards perceiving a bridging of modes of expression. Students and instructors come to organize ideas and concepts coherently,

avoid plagiarism, (Hale, 2018; Liu, 2012; Narkiewicz & Skukauskaitė, 2022), and also understand applications of concepts to real-life. Transfer is a byproduct of a situated interaction between student and context, allowing interpretation of scientific concepts as everyday concepts, in line with principles of cultural-historical psychology (Tilak & Glassman, 2022).

Text-to-image GenAI creates images to support multimodal assignments with careful prompting. Such tools, that can heighten artistic expediency can be used by students with varying levels of artistic skills to create visual output. Much like contemporary musicians and visual artists like Grimes (Claire Boucher) suggest, the argument is two-edged; those with little creativity benefit; but existing skill too may see an augmented form:

"When everyone has the same tools that can make professional quality stuff, then you get to see the actual talent, like, really rise to the top." (PBS, 2024)

Producing images from GenAI can be tailored to users' needs based on varied parameters like sampling type, image dimension, and seed values. A uniform seed value helps maintain image consistency in Stable Diffusion, but sometimes, inconsistencies need iteration. Careful prompting can also help maintain consistency and tone.

Critics say we need to question whether output from GenAI is art (Zylinska, 2020). Training such tools on limited data may lead to reinforcement of cultural stereotypes (Dehouche, 2021), and the influence drawn from legally protected art raises concern (Franceschelli & Musolesi, 2022). However, some scholars believe that such tools could house eons of artistic expression, making them effective tools in classes related to aesthetics, artistic technique, and art history.

A study by Vartiainen & Tedre (2023) showed teachers began to wonder about the possible and impossible when using text-to-image GenAI in craft classes. Teachers also believed GenAI could help children (irrespective of artistic prowess) portray concepts clearly. They also raised concerns about text-to-image AI presenting a risk to create falsehoods about the skill-level of the student by generating images richer than provided prompts. Brisco et al. (2023) studied 20 design students, showing that the use of text-to-image AI could generate visuals of a chair as a concept that sometimes transcended students' perceptions of the concept, but were not always "functional" in practice. Zhang et al. (2023) conducted a study with 11 adults having backgrounds in design/architecture, seeing that they perceived potential in using AI with sketches as input to augment inspiration and generate images with consistent style. Participants faced challenges with the practical applicability of AI-influenced images, and expressing domain knowledge correctly.

Effective prompting could help overcome some of the limitations associated with using GenAI to create images and narratives described in extant literature. Dehouche & Dehouche (2023) identified three photographic principles guiding effective image prompting:

1. **Mise-en-scène:** Visual/compositional elements defining relationships between objects in frames.
2. **Dispositif:** Configuration of material technology used to capture images, or post-processing.
3. **Cultural Object:** Subject of art, and its nature in reference to previous and present themes in design/popular culture.

This study reflects upon the victories and limitations arising from the use of these principles in collaborative prompting and re-prompting GenAI to create storyboards in a psychology class. It applies a conversation theory approach.

3. GenAI-assisted storyboarding through a conversation theory lens

This study implements Gordon Pask's conversation theory to understand processes implemented by instructors and students in generating GenAI-mediated storyboards, and how these processes embody guidelines described by Dehouche & Dehouche (2023). Pask's aim was to create a domain general framework to help psychologists, educators, designers and computer scientists better understand mechanisms at play in conversations at large; machine-dependent or independent (Tilak et al., 2024). Conversation theory relies on concepts from cultural-historical psychology (Pask, 1975, p. xi) to understand how humans and artificial systems together, embody and transform concepts. It utilizes paired experiments that analyze how individuals/groups interact with each other, and/or tools to create artifacts imbued with meaning (Pask, 1975, 19-20).

The first use of conversation theory is to understand what concepts are navigated in human-human, human-machine, and machine-machine interaction through an interplay between cognition and observable activity (see Tilak & Glassman, 2022; Tilak et al., 2024). It can also be used as a theory of theories, to inform parameters guiding effective design blueprints for machine-dependent and independent sociocognitive collaborative processes. Designers orchestrating these collaborative interactions become co-observers in the process (see Pangaro, 2008; Silverman, 2023; Tilak et al., 2024), navigating the needs of agents interacting within the system under consideration.

Per conversation theory, M-individuals are systems with material presence (human bodies/brains, machines). M-individuals embody and manipulate one or more P-

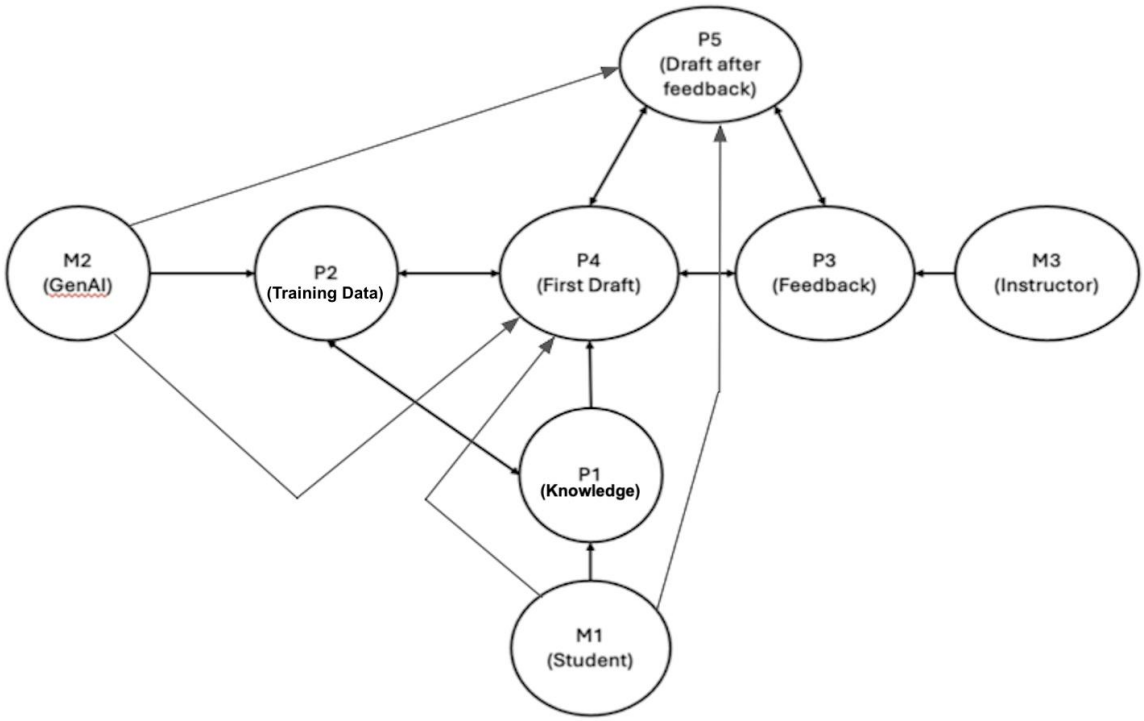
individuals, or conceptual operators. P-individuals could be rule systems, thoughts about a topic, self-perceptions (e.g., self-efficacy), perceptions of others, and even the conversation as a whole (De Zeeuw, 2001; Scott, 2001). M-individuals can embody several P-individuals, or together embody one P-individual.

This paper applies conversation theory to investigate processes unfolding as students interact with AI and take feedback from an instructor to re-prompt AI. The bodies/brains of students, the instructor, and the hardware loaded with GenAI used to create storyboards (computers/cellphones) are M-individuals. Previous knowledge possessed by students (P1), and data upon which GenAI is trained (P2) are interacting P-individuals, producing an initial storyboard draft (P4). The instructor (through feedback, P3) and student iterate upon this P-individual, understanding how to re-prompt AI to tell a cogent story (see Figure 1).

While webs of concepts can be used to help understand contents of these P-individuals, this study is concerned with understanding how to effectively design interactions students and instructors undertake to create GenAI-mediated storyboards (P5).

Figure 1

Diagram depicting human-computer interaction in the current study.



In line with Pask's assertion that both sharp and fuzzy methods can power studies using conversation theory (Westermann, 2018), we implement narrative inquiry methodology to

recount processes of human-computer interaction, and understand whether prompting and re-prompting of AI incorporates principles outlined by Dehouche & Dehouche (2023) described in the previous section. We embrace Scott's (2001) assertion that the entire conversation is a P-individual, and outline its varied components, or stepwise interactions between students, instructor, and GenAI.

4. The Current Study

This participatory study recounts experiences of 22 undergraduate students and their instructor using GenAI to develop storyboards as part of an introductory psychology course. It explains processes powering effective prompting and re-prompting of text-to-image GenAI to create intertextual assignments, as well as challenges encountered during these activities. We ask three research questions:

RQ1: *What processes do college students and their instructor follow while prompting GenAI to create storyboard assignments?*

RQ2: *What role do photographic elements play in image prompt generation?*

RQ3: *What limitations are encountered in the collaborative creation of text-to-image GenAI mediated storyboards?*

5. Methods

Co-Observers

An instructor and 22 undergraduate students enrolled in Psychology 101 at a small liberal arts university (Average age= 19.8 years, 47.9% White, 17.3% African American, 8.6% Asian, 4.4% Native American/Alaskan Native, 21.8% Mixed Race, 47.8% Female, 47.8% Male, 4.4% Non-binary) acted as co-observers. The class covered concepts on the nervous system, cognitive psychology, human development, and learning. The study was approved as an exempt action research project by the Institutional Review Board (IRB).

Curriculum

The class followed the 6th edition of *The Science of Psychology: An Appreciative View"* by Laura King (2022). The chapter list was as follows:

- **Chapter 1:** What is Psychology?

- **Chapter 2:** Research Methods
- **Chapter 3:** The Nervous System
- **Chapter 4:** Sensation and Perception
- **Chapter 5:** States of Consciousness
- **Chapter 6:** Learning & Education
- **Chapter 7:** Cognition
- **Chapter 8:** Memory Models
- **Chapter 9:** Human Development

Each student was to create a storyboard on one of the nine topics, and were given the choice to create an AI-mediated assignment. The class wrote the current paper as a self-reflective project to recount processes involved in creating the storyboards that utilized GenAI.

Measures

We reflected, as a classroom, on six questions generated based on the process diagram in Figure 1:

1. What tool did you use to generate your storyboard?
2. The next few questions will focus on the process we followed:
    a. How did you initially prompt AI? (P1)
    b. How did you modify prompts to make the first draft you wanted? (P1, P4)
    c. What feedback did the instructor have? (P3)
    d. How did you incorporate it? (P5)
3. What are the challenges and advantages of using AI for multimodal communication?

In addition, student responses are tied back to Dehouche & Dehouche's (2023) three part framework to gauge the role photographic principles played in prompting and re-prompting processes part of the machine-dependent collective action being investigated.

Data

Data is drawn from nine AI-assisted storyboards made by eight students, and reflections upon the process. While the instructor demoed Microsoft Copilot, the eight students sharing storyboarding reflections also used other tools like OpenArt and Canva to generate final storyboards, and explored other options like Fotor, Shutterstock, and DeepAI. They prompted AI to generate images about ideas they wished to cover (related to chapters 2-5 for Unit 1, or 6-9 for Unit 2).

Data Analysis

Co-observers reflect on steps followed to prompt GenAI to create initial drafts, to incorporate feedback and create final storyboards, and limitations faced in the process, using open-ended responses to the six questions provided in the measures section. Open-ended responses are shared using a narrative inquiry (Connelly & Clandinin, 1990) to recount human-computer interaction and elaborate how to effectively design these processes; a use of conversation theory outlined explicitly in previous sections. Students' prompting techniques are situated within Dehouche & Dehouche's (2023) guidelines that rely on principles of photography.

6. Results

Storyboards 1 & 2

The student who created Storyboards 1 and 2, a Caucasian Female, and German exchange student, is credited with ideating the use of GenAI for storyboarding. She messaged the instructor, sharing her AI-mediated storyboard prototype. Figure 1 showcases the Google chat initiated by the student. She had tried to use four tools in total, Canva Magic Media, Fotor, Shutterstock's AI, and Deep AI for her draft.

Figure 1

Chat communication bringing up possibility to use AI.

I hope this message finds you well. I wanted to inform you that I have invested some time in initiating the creation of the storyboard for the upcoming assignment. I chose the topic about Cognitive Development Theory, using the example of Jean Piaget. Using a free AI, I created visuals for the story pictures. Furthermore I designed a mind map to explain the theoretical aspects as well as a practical exampel.
I'd appreciate your feedback when you have a moment. Please let me know if I'm meeting your expectations and where I can improve.
Thank you for your time.

Initially, the instructor was reticent to allow using AI owing to ethical implications of relying on computer-generated art. Upon deeper consideration, he thought it would be interesting

to study how students used AI to create meaningful storyboards and ensure effortful agency in doing so.

He responded to the student's chat message with enthusiasm and curiosity, planting the seed to initiate a class project:

"...I think you did something really cool. Do you by chance have your chat log with the bot? We can possibly use AI and work on these assignments collaboratively, using feedback from me and class on the storyboards and putting it into the AI."

The student's first visual was shared with the class to initiate the conversation about employing GenAI for the assignment. When asked about how she initially prompted the AI to create her stage theory storyboard, which she used to depict assimilation and accommodation, as outlined in Piaget's approach (Chapter 9), the student said prompting content for the frame, and its tone produced better output. Relationships between objects in frame (mise-en-scène), and imagistic style (dispositif) was regarded as important:

"I gave a lot of details about colors, objects, people, surroundings, style and atmosphere. For example, I added a 'little boy, with blond hair and yellow shirt' to each prompt to maintain the consistency of the images. I made sure to clearly indicate the artistic style or aesthetic I preferred, for example realistic, impressionistic or modern. In the process I used different styles but in the end I decided on the modern 3D style and applied it to all the image generations. I made sure that my prompt provided a clear context, such as the place, time, situation or mood."

Realizing components to a good prompt involved attention to style/frame, the student worded prompts accordingly, and iteratively provided feedback to GenAI about output based on reference images she had herself collated:

"Several trials helped me to generate different versions of the image with different prompts or parameters and select the best result. Feedback and customization were also important steps in the process. By reviewing the generated images and giving feedback to the AI, I was able to improve future results. Finally, I compared the generated images with real reference images to evaluate them and make further improvements. The combination of these approaches has enabled me to create a design that meets my expectations."

The storyboard is provided in Figure 2.

Figure 2

The initial storyboard or Storyboard 1, that initiated the idea to use GenAI to create storyboards.

Based on the first trial run, the student stated the following advantages and challenges of using GenAI:

"AI can automate tasks and thus save time and costs. However, I need to be careful to use high-quality prompts to achieve accurate results. The complexity of integrating different types of communication is a challenge and it is important to ensure data privacy and security. There is also a risk of misuse or the spread of misinformation."

The student went into Unit 2 prepared to carefully prompt Copilot and create a cogent narrative. She decided to focus on Freud's theory (Chapter 5) and prompted the AI keeping in mind visual components, parts of each scene and interactions within and across frames (mise-en-scène). She realized these factors mesh with cultural symbols and references to specific phenomena like dreaming. Accordingly, the student relied on these references to dreams, and theories associated with them to influence the GenAI's imagistic output:

"My first ideas revolved around key dream themes such as peaceful sleep, surreal dream transitions, Freud's influence on dream interpretation, and different dream theories."

The student elaborated on how she incorporated these symbols into her prompts to attain specific visual output, saying:

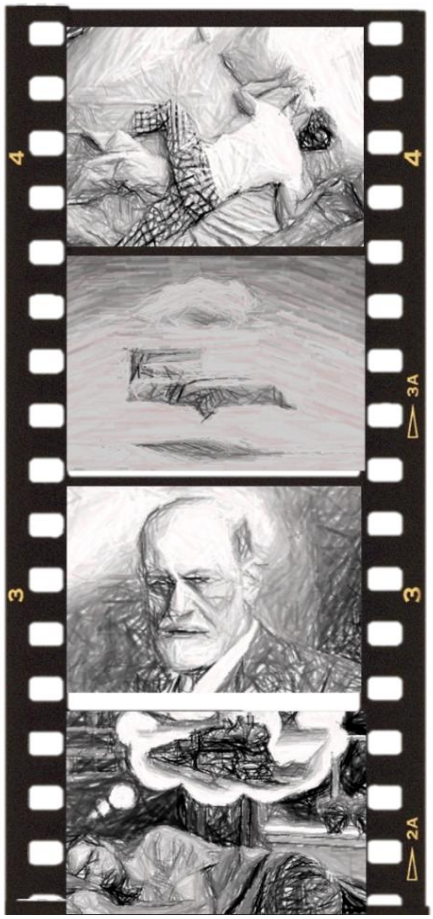
"When it came to Freud's connection to dreams, I experimented with incorporating symbolic elements that represent the unconscious mind. This approach helped create a thought-provoking visual narrative. The scene depicting the dreamer on a train talking to a friend required careful attention to detail. I focused on capturing the essence of manifest content, ensuring the train setting

and interaction with the friend were realistic and relatable. Exploring latent content and dream symbols was another opportunity to get creative with the AI. I emphasized the dreamer's contemplative state, surrounded by floating symbols that hinted at deeper meanings within the dream. The transition to a sleep lab provided a fascinating challenge as I sought to blend dream imagery with scientific elements. By focusing on researchers at work and dream patterns, I was able to create a harmonious blend of technology and imagination."

The first draft is provided in Figure 3.

Figure 3

Draft of Storyboard 2.



Frame 1: Introduction

Scene: Peaceful bedroom with a sleeping individual.

Text: "Meet Luca, exploring the mysterious realm of dreams."

Frame 2: Dream Sequence

Scene: Dream transition with surreal visuals.

Text: "Diving into Freud's Psychodynamic Approach."

Frame 3: Freud's Beliefs

Scene: Freud's silhouette emphasizing dreams as keys to the unconscious.

Text: "Dreams symbolize hidden desires; manifest vs. latent content."

Frame 4: Manifest Content Example

Scene: Dreamer on a train, talking to a friend.

Text: "Manifest content: surface - the train ride and conversation."

Frame 6: Modern Perspective

Scene: Transition to a sleep lab with researchers studying dreams.

Text: "Modern psychologists view dreams as mental events."

Frame 7: Dreams vs. Reality

Scene: Dreamer comparing dreams to everyday life.

Text: "Research shows dreams are often similar to waking experiences."

Frame 8: Peculiar Perception

Scene: Dreamer surrounded by bizarre dream visuals.

Text: "Perceiving dreams as strange due to vivid memories."

Frame 9: Emotional Aspects

Scene: Dreamer experiencing intense emotions in a dream.

Text: "Dreams often contain heightened negative emotions."

Frame 10: Dream Theories

Scene: Two paths diverging - Cognitive Theory and Activation-Synthesis Theory.

Text: "Exploring dreams through theories: Cognitive vs. Activation-Synthesis."

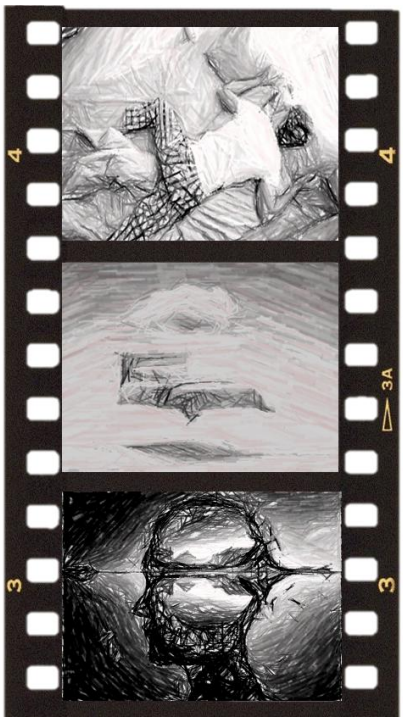
The instructor suggested the last frame about theories of dreaming could be incorporated across the whole narrative by focusing on the high-levels of brain activity that emerge during sleep. Recounting feedback incorporation, the student shared:

"I started refining my prompts to include not just visual descriptions but also the underlying concepts and emotions I wanted to capture in each frame. For example, I described the brain's activity during sleep in terms of vivid, dreamlike imagery."

Frames depicting Freud's likeness were replaced with abstract imagery representing the subconscious, manifest and latent content. Additionally, the last frame depicting an abstract fork between two theories (Cognitive Theory, Activation Synthesis) was removed. The student thus incorporated specific interactions between objects in frames strategically, making sure they tied back to the abstract content of dreams, and cultural references tied to them.

Figure 4

Storyboard 2.



Frame 1: Introduction

Scene: Peaceful bedroom with a sleeping individual.

Text: "Meet Luca, exploring the mysterious realm of dreams."

Frame 2: Dream Sequence

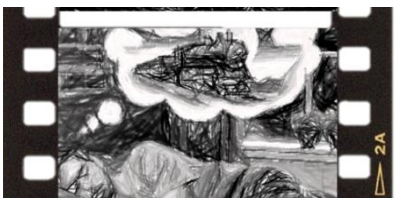
Scene: Dream transition with surreal visuals.

Text: "Diving into Freud's Psychodynamic Approach."

Frame 3: Freud's Beliefs

Scene: Visual depicting someone's inner world.

Text: "Dreams symbolize hidden desires; manifest vs. latent content."



Frame 4: Manifest Content Example

Scene: Dreamer on a train, talking to a friend.

Text: "Manifest content: surface - the train ride and conversation."

Frame 5: Latent Content Exploration

Scene: Dreamer analyzing dream symbols (train, friend).

Text: "Uncovering true meaning through associations."

Frame 6: Modern Perspective

Scene: Transition to a sleep lab with researchers studying dreams.

Text: "Modern psychologists view dreams as mental events."

Frame 7: Dreams vs. Reality

Scene: Dreamer comparing dreams to everyday life.

Text: "Research shows dreams are often similar to waking experiences."

Frame 8: Peculiar Perception

Scene: Dreamer surrounded by bizarre dream visuals.

Text: "Perceiving dreams as strange due to vivid memories."

Frame 9: Emotional Aspects

Scene: Dreamer experiencing intense emotions in a dream.

Text: "Dreams often contain heightened negative emotions."

Storyboard 3

Aiming to create an informative storyboard showcasing the states of consciousness (Chapter 5) through "a day in the life of" visual, the student who created Storyboard 3, a Caucasian male, focused on the set and setting of images, and actions of a main character (mise-en-scène) to prompt AI, showcasing an average day from wake to sleep for his character. The student used OpenArt to create frames. In describing the process he said:

"This was a process that took me a while to conquer. I used the website OpenArt. I didn't realize I needed to describe exactly what I wanted as much as I ended up doing for my final product. For example, I had to mention the tone and the mood in which I had to describe as a warm tone and what part of the day."

The consistency of characters in the frames (the mise-en-scène) became key issues in storyboard creation for this student. When asked about the steps followed in creating a first draft, and whether there were challenges associated with the process, he said:

"*I had to change the way I was describing the image a lot of times because they didn't come out the way I wanted."*

The student created a storyboard with consistent images by prompting to include a famous person (the rapper Travis Scott) as the main character, and thus had to adapt the activities showcased in the storyboard to match Scott's life as a musician:

"I would also recommend using a character as your main storyline so it is consistent and doesn't change your character all the time so I used Travis Scott to keep consistency and mood of the character. "

Artistic references to Scott's image in the media play an important role in how the draft was created (cultural object). This first draft is provided below, in Figure 5, and features a brief textual description for each frame.

Figure 5

Draft of Storyboard 3.

Summary:

Image 1(Sleeping): *Low levels of consciousness to the outside world and internal mental activity is high.*

Image 2 (Woke up from a long night's rest): *Subconscious awareness.*

Image 3 (Getting Ready in the Morning): *Lower Level Consciousness.*
Image 4 (Brushing teeth in the Morning): *Lower Level Consciousness.*
Image 5 (Getting in his car to meet up with friends): *Lower Level Consciousness*
Image 6 (Driving his car to meet up with friends): *Lower Level Consciousness, can over time become subconscious because of such routine.*
Image 7 (Meeting up with friends): *Lower Level Consciousness.*
Image 8 (Sipping lean): *Altered States of Consciousness owing to effects of drugs, depressants such as lean or pills slows down the brain activity and produces relaxation and drowsiness which is how people can find them addicting to try and escape reality in a sense.*
Image 9: *With this slowing down the brain activity it makes it harder to function on higher conscious level activities.*

The instructor asked the student to add frames of Scott performing to indicate the highest levels of awareness during an average day on tour; he also asked the student to lay images chronologically and describe them in sequence using a separate textual summary of 100-150 words. The student incorporated feedback as follows:

"I incorporated this by changing the last few photos of my storyboard and changed my description as well to make sure each section was accurate by description. The last few photos to wrap up Travis Scott's day, passing out and then waking up to do a concert incorporated the last stages of consciousness I didn't yet cover and rounded out my story well."

The final draft is shown in Figure 6 with a summary below it.

Figure 6

Storyboard 3.

***Summary**: I generated Travis Scott and how he experiences all the levels of consciousness in each day. Throughout the day he has parts he has to focus on like a concert, or recording music and times when he isn't in need to focus so he hangs out with his friends and takes drugs to feel relaxed. This shows how each part of the day and decisions he's made affects his thinking and affects the brain either positively or negatively.*

A disclaimer for this storyboard is that it only uses certain scenes related to drug use to discuss the states of consciousness, rather than accurately portray Scott's lifestyle as a celebrity and performer.

Storyboard 4

The fourth storyboard focuses on Piaget's stage theory (Chapter 9). The student, a Caucasian female, used Copilot to generate both her initial and final drafts. She outlined storyboard frames in sequential stages, like Piaget's theory of child development, to showcase progression in abstract thinking as children get older from the sensorimotor stage all the way to the formal operational stage. In describing how she initially prompted GenAI she shared:

"I gave AI prompts I thought were very clear as to what I was looking for, but I quickly learned that my dialect and AI dialect were very different. For example, I would tell AI to "generate an image of a baby pointed to an ocean." AI would not produce what I was looking for and I would have to alter what I had done."

When asked about how she altered initial prompts to come up with a first draft (shared below), she highlighted the inconsistency of the effect that specifying the quality of the image (e.g., animated, realistic), or its dispositif had on output:

"To modify prompts I would add words such as "realistic, not _____, etc." or other key words that were very descriptive as to exactly what I was looking for. Sometimes this method would work..."

The first draft is shared in Figure 7.

Figure 7

Draft of Storyboard 4.

Summary:

Image 1*: This image is just as it looks, a baby bottle filled with water (yes, I know babies cannot actually drink water). This image plays into image 2 because when we are young, we do not know why we are given things, or told to drink water, we just do it without knowing anything about it.*

Image 2*: The baby is seen here holding the bottle of water. The baby is handed water and is just practicing learned skills of putting the bottle into their mouth, and drinking, unaware of why or what this really is. This child exists in the sensorimotor stage as the water is just a mental representation of "drink this."*

Image 3/4/5: *These images are all related. In the preoperational stage, the child has well developed mental representation and language. Image 3 shows a child pointing to a glass of water, which they are most familiar with because they have been drinking and seeing water in this capacity their entire life. Images 4 and 5 are of water, but in a different capacity, an ocean and a pond, respectively. As the child has well-developed mental representation, the term "water" can be applied to a much broader concept, which has been done here.*

Image 6: *This image begins the concrete operational stage of a child's life, where conservation is understood, but abstract thought is not. Since this child understands conservation, they are aware that glass 1 and 2 have equal amounts of water, but they are unaware as to why and how these containers look so different yet hold the same amount of water. What the child is aware of in comparison to a preoperational child is that since the water was just poured from one cup to another, the amounts are equal despite size changes.*

Image 7: *This half-full cup is the beginning of abstract thought. This cup sets the stage for the debate of if the cup is half-full or half-empty.*

Image 8: *Here the man is depicted holding the previous cup of water that is only half-filled. The man is asking "half-full or half-empty?" This is because this is a very abstract question that requires significant reasoning, which is characteristic of the formal operational stage. This question commonly does not have any one answer, which plays into abstract thought and reasoning further.*

The instructor asked the student to showcase how social experience and the knowledge of seasoned others (i.e., parents) led to a deeper understanding of the form and function of water. Frames 6 and 7 were initially more abstract, and the instructor asked to create frames with an adult asking which of two glasses with different shapes, but the same amount of water were "more full" to showcase conservation. These changes required careful attention to mise-en-scène and a clear understanding of ways to depict everyday tools like a water glass (cultural object). She was also asked to describe rough age ranges for each developmental stage depicted in her summary. The student described the feedback incorporation as follows:

"To incorporate feedback from my instructor, I changed the first image to feature a mother drinking water while also holding a baby who is drinking water. I also changed the second to last frame to feature an adult asking a child which glass has more water to show the challenges of conservation and abstract thought."

The final draft and summary are shared below (see Figure 8, italicized text under it).

Figure 8

Storyboard 4.

***Summary*:** *These images show Jean Piaget's theory on the stages of cognitive development in regard to a glass of water as a child moves through life. The first images depict the sensorimotor stage (birth - 2 years old) and preoperational stage. The child learns sensorimotor skills from their mother by viewing her drinking water and also being told to drink this liquid out of their bottle, without fully understanding why. The preoperational stages are depicted by the child beginning to understand that there are various forms of water, i.e. the kind you drink, oceans, ponds, lakes, etc. Then the images transition into the concrete operational stage (age 7 - 11). In this stage the child understands conservation and sees that both glasses contain the same amount of water when they are asked by the adult. Finally, there is an adult who exists in the formal operational stage (age 12 and beyond) who begins to ask very abstract questions that are not answered with just one right answer.*

Storyboard 5

Storyboard 5 focused on memory (Chapter 8), and applied principles of information processing to the process of songwriting. The student, a Caucasian Male, and British exchange student, used Copilot. The student went in with a rough idea of his story, but prompted AI directly to receive image output matching the story. The initial outline relied on Atkinson and Shiffrin's tripartite model of sensory, short-term and long-term memory; and encoding, storage, and retrieval processes guiding this architecture (King, 2022). When asked to describe his prompting technique, he spoke about using input describing the mise-en-scène in the frame:

"To prompt AI, I would ask it to generate something like "a man looking confused on a couch", or "a man with a notebook". Quite often it would give me results I didn't want to use, so I would keep trying. I would say "generate an image of a real person looking confused on a couch" for example. This would give me more realistic and better animated images that I could use for the storyboard. "

The student created nine frames about an individual forgetting songwriting ideas, and remembering them through consolidation and association with an intense event (a storm). This first draft is provided in Figure 9.

Figure 9

Draft of Storyboard 5.

***Summary*:** *My storyboard is about Alex who is starting to write a song. He begins to think of his main chorus and lyrics to write about, but he gets distracted, forgets the lyrics, but begins to remember them again.*

1) *Alex starts to plan his song he is creating, he gets ideas from talking to his friends and reading books, but he forgets them and he is struggling to think of lyrics to write down, and he starts to overthink and confuse himself. Alex's short-term memory is working here as he thinks of an idea but only for a short amount of time (30-60 seconds). Baddeley and Hitch in 1974 created a Working Memory Model, which includes the central executive (controlling attention and coordinates), the phonological loop (handling auditory information), and the visuospatial sketchpad (processing visual and spatial information). STM just refers to retention of information in a system after information has been categorized and reached consciousness. It has the capacity to store a small amount of information in the mind and keep it readily available for a short period of time.*
2) *Alex becomes excited as he starts to form thoughts as to what the lyrics of the song could be.*
3) *With this information, he begins to write down ideas in the notebook. With the ideas and thoughts he has stored in the STM, he quickly begins to write them down. But he only gets so far as he becomes distracted.*

4) *Unexpectedly, severe thunderstorms and bad weather causes Alex to get distracted, dropping his notebook and he runs around the house, making sure all windows are closed.*
5) *As the weather clears up, he returns to his notebook, but he suddenly forgets all the ideas he had come up with before. He looks confused again, staring at his notebook, in disbelief as he has forgotten all the lyrics he had thought of before. Alex experiences divided attention. This is when there is another form of interference in attention, in this case the weather. This presents a problem for both encoding and retrieval processes, therefore Alex struggles to retrieve the past thoughts he had.*
6) *Alex moves on from the notebook, going about his normal day but occasionally stopping to ponder about the ideas, but he is unable to recall them. Divided attention also occurs here as he is trying to retrieve information that was properly stored, so he stops what he is doing and focuses on this task, which is trying to retrieve the information he needs.*
7) *In the depths of Alex's mind, the long-term memory is depicted as a vast library, where shelves of memories are stored. Due to certain shelves missing in the LTM, Alex is still unable to recall the ideas. Long-term memory is the transfer of information from STM to long-term storage in order to create memories. This type of memory is unlimited in capacity, and it lasts for years or even a lifetime.*
8) *After multiple days of frustration, Alex sits down and relaxes, still angered about the loss of ideas. All of a sudden, the ideas begin to resurface.*
9) *A sense of relief and happiness is seen on Alex's face and he rushes to grab his notebook, whereby he is ready to write down the ideas he has finally captured. Alex's explicit memory is working as he remembered information that he had to consciously work to remember. The short-term memory became a long-term memory through consolidation.*

The student initially presented the storyboard as a document where each frame had an extensive description. The instructor commented it was word heavy. The metaphor of short-term memory as a library was regarded as apt, but the transition from this image to those depicting consolidation were not comprehensive, per feedback. The student was asked to highlight the association between the occurrence of a storm, and the lightbulb ideas the songwriter led to consolidation. Lastly, the character had three arms in the second frame. The student incorporated the feedback as follows:

"I just added more information that clearly outlined the frame I was talking about. I also ended up changing a couple images as there were some mistakes I didn't realize."

The final storyboard is shown in Figure 10; the summary was retained despite feedback.

Figure 10

Storyboard 5.

The student shared some challenges with using GenAI, as described below:

"The advantage of AI is that it is very creative. It gives you very realistic and detailed images that can be helpful. On the other hand, the AI doesn't usually give you the image you have asked it to do. You have to be very detailed in the prompt otherwise it can go on a tangent."

Storyboard 6

Storyboard 6 showcased human development during old age (Chapter 9) through the lens of Erikson's theory. The student, a Caucasian male, wanted to tell the story through the eyes of a man diagnosed with Alzheimer's. The student started with a brainstorming process, which he described as:

"I created a table on Google docs with the labels "Frame 1," and so on. In this table, I added a description of what I vaguely wanted the frames to look like, as well as the dialogue I planned to incorporate. This is what some of the initial planning page looked like."

Figure 11 shows a picture of the brainstorming template the student used. The prompt text mainly focuses on the mise-en-scène of images part of the storyboard narrative.

Figure 11

Brainstorming template.

Frame 1: Old man sitting in his house with his cat, comfy cozy "Getting older isn't always scary. Some nights are warm and soft, and my darling, Fifi enjoys the silence with me."	Frame 2: • Old man talking to his grandkids • "Other days I just can't stay quiet.. I've seen so much of the world, and I've done so many incredible, and terrible things. I only want to share that knowledge with the people I hold close, in hopes they learn from my stories"
Frame 3: • Old man with cat knock mug shattered on floor • "But, I do notice the changes that come with living so long. I no longer can keep up with Fifi's mischief, even if she has aged with me."	Frame 4: • Young man who caught the mug • "When I was still spry, I could play with her or the grandkids for hours. If I was there to witness my kitten's delinquency, I could always catch her or her victims in time."

The student began putting the proposed prompts for each frame into Copilot. He also asked for the text to be copied on the image frames, but faced issues with legibility, saying that the dispositif of text in generated images was poor:

" I realized that AI generators are awful at producing text. After the first few attempts to produce the text I wanted, I came to the conclusion that AI can only create illegible gibberish on my images."

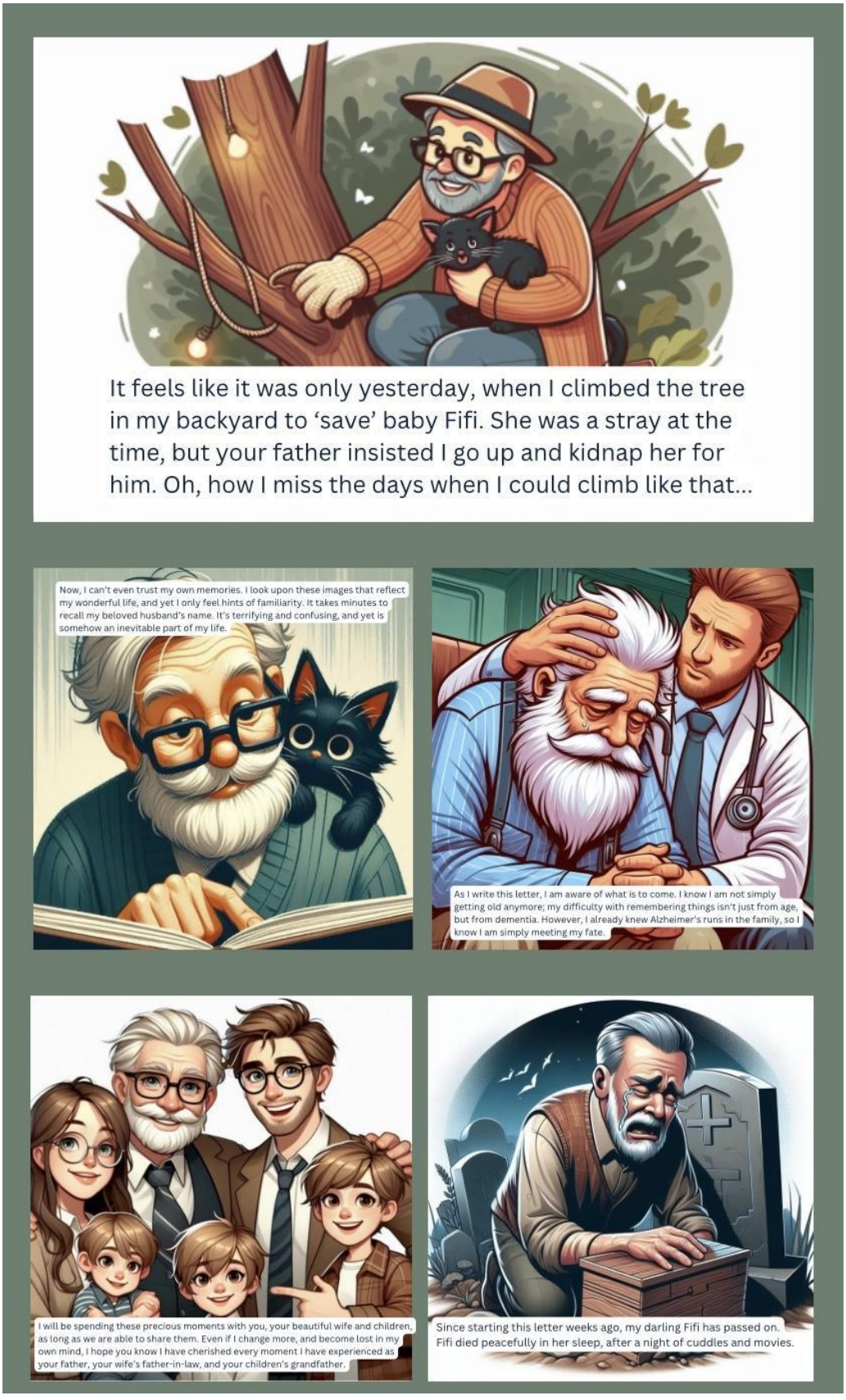
The student added the text in himself, rather than relying on the ways in which the tool conceived of words and symbols (cultural object). He chose to provide short, specific prompts after some issues with longer ones, and specified the digital processing style (dispositif) as animated, calling upon previous training data containing cultural symbols related to cartoons, saying:

"*I adjusted my prompts to be more specific and short. An example of this is, "Create a cartoon drawing of a family picture of an older black man holding a black cat, his white husband, and a middle aged white man." This is what most of my starting prompts for my frames looked like. I'd then request for more specific features for the characters, colors for the background and animals, then the overall style."*

The first draft is provided in Figure 12.

Figure 12

Draft of Storyboard 6.



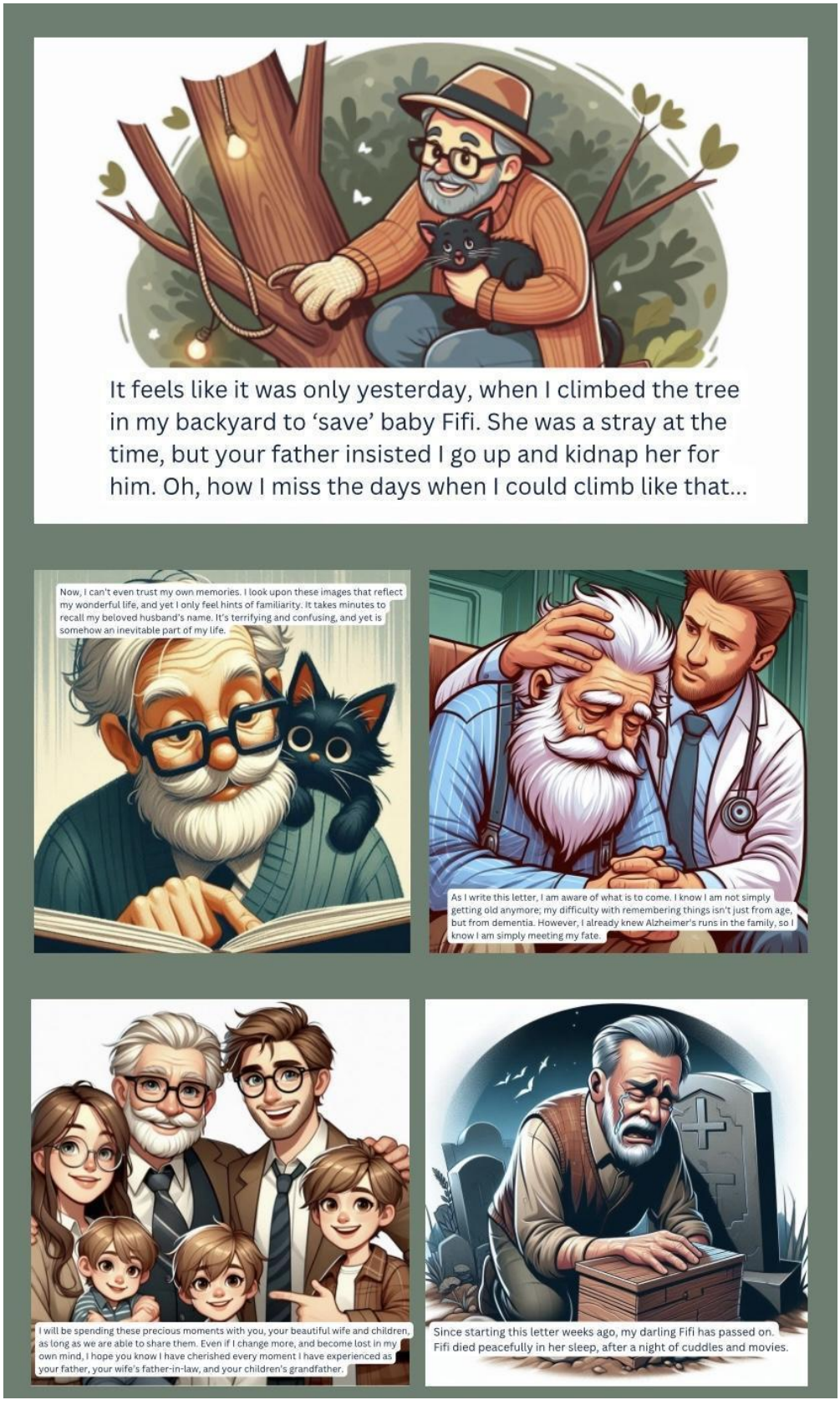
The instructor appreciated the descriptions and consistency of images in Storyboard 6. However, one piece of feedback was given about incorporating themes related to integrity and despair, the final stage in Erikson's theory, more explicitly. While the character in the story reminisces about past victories, little was done to depict regret. The student decided to add an extra frame, specifying the mise-en-scène, saying:

"I prompted a new frame of the old man sitting alone in his room, lamenting about the love he once had. I wanted the man to talk about his regrets regarding his husband, and how he wishes he could go back in time to re-experience the only love he ever had."

The final draft is provided in Figure 13.

Figure 13

Storyboard 6.




Although she lived with your father and I since she was a kitten around 15 years ago, Fifi did always prefer your father. She and I found solace in each other's company after your Pops passed away.
Some part of me yearns for a do-over. I wish I could go back and hold my husband's hand again. I just want to kiss him, and remember what it felt like to be loved, in the way only he ever truly did. Even if my regrets fill my final days with grief, I know you will be there to care for me.
I hope you can find solace in knowing I too, will pass in comfort and happiness, even if I don't remember the life that brought me such feelings. The life that brought me you. I love you, son.
<3 Dad

The student had detailed insights about limitations of cutting-edge GenAI tools:

"Every time I'd ask the generator to add a detail, such as square frame glasses, something else would become amiss, or an older detail would be erased. Sometimes, limbs would become attached in odd places and wouldn't make sense; for example, I created a frame of the old man sitting down, but it generated him with three feet, and his hands were somewhat fused together."

Alluding to GenAI's capacity to reflect diversity, he said:

" I had a specific story that needed a diverse cast of characters, but I found it impossible to create a picture with all the characters as the races I planned them to be. The family picture I was editing would change their skin color to white (or neon orange?) or make the entire cast black."

Challenges accounted for, the student remarked that GenAI to allowed creating visual artifacts despite having little artistic expertise:

" …I am not much of an artist. Having the power to create a comic strip with the style I wanted, without having to go take art classes, was amazing. It was difficult and took time to adapt my prompts, but original art isn't necessarily easy or fast either. Overall, I think that with Microsoft Copilot, multimodal storytelling is made easy and accessible, especially for individuals who don't have the capabilities, skills, or interest in/for traditional art. "

The idea of increasing confidence in one's own creativity despite a lack of artistic expertise highlight the positive outcomes associated with using text-to-image AI.

Storyboard 7

The student who created Storyboard 7, a Caucasian male, initially faced difficulties in keeping images and characters consistent. The student used Copilot after trying OpenArt, and generated a first draft (Figure 14) describing seasonal depression (Chapter 5) wherein each frame was accompanied by prompt input. An example of a prompt is given below, for Frame 1:

"Generate a picture of a person enjoying a nice summer day walking his dogs with a cold drink in his hand."

When asked to describe the process he used, the student said that ensuring the existence of a consistent character across frames, and maintaining a cohesive mise-en-scène across frames was challenging at first when using OpenArt for his first draft, but later navigable using Copilot:

"I found that Copilot by Microsoft was the most convenient for me because the other AI's were troubling and confusing. I tried to be very descriptive with my prompts because sometimes the AI would go off by itself and start making up things that weren't said in the prompt. I kept using the phrase "same person" to make sure the AI would keep using the same character in all the different pictures."

Figure 14

Draft of Storyboard 7.

The student initially tried to prompt OpenArt using short, precise words. However, he realized:

"The AI had a hard time sticking with the same person. Most of the time the person that would come from the AI would look nothing like the person from the previous picture even though I said, "same person."

Despite being careful to prompt OpenArt to generate the same character, discrepancies were seen. The instructor asked the student to keep the character across frames consistent, but also showcase set and scene more vividly to highlight the correlates of seasonal affective conditions. The student described the process of creating the final product (Figure 15) as follows:

"In the end I didn't need to use a famous person because I found an AI generator that was able to stick with a similar man through all the pictures [Copilot]. I was also able to switch up my story a little bit to show the different moods and emotions that come with different weather patterns such as being in a good mood in the hot and a poor mood in the cold."

The final storyboard is provided in Figure 15.

Figure 15

Storyboard 7.

When asked about challenges and advantages of using GenAI, the student responded:

"I think some of the challenges of using AI for multimodal communication is the lack of human interaction and emotion in the AI's communication. There could also be errors in the information. For example, this is read at the bottom of Chat GPT's website, "ChatGPT can make mistakes. Consider checking important information". Some of the advantages could be the speed of the communication and a lot less work that humans have to do."

The takeaway was that AI could be an expedient collaborator, but one that could create falsehoods that need to be assessed by human agents.

Storyboard 8

Storyboard 8 was created by a mixed race female student of Filipino, Irish, and Latin American descent. The visual and text output created showcased the story of a student studying for a mathematics test (Chapter 6). Copilot was used, and the student described her process to prompt the tool and maintain cohesive frames, characters, and subject-background interactions (mise-en-scène):

"The story I was going for was about a young girl studying for the upcoming math test. I wanted AI to prompt a young student around the preteen stage to pay attention in class. With using Copilot, I tried to be as detailed as possible to keep up with the storyline. Unfortunately, if I was too detailed AI didn't formally generate the vision I had for the story. Later on, I learned to not be as detailed as I wanted to be. I just added the general information that I needed and AI-generated the story that I had visualized in my head."

Upon creating concise prompts, the student was able to generate eight frames showcasing the learning journey of the child (Figure 16).

Figure 16

Draft of Storyboard 8.

The instructor felt there needed to be frames wherein the student worked with others to enhance her knowhow. A spelling error was also seen in Frame 3 of the draft, with test spelt the wrong way on the graphic organizer. The student was also requested to add a textual summary to her frames.

The student added frames to incorporate the social aspects of learning, and also corrected Frame 3 by creating a graphic planner without textual components, prompting the AI to rely on previous data related to the form/function of a schedule/planner (cultural object).

Figure 17

Storyboard 8.

Summary: *A middle school student is in math class taking notes. The teacher had announced that the class would take a test soon, so the students went home to study. When the child got home, she studied on her own by practicing math questions. Throughout the week, the girl and her classmates studied together by writing down equations and looking over notes. By keeping focusing and writing down notes the girl remembers all the material for the test. From studying, note-taking, and listening to the teacher, the student gave their sustained attention in math class. Sustained attention is a type of attention that causes one to remember information for some time. The long process of using cognitive skills and writing down everything the teacher had taught helps her remember the information.*

The refined storyboard is provided above, in Figure 17.

Storyboard 9

The student who generated Storyboard 9, a mixed race female of Indian and African American descent, focused on Erikson's stage theory of development (Chapter 9), specifically the trust vs. mistrust stage. Wanting to depict a scenario wherein a child took a fall down the stairs, and faced nurturing/neglectful interactions with a caregiver, she experimented with two tools (Deep AI, and Canva Magic Media), concluding that Canva met her needs:

"I originally tried to use Deep AI but I encountered an issue with their guidelines while formatting my prompts, I then used Canva Magic Media which worked more efficiently. I initially tried to be straightforward in my prompts, which worked in my favor."

However, the first draft the student created (Figure 18) did not depict consistent characters across frames. A summary was needed to explain frames.

Figure 18

Draft of Storyboard 9.

The student, upon receiving feedback, chose to depict Teyana Taylor, and her daughter Junie as characters in her story to keep frames consistent. Short, specific prompts were key to achieving the desired mise-en-scène; but multiple options generated by Canva gave the student flexibility:

"My favorite advantage of using Canva's AI generator was that they gave me various pictures and I could choose one to have more generated similar to what I chose. I feel like an advantage of using AI is having it understand what you are thinking without simplifying your idea or visualization."

The second piece of feedback involved more explicitly delineating the trust and mistrust scenarios using labels. This was done using textboxes.

Figure 19

Storyboard 9.

The final draft of Storyboard 9 is provided in Figure 19, and only uses scenarios depicting Taylor to discuss Erikson's theory rather than depict her lifestyle or character as a mother.

7. Discussion

Our method and results structure out human-computer interaction using process diagrams, and explain mechanisms at play using narrative inquiry (Connelly & Clandinin, 1990), respectively. This study's purpose is to use fuzzy methods that conversation theory permits (Westermann, 2018) to decode how to effectively design collaborative storyboarding activities/assignments involving students and instructor using text-to-image GenAI.

We ask three research questions. RQ1 asks**:** *What processes do college students and their instructor follow while prompting GenAI to create storyboard assignments?* The process of drafting final assignments in working groups of the instructor, GenAI, and each student matches the P-individuation process outlined in the theoretical framework, wherein the P-individual representing the student's knowledge about a topic (P1) and the conceptual repertoire of the GenAI (dependent on training data) (P2) interact to produce initial output (P4). This initial output is operated upon by the instructor, who provides the student with feedback (P3), prompting re-prompting GenAI to create a final product (P5). The whole

conversation is also a P-individual in itself. Our narrative showcases the conversational feedback loops involved in GenAI assisted storyboarding, informing college professors and researchers about parameters that can inform effective design for such activities.

RQ2 asks: *What role do photographic elements play in image prompt generation?* Results showcase how mise-en-scène, dispositif, and cultural object (Dehouche & Dehouche, 2023) are interacting factors guiding image-generation. The interaction between components that are a part of the frame (mise-en-scène) was an ubiquitously important factor. The ways in which images are processed (dispositif) were key for those creating animated storyboards (Storyboard 6), or even more realistic ones (Storyboard 4). In creating images involving special attention to form and function (as in Storyboard 4, in the example related to conservation of matter using the two glasses example), and references to popular culture (Storyboard 3) prompting GenAI specifically about creating images relied on conceptions of what such tools and cultural figures are in terms of design and reputation, respectively (cultural object). How individuals and objects with cultural meaning were to be placed and configured within a frame or set of frames (mise-en-scène) was also focal to creating such storyboards.

RQ3 focuses on hurdles faced in GenAI-mediated storyboard generation, asking: *What limitations do students and instructors encounter, while collaboratively interacting with text-to-image GenAI to create storyboards?* Insights from students (as with the student who created Storyboard 7) reveal that one of the limits of AI is the potential it has to stray away from representing cultural diversity accurately (Storyboard 6). Secondly, difficulties were seen with inserting text into frames (Storyboard 6), prompting students to add text themselves to ensure accuracy. Consistency in visual style and character depiction in the storyboards also emerged as a common limitation (Storyboard 3, 7, and 9), leading some students to use famous personalities to showcase concepts.

8. Limitations

The first limitation of this study is its self-reflective findings; directly opposing the traditional scientific method separating observer observed, but embracing second-order cybernetics by blurring these boundaries (Silverman, 2023). Results are not generalizable, they use a context-specific example to showcase how GenAI-mediated activities may be navigated in college classroom environments. The second is the selective sharing of nine of 22 storyboards, and the choice to focus on only AI-generated output rather than compare AI and non-AI assignments. The choice of presentation stems from lack of sufficient non-AI influenced storyboards (two in number), and time constraints with incorporating feedback into all 22 assignments, some of which were completed as this project was edited by the whole class. A rich narrative inquiry (Connelly & Clandinin, 1990) makes up for the brevity

of our presentation, and lays focus on student experiences. The storyboards depicting famous characters to keep a consistent story are reflective of ethical implications of using GenAI; we maintain transparency by specifying these narratives showcase concepts relevant to the introductory psychology course that this study was drawn from, rather than celebrities' lives.

9. Conclusion

While GenAI is designed to create output based on data it is trained upon; the human mind is a sophisticated tool that can prompt GenAI, and iteratively refine output to avoid falsehoods. Distributed human-machine interactions can enrich perspectives used as input for GenAI. Conversation theory can used to understand mechanisms at play in a network of human minds and computing devices and self-reflect upon them, helping better understand the parameters guiding effective collective actions in such a system.

References

Balzotti, J. (2016). Storyboarding for invention: Layering modes for more effective transfer in a multimodal composition classroom. *Journal of Basic Writing*, 63-84. https://doi.org/10.37514/JBW-J.2016.35.1.04

Bickmore, L., & Christiansen, R. (2010). " Who Will Be the Inventors? Why Not Us?" Multimodal Compositions in the Two-Year College Classroom. *Teaching English in the Two Year College*, *37*(3), 230. https://doi.org/10.58680/tetyc201010229

Connelly, F. M., & Clandinin, D. J. (1990). Stories of experience and narrative inquiry. *Educational researcher*, *19*(5), 2-14. https://doi.org/10.2307/1176100

Dehouche, N. (2021). Implicit stereotypes in pre-trained classifiers. *IEEE Access*, *9*, 167936-167947. . https://doi.org/10.1109/ACCESS.2021.3136898

Dehouche, N., & Dehouche, K. (2023). What's in a text-to-image prompt? The potential of stable diffusion in visual arts education. *Heliyon*, *9*(6). https://doi.org/10.1016/j.heliyon.2023.e16757

De Zeeuw, G. (2001). Interaction of actors theory. *Kybernetes*, *30*(7/8), 971-983. https://doi.org/10.1108/03684920110396864

Franceschelli, G., & Musolesi, M. (2022). Copyright in generative deep learning. *Data & Policy*, *4*, e17. https://doi.org/10.1017/dap.2022.10

Hale, M. (2018). Thwarting plagiarism in the humanities classroom: Storyboards, scaffolding, and a death fair. *Journal of the Scholarship of Teaching and Learning*, *18*(4). https://doi.org/10.14434/josotl.v18i4.23174

Liu, J. (2012). Effects of comic strips on L2 learners' reading comprehension. *TESOL*

quarterly, *38*(2), 225-243. https://doi.org/10.2307/3588379

Mishra, P., & Oster, N. (2023, November). Developing a Teaching Compass in the Age of AI A Concept Paper Focusing on Teacher Competencies. *OECD Future of Education and Skills 2030* Global Forum on *Implications of the Use of Generative AI for Teaching and Learning: Towards the OECD Teaching Compass. Retrieved from: https://punyamishra.com/wp-content/uploads/2023/12/Developing-a-Teaching-Compass-in-the-Age-of-AI.pdf*

Narkiewicz, N., & Skukauskaitė, A. (2022). Using Sequential Art of a Comic Strip to Explore the Teaching and Learning Qualitative Research. In J.C. Richards, A. Skukauskaitė, & R. Chenail (Eds.), *Engaging Students in Socially Constructed Qualitative Research Pedagogies* (pp. 143-162). Brill. https://brill.com/display/title/62932#page=171

Pask, G. (1975). *Conversation, cognition and learning: A cybernetic theory and methodology*. Elsevier.

PBS (Public Broadcasting Service) (2024, April). AI is Transforming How We Create & Engage with Art (feat. Grimes). *A Brief History of the Future*. Retrieved from: https://www.youtube.com/watch?v=iioSUwLubhw

Scott, B. (2001). Conversation theory: A constructivist, dialogical approach to educational technology. *Cybernetics & Human Knowing*, *8*(4), 25-46. https://www.ingentaconnect.com/content/imp/chk/2001/00000008/00000004/103

Sharples, M. (2023). Towards social generative AI for education: theory, practices and ethics. *Learning: Research and Practice*, *9*(2), 159-167. https://doi.org/10.1080/23735082.2023.2261131

Silverman, H. (2023). Recursively Contextual Identity: A Variant Formulation of First-and Second-Order. *Enacting Cybernetics*, *1*(1), 3. https://doi.org/10.58695/ec.1

Tilak, S., & Glassman, M. (2022). Gordon Pask's second-order cybernetics and Lev Vygotsky's cultural historical theory: Understanding the role of the Internet in developing human thinking. *Theory & Psychology*, *32*(6), 888-914. https://doi.org/10.1177/09593543221123281

Tilak, S., Manning, T., Glassman, M., Pangaro, P., & Scott, B. (2024). Gordon Pask's Conversation Theory and Interaction of Actors Theory: Research to Practice. *Enacting Cybernetics*, *2*(1). https://doi.org/10.58695/ec.11

Vartiainen, H., & Tedre, M. (2023). Using artificial intelligence in craft education: crafting with text-to-image generative models. *Digital Creativity*, *34*(1), 1-21. https://doi.org/10.1080/14626268.2023.2174557

Westermann, C. (2018). On delight: Thoughts for tomorrow. *Technoetic Arts: A Journal of Speculative Research*, *16*(1), 43-51. https://doi.org/10.1386/tear.16.1.43_1

Zhang, C., Wang, W., Pangaro, P., Martelaro, N., & Byrne, D. (2023, June). Generative Image AI Using Design Sketches as input: Opportunities and Challenges. In

Proceedings of the 15th Conference on Creativity and Cognition (pp. 254-261). https://doi.org/10.1145/3591196.3596820

Zylinska, J. (2020). *AI art: machine visions and warped dreams*. Open Humanities Press.