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SHORT COMMUNICATION

Looking Closely at the Human Experience: Visual Art–Based Exercises in Preclinical Neuroscience Education

Tamara B. Kaplan[1,2] · **Michael Stanley**[3,4] · **Christine M. Bentley**[5,6] · **Joel T. Katz**[2,5,7]

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Abstract

Background Preclinical neuroscience often feels abstract, contributes to neurophobia, and may obscure the patient experience. Visual arts-based learning may strengthen observation and interpretation.

Activity We integrated gamified, visual arts-based exercises into readiness assessment questions in a required six-week preclinical neuroscience course for 172 s-year medical students.

Results & Discussion All students completed the exercises. Of 123 survey respondents, 43% agreed the activities promoted novel thinking and engagement. Narrative comments highlighted emotional impact, interdisciplinary appreciation, enjoyment, and opportunities for refinement. This feasible approach may support more observational, interpretive, and human-centered neuroscience learning.

Keywords Arts-based learning · Visual literacy · Neuroscience education · Medical humanities · Gamification

Background

Preclinical neuroscience education remains challenging. Although understanding brain structure and function is foundational to clinical reasoning, students often experience the material as abstract, detail-heavy, and disconnected from the lived experience of neurologic disease. Traditional approaches, including slide-based teaching, neuroanatomical atlases, and multiple-choice questions, emphasize memorization and systems mapping but less often cultivate the observational and interpretive skills needed for neurologic diagnosis or highlight the human experience of neurologic disease. This gap contributes to neurophobia, in which students perceive neurology as especially difficult and inaccessible [1].

This challenge is compounded by the constraints of self-directed learning models increasingly used in preclinical curricula. In flipped-classroom models, students are expected to engage with complex anatomical structures and physiologic concepts before they have developed strong frameworks for integration and application. At HMS, students complete prework followed by readiness assessment questions (RAQs), which reinforce accountability but primarily emphasize correctness and recall. These tools provide limited opportunity to integrate humanistic, cultural, and clinical context. The Association of American Medical Colleges has identified arts and humanities integration as a priority in medical education through its Fundamental Role of the Arts and Humanities in Medical Education initiative [2]. In neurology, close observation, pattern recognition, spatial reasoning, and visual interpretation are central to lesion localization and neuroimaging, yet these skills are rarely practiced explicitly in the preclinical classroom. Because neurology relies heavily on these skills, visual arts-based pedagogy may specifically strengthen the cognitive processes underlying neurologic reasoning, rather than

✉ Tamara B. Kaplan
tbkaplan@bwh.harvard.edu

1 Department of Neurology, Mass General Brigham Inc, Boston, MA 02115, USA

2 Harvard Medical School, Boston, MA 02115, USA

3 Department of Neurology, Tufts Medical Center, Boston, MA 02114, USA

4 Tufts University School of Medicine, Boston, MA 02114, USA

5 Program for the Visual Arts in Healthcare, Boston, MA 02115, USA

6 Missouri Southern State University, Joplin, MO 64801, USA

7 Dana-Farber Cancer Institute, Boston, MA 02115, USA

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serving only as an engaging supplement. Prior work suggests that visual arts-based training can strengthen visual literacy and diagnostic observation,[3 4] but such approaches have rarely been embedded in required biomedical curricula [3]. We designed a gamified, visual arts-based innovation to address this gap by incorporating close observation, pattern recognition, and interpretation into preclinical neuroscience learning.

Activity

Setting and Participants

This innovation was implemented during the 2025–2026 academic year in the required six-week Mind, Brain, and Behavior (MBB) course at Harvard Medical School, taken by 172 s-year students. MBB covers basic neuroscience, neuroanatomy, and foundational neurologic and psychiatric diseases.

Game Development and Collaboration

The project was developed by a multidisciplinary team with expertise in neurology, art history, humanities, and game design. Exercises were designed to balance scientific accuracy, visual engagement, and historical context, using artworks selected to reinforce neuroanatomical concepts and diagnostic reasoning through interpretive challenge. Each exercise was designed to connect a specific neuroscience concept to a visual interpretive task that encouraged close observation, comparison, or pattern recognition. Team members from neurology, art history, and game design jointly reviewed exercises, revising them until each incorporated a scientific, historical, and interactive element.

Educational Framework

The innovation was informed by three complementary educational approaches: gamification, visual literacy, and experiential learning [4–6]. Gamified elements such as progressive challenge and immediate feedback were used to support attention and active engagement [7]. The visual arts framework emphasized close observation and interpretation of visual information, with explicit links to neuroanatomical and clinical concepts [4, 8, 9]. Experiential learning principles guided the movement from image-based observation to conceptual understanding and clinical application [6]. Representative examples illustrating each of these principles are provided in Table 1; Fig. 1.

Table 1 Representative visual arts-based games integrated into readiness assessment questions (RAQs)

Artwork/Source	Learner Task/Game Mechanic	Neuroscience Concept/Learning Goal
The Creation of Adam (Michelangelo, 1512)	Toggle interactive overlays to identify anatomical forms embedded within the painting	Reinforce visual identification of neuroanatomical structures and spatial relationships
Self-Portrait Series (William Utermohlen, 1995–2000)	Sequence portraits chronologically based on visible changes across the series. Progressive challenge: earlier portraits in the sequence are visually similar and harder to distinguish, while later portraits show more overt change.	Alzheimer's disease beyond memory impairment, including visual-spatial dysfunction and altered self-representation
Le mal de tête (Honoré Daumier, 19th-century lithograph)	Match illustrated pain depictions to headache syndromes based on pain quality and description	Emphasize how pain quality and symptom description can inform headache diagnosis
The Forest Has Eyes (Bev Doolittle, 1984)	Identify embedded faces and reflect on ambiguous perception	Explore perceptual ambiguity, visual interpretation, and higher-order visual processing

Design of the Innovation

Gamified, visual arts-based exercises were incorporated as additional RAQs to make pre-class preparation more engaging and integrative. These items were added to existing RAQ sets rather than replacing traditional items; the content blueprint for traditional items was unchanged. Each RAQ asked students to analyze a historical or contemporary artwork depicting a neurologic concept and apply course content to interpret their observations. These modules were intended to move pre-class preparation beyond factual recall by prompting students to interpret visual material in ways that supported conceptual integration and clinical reasoning. Exercises included identification of structures or pathology, brief attention to historical or cultural context, and completion of multiple-choice, labeling, or matching tasks in an interactive platform with immediate feedback. Each exercise required approximately 1 to 5 min. These modules were required coursework and were incorporated into the same assessment structure as traditional RAQs. Students completed one to two RAQ sets twice weekly, with each set containing 5 to 8 questions, and cumulative performance across all RAQs contributed 7% to the final course grade, with full credit awarded for achieving more than 50% correct. Representative examples are shown in Table 1; Fig. 1.

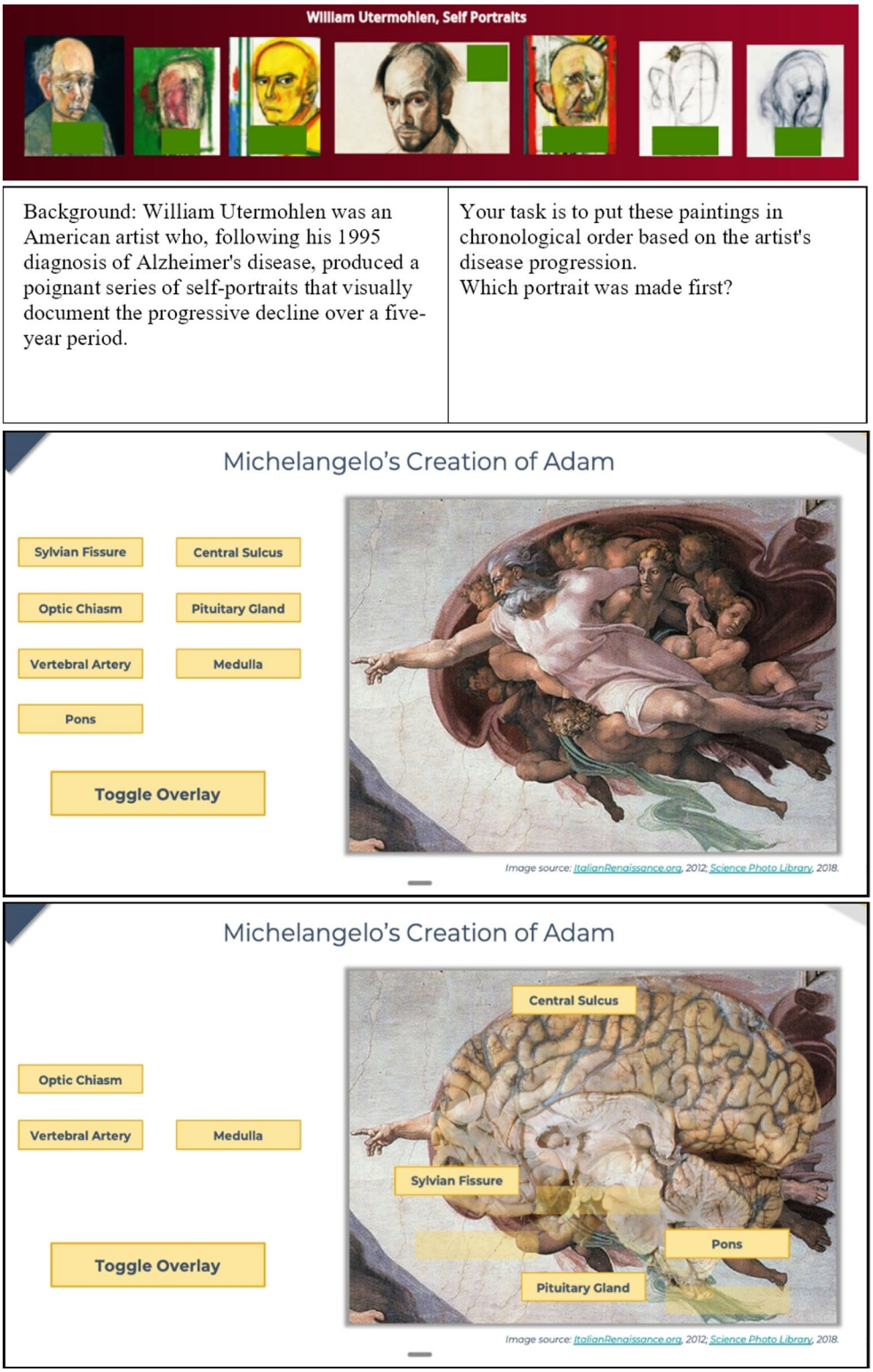

Fig. 1 Representative educational activities including (**A**) chronological sequencing of William Utermohlen's self-portraits following his Alzheimer's diagnosis; and (**B**–**C**) the anatomical alignment of a sagittal brain section with Michelangelo's The Creation of Adam

Evaluation and Data Collection

Evaluation included RAQ participation, completion rates, and time-on-task data from the learning management system. Student perceptions were assessed using two additional 5-point Likert-scale items on the standard end-of-course evaluation and open-ended narrative comments. Narrative feedback was reviewed descriptively, with one author independently coding responses and refining themes iteratively. All data were collected anonymously, and the HMS Office

of Medical Education determined the project to be educational quality improvement exempt from full institutional review board review.

Implementation and Adaptability

These exercises were embedded within students' existing pre-class RAQ assignments as part of the standard flipped-classroom prework, rather than during scheduled class time. Although items were added rather than substituted, each exercise required an average of only 80.32 s to complete; across approximately 5.4 exercises per student over the six-week course, this added an estimated 7 min of total preparation time per student, a negligible addition to overall workload. Implementation therefore required no additional synchronous class time.

Results

All 172 students in the 2025–2026 MBB course completed the gamified, visual arts-based RAQs. Embedding the art-based modules within this existing system ensured that all students engaged with the activities as part of standard course participation.

Platform analytics showed that 924 exercises were completed. Mean time on task was 86.41 s (SD 148.16) per module. After removal of two extreme outliers, likely reflecting screens left open, the mean time was 80.32 s (SD 67.83). These findings suggest that the activities were feasible to complete within the normal rhythm of pre-class preparation.

Of 172 students, 123 completed the post-course survey (71.5% response rate). Response distributions were identical across both Likert-scale items assessing whether the art-based RAQs promoted novel thinking and engagement (Fig. 2). These findings suggest the activities resonated clearly with a substantial subset of learners, while also indicating mixed perceptions across the class.

Narrative comments provided additional context for these mixed responses. Five major themes emerged: emotional and humanistic impact, interdisciplinary appreciation, engagement and enjoyment, learning value, and areas for improvement (Tables 2 and 3). Students described the exercises as helping them connect with the human experience of neurologic disease, particularly through visual depictions of disease progression. Others valued the integration of neurology with the arts and humanities and appreciated the historical and social context evoked by the artwork. Many comments emphasized enjoyment and variety, describing the activities as a welcome pause from dense preclinical content. Perceived learning value was more variable, paralleling the survey findings. Some students found the modules helpful for identifying structures and remembering concepts, whereas others requested clearer answer keys, stronger alignment with learning objectives, and technical refinements (Tables 2 and 3).

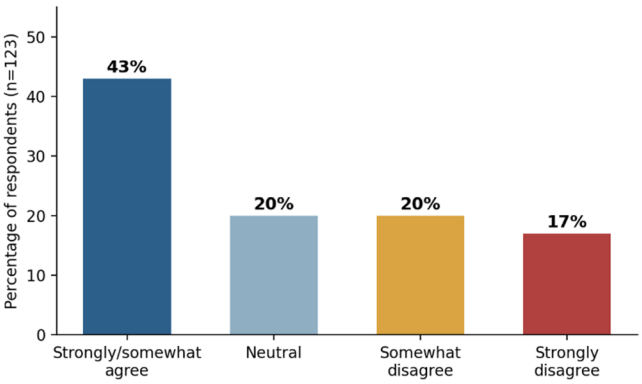

Fig. 2 Distribution of student agreement with the two Likert-scale items assessing whether the art-based RAQs promoted novel thinking and made the material more engaging ($n = 123$; identical distribution across both items)

Table 2 Major themes and representative student quotes from post-course feedback

Theme	Representative Student Quote
Emotional and Humanistic Impact	"The Alzheimer's portraits really helped me visualize the progressive nature of the disease and evoked an emotional response."
Interdisciplinary Appreciation (Art–Medicine Connections)	"I appreciated connecting neurology to the arts." "It was cool to see that there are connections between science and art."
Engagement and Enjoyment	"Fun to pause the dense material and do something a little different." "It was a nice break and added variety."
Learning Value (Positive & Mixed)	"I found the anatomy-based ones helpful for identifying structures." "Seeing visual depictions helped me remember concepts."

Table 3 Learner-suggested areas for improvement

Suggested Improvement	Representative Student Quote
Suggested improvements • Desire for answer keys/ explanatory feedback • Greater clarity of learning objectives/alignment with course content • Technical Feedback/ Usability	"I would suggest that the game show the answer key after the exercise to check understanding. Overall, great exercise" "They would have been more helpful if answers/explanations were given." "Respectfully, I did not find the art games to be helpful at all. The connection to the content was very tangential, and sometimes the games didn't even tell you the correct answers." "Some modules felt buggy or confusing."

Discussion

Taken together, these findings suggest that visual arts-based exercises may enrich pre-class neuroscience learning not only by increasing engagement for some learners, but also by adding emotional resonance and interdisciplinary context to foundational material. For some students, visual narratives appeared to make abstract concepts more memorable and more clearly connected to the lived experience of illness. At the same time, the mixed survey responses and narrative feedback indicate that the educational value of these activities was not self-evident to all learners. In a required scientific curriculum, students may be less accustomed to approaches that involve interpretation, ambiguity, or explicit humanistic framing. Without clear explanation of purpose, some may be uncertain how such activities relate to core neuroscience learning.

These findings underscore the importance of careful design when integrating arts-based approaches into required coursework. Clear learning objectives, explicit connections between visual observation and clinical reasoning, and structured feedback are likely essential for helping students understand the relevance of this approach. Future iterations will therefore include clearer objectives, more explicit explanatory feedback, and structured in-class debriefing. Prior work in arts-based health professions education suggests that guided debriefing can support transfer of learning by helping students connect interpretive experiences to clinical reasoning and medical practice [10]. In this context, the absence of formal debriefing may have contributed to uncertainty about the purpose and relevance of some modules. Additionally, if competitive or reward-driven elements become more salient than reflective observation, gamification may inadvertently dilute deeper learning of course content.

This innovation is notable because most arts and humanities initiatives in medical education remain elective or extracurricular. Here, visual arts-based exercises were embedded directly into required preclinical neuroscience coursework with only a negligible addition to curricular preparation time. This model appears feasible, sustainable, and adaptable within a flipped-classroom structure, and it aligns with prior literature showing that arts-based approaches can strengthen observation, interpretation, empathy, and tolerance for ambiguity across medical education [3, 9]. Future work should examine whether repeated exposure influences visual reasoning, conceptual retention, and comfort with uncertainty. More broadly, embedding arts-based exercises into required coursework may offer a practical approach for making preclinical education more observational, interpretive, and human-centered.

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Data Availability The deidentified data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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