A Constructionist Approach to Note-Taking

Making and Innovation in Constructionist Learning

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Abstract

Note-taking is a fundamental learning practice, yet traditional outlining methods often limit students' ability to actively generate new knowledge. This study explores how constructionist note-taking practices emphasizing artifact creation, active processing, collaboration & feedback, and reflection & refinement, grounded in the 4E framework (Externalize, Equate, Engage, Examine), enhance the generativeness of notes. Using a quasi-experimental design, undergraduate students were divided into two groups: Experimental (constructionist note-taking) and Control (Traditional outlining). Quantitative analysis using independent t-tests indicated that the constructionist note-taking produced significantly more non-obvious connections, self-generated questions, and insights (M = 3.54, SD = 0.52) over the control group (M = 1.63, SD = 0.67). On average, participants in the experimental group produced 53.94% more novel insights compared to the control group. Qualitative findings revealed that constructionist note-taking promoted cross-disciplinary connections and deeper conceptual engagement. Participants in experimental groups demonstrated a higher frequency of novel perspectives, with one student linking blockchain technology with regenerative agricultural supply chains, while another identified unexpected parallels between alternate crop rotation and ecological resilience. These findings support the idea that constructionist note-taking practices transform notes from an external storage mechanism to an evolving 'object-to-think-with'. The study underscores the active role that instructors play in guiding students toward effective generative note-taking practices. By integrating the 4E framework into note-taking pedagogy, educators can foster a more dynamic, creative, and cognitively enriching learning environment where students move beyond passive reception to active knowledge construction, deeper inquiry, and novel insight generation.

Keywords and Phrases: Generative note-taking, Constructionism, Instructional design, 4E Framework, Higher Education

1. Introduction

The practice of note-taking is fundamental to learning, enabling students to record, organize, and revisit information. Traditional approaches often focus on passive recording of content, but emerging perspectives suggest that note-taking can be more than just an archival process – it can be generative, fostering deeper understanding and knowledge creation (Peper & Mayer, 1978; Piolat, 2005). *Generative note-taking* is viewed as a valuable tool for fostering deeper learning, critical thinking &

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analysis, metacognitive skills, collaboration & communication, and multimodal communication aligning itself with 21st century competencies (Morehead, 2019). This study adopts the definition of generative note-taking from Peper & Mayer (1978): "A method that emphasizes active construction of meaning by connecting abstract information with prior knowledge". They highlight that generative note-taking results in better learning outcomes than traditional outlining by enhancing understanding, knowledge transfer, and problem-solving skills. However, Kiewra (1989) notes that students struggle with generative processing during lectures due to high cognitive load, potentially detracting from the primary tasks of listening and understanding lecture content, resulting in verbatim note-taking. This practice of verbatim note-taking leads to emphasis on the storage function of note-taking over processing, thereby resulting in poor externalization of mental representations (Kiewra, 1989). Additionally, lack of formal training in note-taking contributes to the limited use of generative note-taking practices, directing students to navigate this crucial skill on their own, resulting in adoption of less effective methods that don't support learning, memory, and achievement (Haghverdi, 2010).

A constructionist approach to note-taking can address the above challenges with an emphasis on active knowledge construction, personal meaning-making, and the creation of tangible artifacts. It provides a theoretical framework that externalizes mental representations and treats 'notes' as an 'object-to-think-with' to enhance the generativeness of the note-taking process. We define generativeness comprising these attributes/descriptors:

1. *Novelty:* Playful experimentation and exploration of materials while engaging with the environment and thoughts that lead to genuinely new questions that aren't merely reformulations of existing questions (Lehmann, 2023).
2. *Links:* Establishing connections within abstract information and with prior knowledge experiences (Fiorella & Mayer, 2016; Parmaxi & Zaphiris, 2014)
3. *Meaning-making:* An active constructive process where learners build their understanding of the world (Peper & Mayer, 1978)
4. *Structure:* Kiewra (1989) posits that the structural aspect of note-taking involves the organization and arrangement of information. Linearity in notes adhere to a sequence, reflecting the order in which information is presented.
5. *Formats of Representation:* The various ways in which knowledge, ideas, and information can be expressed and communicated e.g., text, diagrams, abbreviations, symbols, etc. (Peppler, 2016)
6. *Engagement* – A complex and dynamic state that involves active, thoughtful, and emotional investment in learning, which is shaped by individual characteristics, social dynamics, and the design of the environment. Some examples of interaction are asking questions, contributing ideas, collaborating, etc. (Peppler, 2016)
7. *Reflection* – A metacognitive process that talks about awareness of one's thinking and learning e.g., thought process, strategy effectiveness, personal strengths/weaknesses, etc. (Parmaxi & Zaphiris, 2014)

The primary essence of note-taking is to achieve meaning-making. Peper and Mayer (1978) & Wittrock (1974) provide attributes to the construction of meaning-making through formation of *links* within abstract information and with prior knowledge. Fiorella and Mayer (2016) categorize the strategies to generate meaning-making in notes into two based on the *structure* of notes: spatial and verbal. Spatial strategies utilize the physical space of the notes in a non-linear way to organize information and show relationships (e.g. diagrams, concept-maps, etc.). Verbal strategies involve

recording information using words, lists, or linear outlines, typically transcribing information that is heard or read. Whereas, on a functional level, the *representation of information* in a respective format or multiple formats play a crucial role in the expression of information that contributes to learning (Peppler, 2016). This is intricately tied to the generative strategies discussed and often dependent on the note-taking medium. Some examples are abbreviations (truncation, suffix contraction, etc.), symbols (mathematical, iconic, Greek-alphabetic, etc.), paraphrasing, etc. As we dive deeper into the process of encoding (active processing of information), we identify *engagement* encompassing focused attention, active cognitive processing, and learner's conscious interaction with the artifact (notes) playing a vital role in the construction of meaning. Positioning notes as an artifact or 'object-to-think-with', we make it a public entity inviting more perspectives & dialogues. Every interaction with object produces to an active note-taking leading to *novel* questions, perspectives, and ideas. Additionally, an integral component of active note-taking is *reflection* as it aids in meaning-making because notes are a form of reflection-in-action that portray how students think and enact mental representations in an external medium. Hence, the above codes were developed: *Novelty, links, meaning-making, structure, formats of representation, engagement, and reflection* to encompass the notion of generativeness in notes.

Therefore, effective notes serve as evolving artifacts that facilitate the exploration, synthesis, and reorganization of ideas. The fundamental purpose of note-taking hasn't evolved yet from external storage & encoding medium with the potential advent of technological tools. This stagnation is evident in a recent study conducted at Kent State University, where Morehead (2019) found that 89% of students believed they took good notes, yet 58% wished for better note-taking skills, and 52% reported never having been taught note-taking skills. Despite its crucial role in learning and academic success in higher education (Kiewra, 1989; Piolat, 2004; Morehead, 2019), note-taking is rarely taught in formal institutions, highlighting a significant gap in educational practices.

In this paper, we propose a constructionist approach designed to enhance the generativeness of note-taking practices within classroom settings. Our goal is to transform the perception of note-taking from a mere external storage mechanism to a dynamic 'object-to-think-with'.

2. Theory

Generative note-taking has its roots in generative learning theory (Wittrock, 1974), which emphasizes active knowledge building by connecting abstract information with prior knowledge. Peper and Mayer (1978) underscore the integral role of 'constructivism' in the evolution of generative note-taking. This active integration with existing schemas prioritizes 'meaningful learning' over simple encoding as meaning facilitates the construction process. Consequently, meaning-making and the establishment of internal and external connections are essential for active encoding. To achieve this style of note-taking, Peper and Mayer (1978) suggest strategies to facilitate internal and external connections, such as paraphrasing & summarizing, organizing information with visual aids, and using assimilative encoding to link abstract information to prior knowledge. The above strategies typically involve a higher cognitive load (time and effort required to cognitively process information). Therefore, effective instruction should consider the interplay between cognitive load and

generative strategies. Unfortunately, studies by Kiewra (1985) and Morehead (2019) highlight that many students have not been formally taught these strategies, leading them to rely on passive and ineffective conventional methods.

Constructionism, with its roots in the work of Papert & Harel (1991), offers a powerful framework emphasizing the construction of knowledge through the creation of tangible, shareable artifacts. 'Learning by Making' is the mantra and the distinguishable principle behind constructionism and constructivism, which is rooted in integral cognitive processes. These tangible artifacts (physical or digital), also known as 'object-to-think-with' help learners to materialize abstract knowledge through different modes of expression (Papert & Harel, 1991). These externalized representations involve learners following an iterative process of design, thinking, and re-thinking, which enhances learning and strengthens their knowledge. Parmaxi & Zaphiris (2014) highlight the evolution of constructionism, building upon the core ideas with an emphasis on the social nature of learning, situating learning at the nexus of interaction between learners, tools, and the environment, to distributed and social constructionism. Dialogue becomes the central driver enhancing the creation, discussion, sharing, and collaboration of artifacts. In summary, constructionism has evolved into a multifaceted learning theory emphasizing making, social interaction, technology use, and learner agency.

2.1 Conceptual Framework

To operationalize the notion of 'object-to-think-with' in note-taking, we introduce the 4E framework: *Externalize, Establish, Engage, and Examine*. This framework structures the process of constructionist note-taking by encouraging learners to create external representations (artifacts), actively process by forming connections within abstract information and with prior knowledge, interact with peers and provide feedback & support, and continuously reflect and question for refinement. This serves as a structured, evidence-based approach to facilitating constructionist note-taking in the classroom for instructors. By integrating this pedagogical tool using scaffolding, instructors can ensure that students move from passive transcription to enhanced generativeness. Finally, it serves as an assessment tool for evaluating students' notes in terms of conceptual organization, the establishment of connections, the inclusion of non-obvious, curiosity-driven, and reflective questions, as well as the frequency of revisiting and refining notes for long-term improvement.

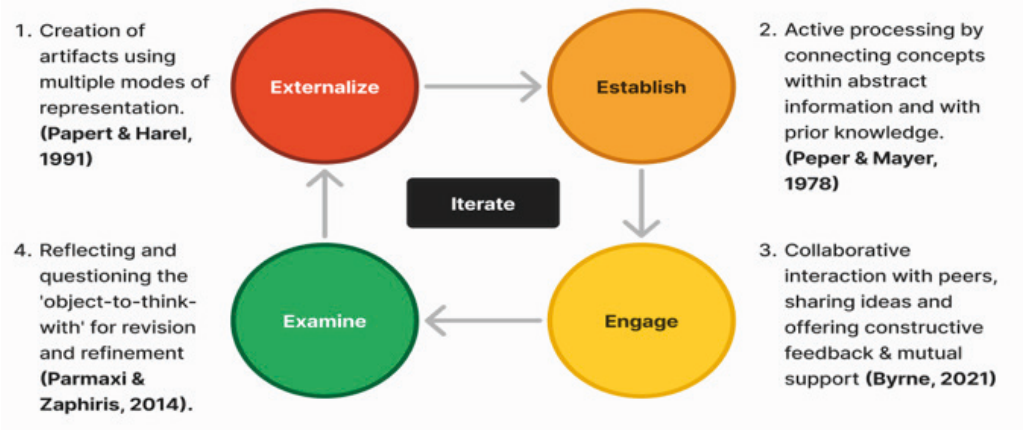

Figure 1: 4E framework.

2.2 Research Question

How can the notion of 'object-to-think-with', one of the constructionist principles, be applied to existing note-taking practices to enhance the generativeness of notes?

3. Methods

A mixed-method research study was conducted in an undergraduate course titled: 'Global Food Production and Health' from the Department of Agronomy at the University of Wisconsin–Madison. The course introduced undergraduate students to agronomic production practices of major food crops and provided tools to analyze sustainability issues and/or practices using systems thinking. Participants were recruited based on their status of enrollment in the course and consent to contribute to the study. The study employed a quasi-experimental design with control group and experimental group to examine the 'generativeness' of notes. It engaged participants in examining a complex agroecosystem through Systems Thinking (ST) to identify potential leverage points for mitigating problems. Participants' notes functioned as external representations of the agroecosystem. To ensure fairness and minimize bias, participants were randomly assigned to groups and further divided into teams of six. Each team utilized a crop fact sheet (e.g., Mango crop fact sheet at Madison) as their information source. The study was conducted in an active learning classroom designed to support collaborative activities. It adhered to the ethical guidelines of the University of Wisconsin–Madison, with participants providing informed consent and data anonymity being assured following IRB guidelines.

3.1 Materials and Tools

1. Control group: Participants followed a traditional outlining method of note-taking in Google sheets on their laptops collectively.
2. Experimental group: Participants followed a constructionist note-taking method using mobile whiteboards using multi-colored markers, multi-colored sticky notes (x4), rough sheets (x5), pencils, pens, and magnetic clips.
3. Both groups had access to the same instructional materials for content consistency.

3.2 Procedure

1. Pre-Survey Questionnaire: Participants completed a pre-test on complex agroecosystems to assess their knowledge in systems-thinking concepts, problem-solving, and decision-making.
2. Intervention Phase: Both groups received instruction on the basic principles of systems thinking.
   a. Experimental group received training on constructionist note-taking that employed the 4E framework through scaffolding.
      i. *Externalize:* Create a representation of the agroecosystem using systems diagrams collaboratively encompassing all the components of the complex system (e.g. soil, crops, climate, biodiversity, etc.)
      ii. *Establish:* Identify and highlight the key interactions among the components of the complex system (e.g. soil, crops, climate, etc.) using the colored markers (e.g. X →Y).
      iii. *Engage:* Observe the representations created by peer groups, share your individual insights, and provide constructive feedback on their designs. Use sticky notes to write your feedback and place them on the relevant areas of their designs.

iv. *Examine:* Rejoin your group and critically reflect on the feedback received to your design. Collaboratively work to enhance and refine your design, incorporation the comments and suggestions from your peers.

b. Control group followed a traditional outlining method of note-taking and worked collaboratively in designing an outline for their complex agroecosystem.

3. Post-Survey Questionnaire: Participants completed a post-test on their understanding of systems thinking concepts.

Notes were collected as images for experimental group and as PDFs for control group. Overall, the study identified 97 pre- and post-survey responses, 8 constructionist notes (experimental group) and 8 traditional outlines (control group) for quantitative analysis of generativeness. Additionally, researchers took field notes from both groups during the study.

4. Analysis

Quantitative: A rubric was developed to systematically evaluate student artifacts grounded in constructionist learning theory. By enabling quantitative comparison and qualitative insights, the rubric strengthens the study's methodological rigor. We apply the rubric below to score the notes from both experimental and control groups across the seven categories: *novelty, links, meaning-making, structure, formats of representation, engagement,* and *reflection*. The score for each category is aggregated and a Welch's independent sample t-test assuming unequal variance is performed on both groups to determine the significant differences between them. Descriptive statistics provide an overview of the performance in each category, while effect sizes help assess the magnitude of the differences between each groups.

Qualitative: Field notes are reviewed to assess engagement, reflection during collaboration, and the generation of novel ideas/perspectives. Observing group dynamics, participation, and reflection helps identify moments of generativeness, such as when students make new connections or ask questions beyond the material. Field notes also elucidate how students engage with representation formats and their impact on idea generation and information organization. Additionally, post-survey responses provide insights into participants' experiences with the 4E Framework. Survey questions prompt reflection on the seven self-reported categories, contextualizing observational data and confirming or contradicting field notes and content analysis findings. Combining field notes and post-survey responses offers a holistic understanding of generativeness.

Codes	Parameters / Characteristics				
	Excellent (5 points)	**Very Good (4 points)**	**Good (3 points)**	**Fair (2 points)**	**Poor (1 point)**
Novelty	Generates 3 or more completely new, original questions/ideas that are not reformulations of existing ones.	Generates 2 new, original questions or ideas that extend beyond existing concepts.	Generates 1 new question or idea, with some connection to existing concepts but showing basic originality.	Generates questie ons or ideas that are mainly reformi ulation of existing concepts with minimal originality.	Fail to generate new or original questions or ideas, only restates existing ones.
Links	Establishes 3 or more deep, meaningful connections between abstract concepts and prior knowledge, leading to new insights.	Makes 2 strong and relevant connections, integrating prior knowledge effectively with abstract concepts.	Forms basic connections between abstract information and prior knowledge but lacks depth.	Identifies some connections, but they are weak, unclear, or lack relevance.	Fails to establish connections or only repeats isolated facts without integration.
Meaning-making	Generates at least 3 or more original insights and applies concepts to real-world contexts with clear, logical reasoning.	Provides 2 original insights, demonstrating strong logical connections between concepts and real-world applications.	Accurately explains concepts with at least 1 original insight, but reasoning remains mostly surface-level.	Partially explains concepts with minor inconsistencies, lacking original insights or real-world connections.	Provides inaccurate explanations with no original insights or logical connections.
Structure	Information is fully organized with a clear and logical sequence, maintaining consistent linearity throughout.	Information is mostly organized, with minor deviations from a clear sequence but overall logical flow.	Information has some organization, but noticeable gaps or inconsistencies in the sequence.	Information is partially structured, with frequent disruptions in order and logical flow.	Information is disorganized with no clear sequence or logical arrangement.
Formats of Representation	Uses 3 or more diverse formats with clear organization, originality, and strong emotional or conceptual engagement.	Incorporates 2 diverse formats, demonstrating clear organization and engagement with the content.	Uses at least 1 additional format beyond basic text but with limited integration or engagement.	Primarily relies on one format with minimal variation or thoughtful integration.	Uses a single rigid format with no variety, organization, or engagement.
Engagement	Actively participates for 90% or more of the time, demonstrates 3 or more types of interaction	Participates for 75-90% of the time, engages in 2 types of interaction	Participates for 50-75% of the time, engages in at least 1 type of interaction	Participates for 25-50% of the time with minimal interaction.	Participates for less than 25% of the time, showing little to no interaction.
Reflection	Reflects on 3 or more specific aspects of thinking and learning with clear, detailed insights.	Reflects on 2 specific aspects, with clear and relevant insights into thinking and learning.	Reflects on 1 aspect of thinking or learning, but with limited depth or clarity.	Reflects on thinking or learning with minimal detail, lacking specific examples or insight.	Provides no meaningful reflection, with no awareness of thinking or learning.

Table 1: Code Book.

5. Results

Quantitative: Participants in the experimental group conditions contributed to increased generativeness in all the respective aspects (novelty, links, meaning-making, structure, formats of representation, engagement and reflection). Table 2 presents the p-values for each condition, demonstrating statistically significant relationships ($p<0.05$) across all attributes/codes.

Code	Control group (n=66)	Experimental group (n=66)	t	p	df	Cohen's d
	M (SD)	M (SD)				
Novelty	1.63 (0.67)	3.54 (0.52)	7.42	<0.0001	20	3.32
Links	1.81 (0.75)	3.63 (0.50)	6.66	<0.0001	20	2.98
Meaning-Making	2.00 (0.77)	3.54 (0.64)	4.18	0.0005	20	1.87
Structure	4.45 (0.52)	1.45 (0.52)	-13.47	<0.0001	20	-6.02
Format of representation	1.09 (0.30)	3.36 (0.50)	1.82	<0.0001	20	5.73
Engagement	3.54 (0.52)	4.63 (0.50)	4.98	<0.0001	20	2.22
Reflection	1.72 (0.64)	3.63 (0.40)	4.74	0.000194	20	2.12
Note: Results for independent t-tests, assuming unequal variance, between participants in control and experimental groups across descriptors (codes) related to generativeness of notes.						

Table 2: Code count comparisons – understanding 'generativeness'.

Our approach to capture the differences in participants' notes between two groups, was to count the mean scores of each team in the respective groups across all respective codes. Figure 2 presents the mean values for both groups across the respective codes.

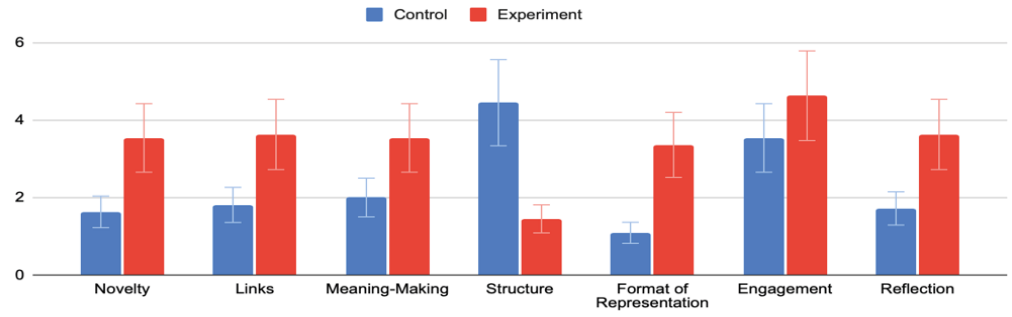

Figure 2: Mean vs Code Values of the study.

The findings reveal that the experimental group (M = 3.63, SD = 0.50) facilitated a greater number of links compared to the control condition (M = 1.81, SD = 0.75), with a 117.18% increase in the formation of connections within abstract information and prior knowledge, followed by the demonstration of higher levels of meaning-making

from experimental group (M = 3.54, SD = 0.64) over control group (M = 2.00, SD = 0.77) supporting the generative strategies in note-taking proposed by Peper and Mayer (1967).

On the other hand, the control group (M = 4.45, SD = 0.52) significantly outperformed the experimental group (M = 1.45, SD = 0.52) in creating well-defined linear notes, as they adhered to a consistent template. In contrast, the experimental group (M = 3.36, SD = 0.50) excelled in utilizing diverse representations, such as diagrams, charts, pictorial representations, etc. compared to the control group (M = 1.09, SD = 0.30), highlighting the effectiveness of the 4E framework through these creative efforts. Regarding engagement, the experimental group (M = 4.63, SD = 0.50) showed higher mean values than the control condition (M = 3.54, SD = 0.52) indicating the aspect of collaboration within groups and outside of groups while providing feedback to peers. Participants in the experimental group also exhibited greater awareness in their learning process (M = 3.63, SD = 0.40) compared to the control group (M = 1.72, SD = 0.64), indicating that 4E Framework fostered an environment conducive to implementing generative strategies in note-taking.

Qualitative: While quantitative results demonstrated the effectiveness through statistical significance, qualitative findings provide rich, contextual insights into why and how constructionist note-taking practices enhance 'generativeness'. These insights are derived from participants' written reflections in post-survey responses and observed field notes during the study, which can enrich the quantitative results. The below anecdote from experimental group captures participants' novel intervention on an investigated agroecosystem that can reduce soil depletion as well as increase resilience of the system.

> "I may have found a new way of thinking about these concepts from our representation. I'm guessing can 'alternate rotation strategy of multiple crops mimicking natural ecosystem resilience rather than imposing rigid agricultural timelines be able to reduce soil depletion." (Participant 10, Group 2)

In other words, experimental group synthesized more novel perspectives, links, and representations contributing to problem-solving as shown above. Additionally, post-survey responses indicate that experimental group perceived the process of creating links as inherently iterative, owing to the affordances provided by the materials which are indirectly influenced by the 4E framework.

> "Our group added/removed/edited connections among the concepts involved in our agroecosystem using the systems diagram representation drawn on whiteboards." (Participant 17, Experimental group)

In other words, participants in the experimental group used their notes as an instrument for thinking about the concepts and actively spend their time in processing and establishing links within abstract information and with prior knowledge over control group. The below anecdote captures the task of outlining where participants spent significantly less time in building links and more time in layout the structure.

> "We had a strict structure of laying out concepts therefore we spend less time in connecting things." (Participant 3, Control group)

In essence, control group spent less time in processing and more time in organizing. To further illustrate these findings, we present several images of the constructionist note-taking artifacts created by participants in the experimental group. Figure 3a incorporated constructionist note-taking method to visualize the complex agroecosystem – Avocado farm in Mexico using the principles of ST.

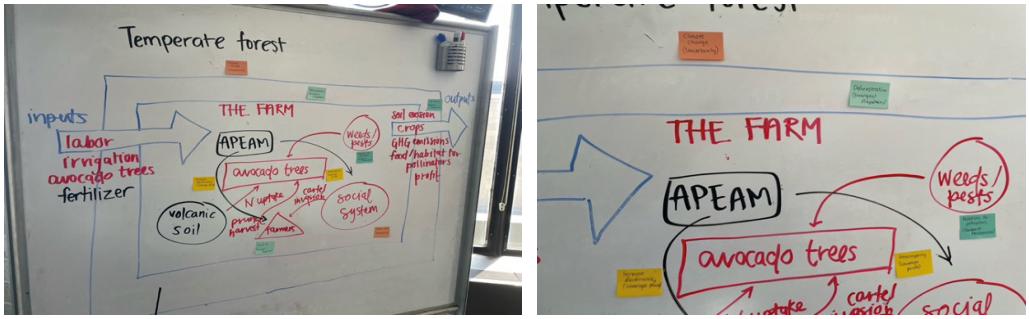

Figure 3: (a) A constructionist note-taking (artifact) representing an Avocado farm in Mexico; (b) Emphasis on multiple colored sticky notes in constructionist note-taking.

Figure 3b presents an enlarged view of the constructionist note-taking, emphasizing the sticky notes and several internal and external connections established by the same team. The sticky notes are strategically placed on specific sections of the whiteboard to underscore innovative ideas and reflections on various components of the complex system that contribute to the next iteration based on the 4E framework. Thus, these images serve as concrete evidence of how constructionist note-taking promotes a more structured yet exploratory interaction with learning materials, enhancing the generativeness of notes.

6. Discussion

The analysis illustrated that 4E framework significantly led to more generative notes as observed in the experimental condition. Participants in the experimental group explored the spatial aspect of note-taking process, through the implementation of systems diagram representing their complex agroecosystem. The 4E framework incorporated the use of materials like whiteboards, colored markers, sticky notes, etc. that fostered a sense of visuospatial sketchpad promoting the aspect of 'manipulation' of the object (notes). This contributed to element of spatial re-organization of ideas leading to increased establishment of connections/links both internal and external in the source information resulting in continuous evaluation of connections established within the representation yielding novel ways of looking at the problem. Positioning the notes as an 'object-to-think-with' invited a dialogic interaction between students and notes. It promotes the action of the above variables contributing to its generativeness. In brief, the 4E framework fostered a sense of closeness and proximity through continuous interaction in an iterative manner between the note-taker, notes, and peers compared to the passive transcription in traditional outlining.

While our results suggest the value of constructionist note-taking, our findings are not without limitations. First, our findings are based on specific participant group (undergraduate students enrolled in agronomy course), which limits the generalizability of the results to broader educational contexts. Second, the study relies on self-reported data of participants' notes, which may introduce some biases related to self-perception and subjective interpretation. Lastly, the intervention period may not have been long enough to fully capture the long-term effects of constructionist

note-taking practices. Thus, 4E Framework can be effectively implemented in higher education classrooms to foster generativeness in notes. Future research will include a longitudinal study to understand how students refine generative note-taking strategies over time. A major project will explore the impact of constructionist note-taking practices on generativeness, using digital tools, multimedia, and collaborative platforms. This will examine digital note-taking platforms and their affordances, aiming to design an application that embodies constructionist learning principles.

References

Ahn, R., Ingham, S., Mendez, T., & Pomona, C. P. (2016). Socially constructed learning activity: communal note-taking as a generative tool to promote active student engagement. *Transformative Dialogues: Teaching and Learning Journal*, *8*(3).

Byrne, J. R., Girvan, C., & Clayson, J. (2021). Constructionism moving forward. *British Journal of Educational Technology*, *52*(3), 965-968.

DiVesta, F.J., and Gray, S.G. (1972). Listening and notetaking. *J. Educat. Psychol.* 63: 8-14.

Fiorella, L., & Mayer, R. E. (2016). Eight ways to promote generative learning. *Educational Psychology Review*, *28*, 717-741.

Haghverdi, H., Biria, R., & Karimi, L. (2010). Note-taking strategies and academic achievement. Journal of Language and Linguistic Studies, 6(1).

Harel, I. E., & Papert, S. E. (1991). *Constructionism*. Ablex Publishing.

Kiewra, K. A. (1989). A review of note-taking: The encoding-storage paradigm and beyond. *Educational Psychology Review*, *1*, 147-172.

Lehmann, J., Cole, R., & Stern, N. (2023). Novelty and Utility: How the Arts May Advance Question Creation in Contemporary Research. *Leonardo*, 56, 488-495.

Morehead, K., Dunlosky, J., Rawson, K. A., Blasiman, R., & Hollis, R. B. (2019). Note-taking habits of 21st century college students: implications for student learning, memory, and achievement. *Memory*, *27*(6), 807-819.

Parmaxi, A., & Zaphiris, P. (2014). The evolvement of constructionism: An overview of the literature. In *Learning and Collaboration Technologies. Designing and Developing Novel Learning Experiences: First International Conference, LCT 2014, Held as Part of HCI International 2014, Heraklion, Crete, Greece, June 22-27, 2014, Proceedings, Part I 1* (pp. 452-461). Springer International Publishing.

Peper, R. J., & Mayer, R. E. (1978). Note-taking as a generative activity. *Journal of Educational Psychology*, *70*(4), 514.

Piolat, A., Olive, T., & Kellogg, R. T. (2005). Cognitive effort during note-taking. *Applied cognitive psychology*, *19*(3), 291-312.

Wittrock, M. C. (1974). Learning as a generative process. Educational Psychologist, 11(2), 87–95.