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"Documentation is now so ingrained in me": how students interpret and value documentation in creative learning domains

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Abstract
Within creative domains in studio- and project-based education, documentation is often central to demonstrating outcomes, process, and progress. Despite much prior work into the instructional practices, technologies, and tools that support cultivating documentation practices, no prior work explores the student valuing and perception of documentation. To address this, we deploy a design probe to elicit and externalize conceptions of documentation with the same cohort of students in two semesters. Eleven participants engaged in higher education undergraduate programs completed the study. We focus our analysis on one activity — listing and ranking documentation's perceived values. Through our analysis, we developed and validated a robust codebook for students' values. We demonstrate the values of documentation to be coherent across background, time, and experience of the student participants. We also share insights on nine main roles documentation plays for students and discuss how documentation plays not only an important role in communicating creative work to diverse stakeholders but in building self-confidence, motivation, and affect for project-based and hands-on exploration.

Keywords Documentation · Studio-based learning · Design probe · Qualitative codebook

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Introduction and background

Documentation in creative practice is a vital, increasingly important, but *often under-supported and under-studied*, aspect of design practice and creative, project-based learning (Bardzell et al. 2016, Sawyer, 2017; Peppler & Keune, 2019; Sterman et al. 2023). By documentation, we mean the digital and/or physical records of an individual's or team's creative learning journey and the associated practices involved in noticing, selecting, capturing, recording, labeling, annotating, journaling, storing, and sharing a reflective account of the iterative and evolving project outputs.

Within creative domains such as art, architecture, design, as well as interdisciplinary maker-based, project-based, and hands-on forms of learning, documentation serves both *mediating* and *metacognitive* roles in learning, especially when instructional requirements are open-ended. Documentation of work-in-progress, and final products become focal objects that mediate the demonstration of craft and skills, as well as locate dialogue and discussion about intent, process, and performance. Documentation also fosters internal metacognitive processes that facilitate reflective habits of mind and moments of self-regulation to plan, assess, troubleshoot, and calibrate one's progress and performance in an unfolding constructive inquiry process (Greene et al., 2019; Boling et al. 2016) Documentation-related practices allow individuals to identify problems, retrospect, and adjust in iterations (Dalsgaard & Halskov, 2012). The act of documenting not only enables students to reflect and understand their own creative inquiry, but it makes learner's thinking visible to other (Brown, 2002; Ritchhart & Perkins, 2008), reveals process, productive failure, and accomplishments (Barron & Darling-Hammond, 2008; Cross, 1982; Sawyer, 2018), affords assessment and inspection of work product and processes (Braun et al., 2019; Clapp et al., 2016), and enables informal feedback, as well as more formal review and critique with diverse stakeholders within and beyond the classroom or studio (Braun et al., 2019; Keune et al., 2022; Sawyer, 2022).

Despite the benefits of documentation for learners and its contributions to cultivating a creative practice, the student perspective on documentation is not well understood. Instead, most prior work investigating the role of creative documentation in studio pedagogies has emphasized the educational frame or the educator perspective (Greene et al., 2019; Sawyer, 2022; Sheridan et al., 2022): instructional strategies to encourage documentation (Gray, 2013; Braun et al., 2019), assessment methods of learner's process, product, or skill acquisition (Doppelt, 2009; Blaikie et al., 2004; Braun et al., 2019), and/or the development of new creativity support, epistemic or technological tools to foster and scaffold documentation practices (Bardzell et al. 2016; Tseng, 2016; Keune et al., 2022; Sterman et al. 2023).

An overt focus on an instructional frame in prior work, however, offers only a partial understanding of the role and value of documentation to learners. In addition to fostering learning opportunities, documentation is a complex practice that also involves and responds to a wide array of professional, creative, and social functions. In particular, these are found in the ways in which documentation facilitates sharing, presenting, and communicating work to diverse audiences, thereby allowing learners to also seek professional opportunities, to build networks, and to gain feedback from beyond the immediate learning community through their documentation. (Scolere, 2019). As such, we believe documentation merits richer understanding as an intersectional practice for student learners. Furthermore, we are not aware of any prior work that has sought to explicitly understand the student perception

and valuing of documentation. Consequently, within this work, we seek to study and characterize the role that documentation plays in creative learning pedagogies. Specifically, we seek to build an understanding of the student-centered perspective on the role and value of documentation to their learning experiences and in the development of their creative practice over time. Our guiding research questions are:

- RQ1: *What are the values (and the characteristics) of documentation that undergraduate learners self-report as important?*
- RQ2: *What are the intersectional learning and professional practices associated with documentation activities that learners identify?*

We situate this work in creative learning settings in higher education and examine why documentation is important to structure learning in constructive, open-ended design-based learning settings. To do this, we developed a series of design probe activities deployed to the same group of eleven undergraduates in Fall 2020 and Spring 2021. This invited them to reflect on, self-report and rate the perceived values of documentation. Comparative findings between the two semesters demonstrates how documentation activity is described and valued by students; describes how documentation is a complex, meta-practice ranging across skills in communication, feedback, accountability, assessment, and showcasing; and characterizes the various roles documentation plays in student learning and professional development in creative fields.

The contributions of this work are: the development of a set of reflective probe activities designed to externalize student valuing of documentation; an inductively derived coding schema that others can reuse, adapt, and extend in their work to characterize and observe documentation values in student cohorts; and finally, the demonstration that changes in documentation practices and values can be observed over time and that these changes align with disciplinary development in creative fields. Our work further contributes to a growing body of evidence that documentation as a practice and product is vital in creative learning environments.

Methodology

Developing a design probe

Design probes are a generative design research method most often used in human computer interaction studies (Gaver et al., 2004; Graham et al., 2007; Mattelmäki, 2006) at an early stage of a design inquiry to reveal aspects of use, surface tacit behaviors, or uncover novel design possibilities. Probes are typically a designed package that includes one or more "evocative tasks" completed by participants in their own time (Sanders & Stappers, 2014; Graham et al., 2007). Probe activities have an open-ended quality, inviting subjective reflection and recording responses on experiences or interactions (Boehner et al., 2007; Graham et al., 2007). This data is intended to provide a rich account of the design situation for interpretation with participants.

We chose to work with probes as the main elicitation method for this study for a number of reasons. A key factor was that this work was conducted during the COVID-19 pan-

demic, where many students were engaged in remote or hybrid learning. Design probes are well suited to collecting rich, experiential data where observation and other forms of direct inquiry might otherwise be challenging. Probes are normally disseminated to participants to complete in their own time and own spaces, thereby allowing them to engage everyday situations, contexts, and experiences within the accounts the probe gathers. Additionally, as a qualitative design research method, the design probe is well aligned with making visible participant's thinking. For example, it has been used previously to externalize, capture, and report perspectives, judgements, and values in contexts such as exploring household waste and perspectives on 'frugality, resource conservation, and sufficiency' (McKinnon et al., 2020); reflective accounts of student's habits and patterns of sleep (Lockton et al., 2020); representing and empathizing with individual experiences with health and exercise routines (Mattelmäki, T., & Battarbee, 2002); and revealing everyday domestic situations (Wallace et al., 2013). Additionally, probes are both grounded in the 'user's subjective world' and acts of 'self-documentation' (Mattelmäki, 2005) that 'aim at focusing the users' attention to noting and recording their everyday life, their values, needs, and social and emotional engagements.' The framework of self-documentation inherent to the probe method added a metacognitive layer to both gather student perspectives, values, and thinking about documentation and foster reflection upon this creative act.

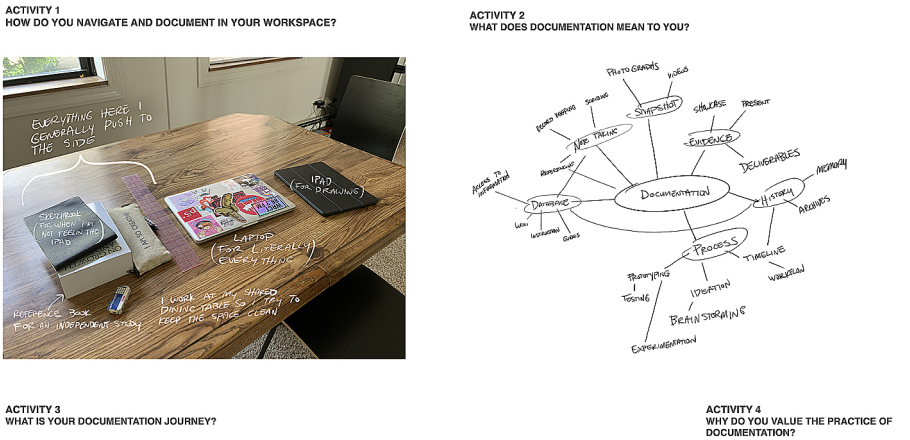

Fig. 1 An example of the design probe activities completed by Participant 5 in Spring 2021. The four activities are depicted: (**1**) annotating their workspace; (**2**) sketching a mindmap of their conception of documentation; (**3**) illustrating a documentation journey through a project; (**4**) enumerating the perceived values of documentation

Our design probe was anchored on questions of how students perceived creative documentation to support their learning. Our probe intended to learn about students' subjective feelings towards documentation and identified educational design opportunities. Four activities were prepared to support this (see Fig. 1): a mind map task that externalized the individual learner's understanding of the term 'documentation'; an image markup task to photograph their workspace and annotate the objects and tools that support documentation; a diagrammatic representation task to map a recent project and how documentation was involved in the workflow; and finally a retrospective exercise inviting participants to enumerate the reasons why they practice documentation and rank on a one-to-five scale the importance of each reason followed by a debriefing (see Fig. 2). *This last activity is the focus of this analysis.* Students were free to use any analog or digital tools to complete the probe tasks according to their preference. The activities were deployed over the course of a single week, one per day, and took approximately 15–20 min to complete. On the fifth day, participants took part in an interpretative session. This took place by a video call and invited participants to reflect on the activities and share additional context in three focus groups. The development of our documentation design probe, a preliminary analysis of the Fall 2020 data, and examples of outputs from this probe activity can be found in Chen et al. (2021).

Recruitment and participants

A total of sixteen undergraduates (eight seniors, four juniors, four sophomores) were recruited at the end of the Fall 2020 semester from two interdisciplinary creative technology programs, namely the Human Computer Interaction (HCI) and Integrative Design Arts and Technology (IDeATe), focused on project-based learning and creative inquiry. Participants were screened to balance for disciplinary backgrounds by majors and minors. Nine participants are enrolled in HCI, nine are enrolled in IDeATe, with three participants enrolled in both HCI and IDeATe. All participants had experience with documentation in project-based learning and indicated documentation as being important to their work - half of the participants rated it as extremely important on a 7-point semantic differential scale. Participants were asked to complete a series of probe activities over the first four days (approx. 15 min per day) followed by a one-on-one semi structured interview (approx. 30–45 min) on the fifth day. Fifteen undergraduate participants completed the study, as one student did not complete the probe activities. At the end of Spring 2022, the same group of participants were asked to repeat the same probe activities. We did this to examine if students' perceived role and value of documentation remained stable or changed over time. Our expectation was that as students took more courses from their programs their perceived values might develop in tandem. As such, we wanted to examine if we could observe and characterize how their perceived values for documentation changed between the two semesters. The debrief interview was replaced with a focus group bringing together three-to-four of the participants in a shared conversation to explore and compare their accounts, values, and perceptions of documentation. As part of the focus group, they were given the opportunity to review and comment upon each other's probe responses. Eleven of the fifteen participants completed the second round. Participants were compensated with a $50 gift card in the Fall and again in Spring.

Fig. 2 Three examples from Fall 2020 (P07, P09, P02) and three examples from Spring 2021 (P07, P09, P02) of participant (P) responses to the valuing activity. P02, P09, P07 are pseudonyms used to protect the identity of participants

Researcher positionality

Two undergraduate researchers were involved in conducting the probe activities and recruiting participants. Researcher one obtained design and human-computer interaction majors, with an expertise in user research and design. This researcher was primarily responsible for deploying the majority of probe activities, recruiting participants, and conducting group interviews. Researcher two brought a background in humanities and social sciences, spe-

cializing in communication techniques, strategies, and theories. In group interviews, he engaged with participants and assisted with note taking and raised follow up questions to clarify or extend discussions.

Data analysis

We adopted a qualitative approach (Benaquisto, 2008; Corbin & Strauss, 2015) to inductively code participants' responses from the fourth probe activity: listing & rating values of documentation and the interview and focus group transcripts. Data saturation is not a primary consideration given that the study is at exploratory stages with goals to explore the value of an understudied practice of documentation. We incorporated the frequency and rankings of statements as quantifiable indicators to help surfacing and provide some measures of what values are most prominent or salient relatively, in support of our qualitative analysis (Dang-Anh & Rüdiger, 2015). The frequencies and rankings are also used as evidence of demonstrating the change or stability of students' perceived values and priorities for documentation from Fall 2021 to Spring 2022 (Grayman, 2009).

We chose to begin analysis with Spring 2021 (127 statements) instead of the Fall 2020 (110 statements) data as a larger number of value statements were reported by participants. In addition, we expected the Spring data would reflect a broader set of values as participants had completed additional coursework in creative and project-based learning. Two coders began by open coding the value statements of the Spring 2021 data: initial codes were discussed by two coders, compared and combined as needed for consistency; and grouped into a set of thematic categories. The interview and focus group transcripts were used to ensure the value statements were interpreted correctly; as part of debriefing interviews and focus groups, the participants explained their listed values verbally and gave additional context to their value statements. The codes were applied to the transcripts, and value statement codes were updated if misinterpreted. Based on participants' explanations from transcripts, the codes and thematic categories were revised. For the Fall 2020 data, we took a hybrid approach to coding; both deductive and inductive coding was conducted and the updated codebook from Spring 2021 was referenced in this process. Interpretations of the codes were validated using a similar approach to the Spring data and the codebook was finalized, resulting in the current version of the codebook provided in Table 1. Throughout this iterative coding process, the two coders regularly presented iterations of the codebook and preliminary findings to the full research team. As a group, the team discussed and refined the definitions of categories, and determined the criteria by which value statements would be organized into specific categories. This process worked to eliminate ambiguities and to ensure reliability of the categories and subcodes. While the research team collaborated extensively in interpreting participants' statements and the undergraduate researcher who conducted the probe reviewed the analysis, there was no direct verification of the categories with participants themselves.

The use of frequency and rankings supplemented the analysis of the codebook through uncovering and comparing the relative significance of each category. We specifically referred to three criteria for each category:

1. Frequency (*Frq*): the overall number of value statements coded with a category or breadth of the category. This indicates the extent to which it is recognized by all participants.
2. The number of participants who listed at least one statement in the category (*Ps*): This indicates the degree to which a category is *recognized* by the participant group as a whole as salient.
3. The number of participants who listed at least one statement in the category and ranked it as no.1 (*Pri*): This indicates the degree to which a category is *prioritized and highly valued* by all participants.

Results

Codebook descriptions

Across Fall 2020 and Spring 2021, participants responded with 237 value statements (Fall = 110; Spr = 127). 14 statements (Fall = 5; Spr = 9) were not coded as they did not convey values around documentation. 1 statement in the Fall data and 4 statements in the Spring data were double-coded as the sentence contained two semantic segments, each corresponding to one category. As such, a total of 228 codes were applied to 223 valid value statements. From this, 9 organizing categories were identified. All categories appeared in both Spring and Fall data. Table 1 shows the categories, their definitions, the total number of statements per category (*Frq*), and the number of participants that identified a category as salient (*Ps*) and highly valued (*Pri*) in each category.

Of the nine categories identified in the student data, four were grouped as *metacognitive* (reflection, self-regulation, organization, creative process) and five were identified as *mediating* (communication, demonstrations, record keeping, proof, requirement). These categories were also ranked by frequency in Table 1. We present and discuss the findings organized by groupings and categories. Figure 3 displays the relative importance of the documentation categories, and indicates in color to which main group each category belongs.

Documentation for externalization

Documentation for Communication (54 of 223, 24.2%): All participants identified documentation as playing a role in communication; and this was also the perceived as the most highly valued (8/11) category by participants. Communication involves students sharing documentation artifacts with others as a reference to construct a shared understanding between them, to inform them of their work and processes, and sometimes to persuade them of the merits of the work. Within the context of the pandemic and the resulting changes to learning, the role of documentation in communication had particular salience, as P04 discussed: "… since we are online, and sometimes in different time zones, [documentation] having the collaborative or constantly documenting nature helps us … keep track of progress."

In addition, participants indicated that documentation supported useful communication with a wide range of audiences: internal stakeholders (17/54), external stakeholders (11/54),

Table 1 A Summary of the categories for the values of documentation (Frequency, Salience, Priority) ⊡ indicates a metacognitive category, while ⊞ indicates an external/mediating category

Category	Definition	Frq	Ps	Pri
⊡ Documentation for Reflection	Documentation is used to **self**-reference prior project work, and work in progress for future projects: e.g. check information, review and reflect design, relearn for future project.	**26.4%** (**59**/223)	10/11	6/11
⊞ Documentation for Communication	Documentation is used to accurately inform or persuade, and receive feedback from **others**: e.g. peers, professors, clients, customers and the public.	24.2% (54/223)	**11/11**	**8/11**
⊞ Documentation for Demonstration	Documentation is used to demonstrate the project attributes and personal capabilities to **others** (e.g. project outcome, the flow of project making, showcase personal skills and competencies) in forms of course deliverables, portfolios, and social media posts.	17.9% (40/223)	10/11	6/11
⊡ Documentation for Self-Regulation	Documentation helps **individuals** build self-confidence, provide motivation for project making, develop growth mindsets, and can provide a sense of joy and accomplishment	10.8% (24/223)	8/11	4/11
⊞ Documentation for Record Keeping	Documentation is used to store, archive and organize records of learning artifacts that **one** may or may not use in the future.	7.6% (17/223)	7/11	3/11
⊡ Documentation for Organization	Documentation helps with the **individual** learner's organization: e.g. planning, coordination, multitasking, time management	4.9% (11/223)	6/11	5/11
⊡ Documentation for Creative Process	Documentation artifacts help support **individuals** generating, exploring, comparing ideas, and preparing iterations.	4.9% (11/223)	6/11	1/11
⊞ Documentation as Proof	Documentation is used as evidence to track group accountability, and provide proof of creative output and ownership to **others**.	2.7% (6/223)	5/11	1/11
⊞ Documentation as a Requirement	Documentation is completed as an expected professional output or deliverable for a course.	2.7% (6/223)	5/11	1/11

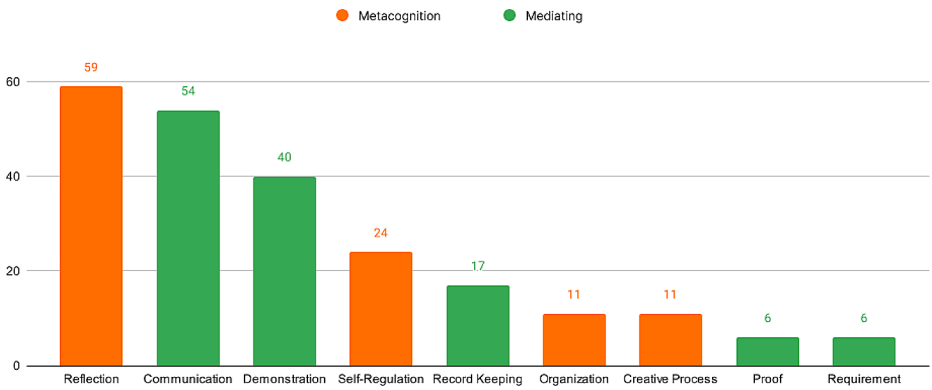

Fig. 3 A bar chart that displays the relative importance of the documentation categories. This combines both the spring and fall statements. The chart is ordered based on the highest frequency. The two main groups, metacognitive (depicted in orange) and mediating (depicted in green), are also highlighted

and general 'others' (26/54). Internal stakeholders represent people who are relevant to the project within the academic setting or a capstone client/company. This encompassed team members, (actual and imagined) subsequent teams, professors and peers. Within *internal stakeholders*, the use of documentation to facilitate collaborative peer communications was the most prioritized (4/11) among all the subcategories. For example, P06 mentioned documentation could "help people in a team be on the same page". Beyond this, 2 participants (P02, P08) envisioned documentation as an important mechanism to help future teams build upon their project work with greater ease. P08 listed a value of documentation was to "improve transition or passing of knowledge to subsequent teams." In the debrief session, P08 elaborated that they pictured themselves "in a business setting when writing this [statement]." Additional statements pointed out how documentation artifacts assist in preparing for presentations, as well as receiving direct feedback from professors and peers in a classroom setting. *External course stakeholders* included established clients, end-users, and critique/review juries. 10 out of 11 statements focused on communication with external stakeholders, and could be organized into two main goals: to explain their ideation; and to present the merits and benefits of their project outcomes. *General 'others'* included statements that recognized other stakeholders or public audiences that were not directly involved in their project, the course or the review of outcomes. The most noted reason for sharing documentation with general audiences was to explain the project, the design processes, and/or decisions to help others more easily understand their work. P07 explained that "I want to share my process, how I do things, and any tips or learning experiences along the way, and documentation helps me record and remember that." Participants also identified values around educating other young scholars and emerging professionals in the field, informing the project process through storytelling, and receiving judgment and feedback. As P07 discussed: "I might need to share the work to my peers or friends for feedback."

Documentation as Demonstration (40 of 223, 17.9%): 10 out of 11 students discussed the value of demonstrating their work through documentation to external audiences from the perspective of determining *what to demonstrate, where to demonstrate* and *to whom*. We distinguished this value from communication in the way that it leaves space for open discussions about how work functions without students' trying to persuade the audience of the original intent. Therefore, the subcategories are organized into: demonstrating the project; displaying personal skills; portfolio making for job application/admissions; and self-promotion and reputation building on social media. Showcasing a project was most mentioned subcategory (22 statements), and could be subdivided into valued practices in showcasing: (1) project process; (2) the overall project and its outcomes; and (3) details of project features. Among the participants, demonstrating project process often referred to developing a visual narrative that relayed the ideation and the key stages of project making. In demonstrating processes, P5 appreciated that documentation could be used "to show a step-by-step process", while P10 discussed how documentation could be used to reveal "the different stages and overall process of a particular project". Demonstrating the overall project reflected the intent to convey a working vision of the entire project alongside the final implementation. Participants' statements that related to showcasing an overview of the final work, expressed a desire to "look at the bigger picture of things (P11)" and "to capture final work/product (P5)." Finally, demonstrating project details refers to statements that aim to take a closer look at the project details, such as the "contexts and scales (P05)." However, among all the subcategories, *portfolio-making for jobs and internship applica-*

tions (frq = 9; Ps = 6/11); Pri = 4/11) was the most consistently valued. "Documentation to place in a portfolio for job applications (P10)" was perceived to strongly connect learners to tangible opportunities for career development. P05 explained that "coming from creative majors and creative backgrounds, portfolios play such a huge part in probably why we all document … if you're trying to get a job, it's really important for us." Additionally, three participants (P07, P10, P11) mentioned the importance of also sharing documentation in social media and on personal websites to obtain social recognition. Social media platforms were particularly resonant with participants in this regard. They were emphasized as key mechanisms "to publicize/promote myself and my work (P07, ranking no. 2)" and to "… get likes (P07, ranking no. 2)".

Documentation as record keeping (17 of 223, 7.6%): Archiving, and preserving work — especially in digital formats —, along with the ability to access accounts of past projects, was seen as very valuable with 7 participants identifying this category as important. Participants viewed documentation as a collection that "serves as a backup (P09)" of their work in case they "lose the actual piece (P07)." Participants also mentioned documentation as archive "can be retrieved anytime (P03)."

Documentation as Proof (6 of 223, 2.7%): 5 participants covered the use of documentation as an evidence to show how they individually (or members of their group in collaborative work) had contributed to a project's development and to its processes. For example, P07 remarked how documentation could "prove that it's my own work." Within this category, demonstrating ownership of creative processes and outcomes was also noted as valuable; P5 considered documentation "as evidence of ideation".

Documentation is a requirement (6 of 223, 2.7%): 5 participants discussed how documentation was often a set expectation, either as a course requirement, or a professional norm. 2 statements noted the requirements of assignment and classroom deliverables were a motivator to document. While 4 statements reflected that documentation is a "recommended…(P07)" and "considered good practice (P09)" for "professionalism (P08)."

Documentation for metacognition

Documentation for Reflection (59 of 223, 26.4%): 9 of 11 participants valued documentation as a vehicle for personal **reflection** that could be used for future reference and relearn from. 6 participants ranked it as the most important value of documentation in their statements. Within this theme, the most mentioned subcategory (28 value statements), as well as the most prioritized subcategory (Pri = 3/11) is to re-examine the project and its design moves, highlighting how documentation enabled students to *trace back the design process* and justify design decisions for themselves during or after project making. For example, P09 valued referring to documentation of a previous project as a means to "understand pathway/decisions leading to final product (no.2)"; and at the same time, P09 acknowledged the value of "refer(ring) back to (documentation) during project (no.2)". Another often mentioned affordance (19 value statements) is using documentation to retrospect, and avoid forgetting or misremembering (either for themselves or within groups.) P03 ranked the value of information checking the highest: "I can easily recall what was discussed or what the progress of the team was by going back to my notes." Other statements in this category ascribed value to the ability to refer to documentation to re-learn and re-immerse in the details of a project to help enact future projects. P11 noted that looking back at documentation holds benefits

because it "help(s) inspire future ideas" and provides reusable materials to "relearn" that "lessen workload in the future".

Documentation for Self-Regulation (24 of 223, 10.8%): The category of self-regulation encompasses students' motivation, dispositions, and emotions in the learning process. This affect towards the project can enhance a student's active participation and engagement through project creation and the performance of creative processes (Greene et al., 2019). 8 participants mentioned the role that documentation plays in helping to build self-regulated learning. Participants noted that documentation aids in reviewing personal progress and seeing self-improvement over time. For example, P07 and P08 ranked the value of "track[ing] my improvement over time" and "changes and growth over time" as the most significant values. Participants were also keenly aware that documentation advanced their self-confidence and contributed to a feeling of fulfillment with their creative work: "(I feel) satisfying in seeing(ing) how far come from before and after a project (P02)", "looking through it (helps) for a self-esteem boost (P07)." Additionally, the most mentioned subcategory (frq = 7) highlighted how documentation provides motivation for students' to improve their projects. For example, P01 gave ranking no.1 to the statements "tend to iterate more", "pushes me to think more about [the project]". Finally, other statements (Ps = 2) centered that the process of documentation is enjoyable and satisfying in and of itself, and that documentation is fun to review. This affect for documentation was affirmative for participants.

Documentation for Organization (11 of 223, 4.9%): 5 participants mentioned that documentation helps with their project management. Participants noted that documentation "helps me stay organized with tasks that are complex (P03)", "helps me juggle multiple projects at the same time (P11)", and "helps me keep organized (P06)" P3 also noted it "practices my structural thinking" and this in turn allowed participants to be "more time efficient in [the] long run (P08)" because documentation offered a way to "record progress for adjusting plans (P04)." All 5 of these participants highly prioritized this metacognitive category.

Documentation for Creative Process (11 of 223, 4.9%): 6 participants discussed how documentation helps them evolve projects. 3 participants recognized documentation's value in "helping generate new ideas (P11)." Eight additional statements indicated documentation's value in making iterations and next steps visible. As P02 explained, documentation helps to "keep track of my progress to find places that need more work." P03 also pointed out that documentation helps to "identify bugs and be able to restart from that step."

Comparison between Fall 2020 and Spring 2021 data

Figure 4 illustrates students' perception of documentation in terms of the count of quotes (*Frq*) and the number of participants that prioritized a value statement under each category *(Pri*) across Fall 2020 and Spring 2021. Comparing data between Fall 2020 and Spring 2021, the frequency distribution of the categories describing students' values for documentation remains stable over time, albeit with some variation in the frequency of statements under each category. However, 6 of 9 categories have a slightly higher prioritization in Spring. In addition, statements in Spring 2021 covered a larger range of subcategories as compared with Fall 2020.

The number of statements coded in *documentation for reflection* decreased by 7 (Fall = 33; Spr = 26). One more participant listed values under this category (Fall Ps = 9/11;

Fig. 4 The changes of counts and prioritization under each category between Fall 2020 to Spring 2021. Bar chart demonstrates the prioritization (Ps) of categories between Fall 2020 and Spring 2021. The points demonstrate the counts (frq) under each category between Fall 2020 and Spring 2021

Spr Ps = 10/11) and 2 more participants prioritized this value in the Spring semester (Fall Pri = 3/11; Spr Pri = 5/11). Within *documentation for reflection*, the most changed subcategory (Change=-6) in Spring was for *relearning and informing the development of future projects*.

Documentation for communication saw an increase of 14 statements (Fall = 20; Spr = 34). While all participants identified this value in both Fall and Spring, 2 additional participants prioritized this value in Spring (Fall Pri = 4/11; Spr Pri = 6/11). The increase in statements is evenly distributed among the communication subcategories, with mild changes typically of ± 1. The subcategory, *facilitating team collaboration*, had an increase of 3 (Fall = 3; Spr = 6), with two more participants from Spring recognizing this subcategory. We observed that participants placed greater emphasis on showing their project work to external stakeholders like clients, making presentations to people within school, and receiving judgements and feedback from stakeholders (internal and external) in the Spring data. This saw an increase of 3 quotes in Spring.

Documentation for demonstration increased by 12 statements (Fall = 14; Spr = 26). 1 more participant value (Fall Ps = 7/11, Spr Ps = 8/11) this category, and 1 more participant prioritized this value during Spring (Fall Pri = 4/11; Spr Pri = 5/11). The subcategory *demonstrating personal competencies* was not mentioned in Fall but only in Spring (Fall = 0; Spr = 2; Change = +2). The highest increased subcategory is the *demonstration of project outcomes* (Fall = 3; Spr = 7; Change = +4).

Another evident change among all categories is the increase of 6 statements in the category *documentation for self-regulation* (Fall = 9; Spr = 6), with 3 more participants in Spring prioritizing this value (Fall Pri = 1/11; Spr pri = 4/11); the highest prioritization increases among all categories. In particular, participants only surfaced use of documentation to reflect upon their personal growth in Spring (Fall = 0; Spring = 5; Change = +5). Interestingly, participants noticing documentation as something providing a *sense of joy* increased by 3 (Fall = 1; Spr = 4.) Conversely, *documentation is a requirement* decreased to one statement in Spring (Fall = 5; Change=-4), and saw the prioritization decrease (Fall Pri = 1/11; Spr Pri = 0/11), indicating that students may have placed less on assessment requirements and professional norms in the Spring. These two factors may be related.

Expanding views of the learning community

Within the Spring focus group, participants uniformly identified the trend of sharing their projects with a broader range of audiences through portfolios, by informal sharing with family, and by posting on social media. P11 mentioned: "my major plays a big part in why I value sharing my work … I like to share a lot of my work, especially with my family." P10 also identified that "creating images (of the project) for social media posts, like LinkedIn, Instagram, it's something a lot of our students do". P04 shared their experiences of using blog and social media posts as a place to progressively document and provide updates to others about their creative projects. Unsurprisingly, participants also referenced an often-discussed aspect of documentation in creative learning: receiving feedback on their work. Feedback is well understood to be a vital form of learning assessment in studio cultures (Boling et al., 2016; Sawyer, 2022). However, we observed that students sought feedback via social media and in particular the discussion of work that could unfold with peer and professional audiences on those platforms. For example, P02 remarked that they "saw this one quote that it's not practice until you hit publish… You have to get your work out there in order for it to truly count as practice and get feedback from people." Participants' expectations to engage in conversation outside of the classroom indicated students are expanding their creative learning community.

Discussion, conclusion and future work

Documentation of work in progress as a key practice in creative-, project- and studio-based learning acts as a point of both *inward* reflection — an internal motivation for learning —, as well as, *outward* form of communication — an external motivation of learning. Our work highlights that participants value these internal aspects in five main categories, documentation: for reflection; for record keeping; for self-regulation; for organization; and for sustaining the creative process. For the external aspects, students valued documentation: as a means to mediate communication, for demonstration, as proof, and as a requirement.

During the Spring semester there was an increase in the number of quotes, as well as the number of statements prioritized by participants, in almost all of the categories concerned with outward connection, except for *documentation as a requirement*. This increased focus on outward connections may potentially be related to a larger prevalence of capstone projects, a normal emphasis on opportunity seeking (internships and jobs), and/or a relaxing of COVID restrictions which were experienced in the Spring semester. Several participants also foregrounded another reason for the increase: an increasing trend among young creative professionals seeking to build a creative community by sharing their documentation to connect with a broader range of audiences outside the classroom and through a variety of channels. Recent scholarship highlights how these digital platforms are reshaping younger generations' perceptions of "social norms, literacy and well-being" that favor a more 'connected learning' sensibility (Ito et al., 2020.) Our work raises implications for the studio setting. We highlight how social platforms are equally shaping professional norms, valued practices, and expectations for students' documentation. While our findings highlight that students are actively cultivating creative communities of interest around their work, we also underscore the need for systematic investigation into the ways learners are developing new

cultures, social engagements, and expanded forms of feedback beyond their formal learning community in creative learning environments.

We have also observed increasing recognition by students of the important role that documentation plays in both helping to manage the metacognitive and affective 'roller-coaster' inherent in studio- and project-based learning. Students valued documentations' role in fostering self-regulation and in how it provides intrinsic motivation to advance the quality of project work, encourage iteration, as well as, to seek self-improvement of skills and performance outcomes. At the same time, students valuing of documentation as a requirement reduced in import. It has often been discussed that students should ideally value documentation as an enjoyable and intrinsically motivated habit of creative practice. Importantly, we have found preliminary evidence that, at least some, students do and are experiencing and valuing documentation in these ways. Better understanding how, when, and why documentation shifts (as observed in this study) from being a requirement to being a valued personal practice, is needed. We believe our design probe method may have utility in investigating this further.

Documentation is at the heart of creative dialogue with oneself, one's collaborators, and with the extended creative community that learns from and builds on the precedent work of each other. This study has aimed to better characterize this from a student-centered perspective. Documentation not only plays an active central role with "animating artifact agency" in the critique feedback setting (Sawyer, 2022), but also takes on an expanded agentic role as being the site and locus of dialogue about the learning artifacts of creative work over time and across communities. Our findings suggest the need to keep studying documentation as an intersectional practice — as well as to provide an exploratory student-centered activity and coding framework in support of this inquiry — in creative learning environments, where there are no right answers, but rather choices to be negotiated around which direction to take.

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Declarations

Conflict of interest The authors declare that they have no conflicts of interest regarding the publication of this manuscript.

Compliance with ethical standards The Carnegie Mellon University Institutional Review Board (IRB) has reviewed and granted approval before initiaion, IRB ID: STUDY2020_00000447. The authors have no competing interests to declare. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Endnotes (1) A full codebook included subcategories and examples is at: https://tinyurl.com/2ejsnrb6

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