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Instructional Designers as Reflective Practitioners: Developing Professional Identity through Reflection

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Abstract As the design thinking approach becomes more established in the instructional design (ID) discourse, the field will have to reconsider the professional identity of instructional designers. Rather than passively following models or processes, a professional identity rooted in design thinking calls for instructional designers to be dynamic agents of change who use reflective thinking to navigate the design space and develop solutions to ill-structured problems. Graduate programs in ID will also need to prepare students to manage the complexities they will encounter in their professional practice, including the establishment of design precedents, reflective thinking skills, and the foundations of professional identity. This research explored the use of reflective writing assignments in an introductory ID graduate course, with results indicating that most students are able to engage in meaningful reflection in relation to prompts concerning design concepts, experiences, and identity attributes, although no clear patterns of improvement emerged over time. Future directions for research include the use of feedback and the structure of prompts (including frequency of writing assignments and wording of prompts) to support improved student performance.

Keywords instructional design, design thinking, reflection, professional identity, design precedents, graduate training

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Fundamental to the design thinking approach, as outlined by Boling (2008), Cross (2011), Lawson (2006), and Nelson & Stolterman (2012) among others, is the idea that designers are the dynamic drivers of the design process who use their knowledge, experience, and intuition to navigate the design space and recursively refine both problem and solution until an innovative outcome is reached. As such, design necessarily relies on designers' judgment, or the ability to balance elements of the design problem against their own storehouse of design knowledge, which is highly personal and can't be separated from the knower, in order to reach decisions (Nelson & Stolterman, 2012). Design knowledge emerges from the accumulated episodes in an individual's history of design choices and consequences, both directly experienced and observed; these episodes have been conceptualized as design precedents (Tracey & Boling, 2013). Reflective thinking, another concept foundational to design thinking (Cross, 2011), provides the designer with a pathway to consider and re-consider design precedents in the face of complex and novel design problems (Tracey & Baaki, 2014), leveraging them in service of design judgment, decisions, and action.

While ID has traditionally viewed itself as a process-driven field, design thinking has assumed an increasingly prominent role in the discipline's discourse over the last several years (Luppardini, 2003; Tracey & Boling, 2013). This shift – from relying on models to govern the design process to positioning individuals as the central source of design solutions that emerge from personal judgment and experience – signals a need to re-imagine the identity of instructional designers. Rather than passive followers of ADDIE or other formal processes, they are active and reflective agents of innovation whose storehouse of design precedents feeds professional judgment and action in the design space. Accordingly, graduate training in ID must support novice designers in developing

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professional identities that align with the complexities and expectations that they will encounter in the real world of design practice. This includes opportunities to build the foundations of their design precedent storehouse as well as build their ability to reflect on the field, their experiences, and themselves, as these entities interact to produce design knowledge, judgment, and action.

A potential avenue for incorporating these elements into ID education is the use of reflective writing in the design curriculum. Reflective writing is commonly used in other academic departments ranging from education (a discipline closely linked to ID) to nursing, social work, medical school, and psychology, and is often incorporated as a pathway for developing professional identity (Bourner, 2003; Davis, 2006; Henderson, Napan & Montiero, 2004; Luehmann, 2007). The research presented in this article investigates the use of reflective writing assignments in an introductory ID course for graduate students, with the goal of improving our understanding of how instructional design novices use reflection in support of precedent building and professional identity construction.

Defining reflection and its role in design

The idea of reflection as a catalyst for learning has its roots in the work of Dewey (1991) who described reflection as an active and ongoing contemplation of one's beliefs, experiences, or other forms of knowledge including critical assessments of their foundations and implications (Blaschke & Brindley, 2011; Davis, 2006; Henderson et al, 2004). While there is a lack of ongoing consensus as to a precise definition of reflection, most conceptions of the term share a common emphasis on reflection as the personal and internal construction of knowledge through volitional and recursive considerations and interpretations of one's experiences or beliefs. Within the tradition initiated by Dewey, reflection can and should be used as a way to solve problems; this is the primary motivation for using reflective thinking. However, reflection can also be seen as a method to define and refine one's beliefs, values, and conceptual perspectives, expanding its utility beyond the sphere of problem-solving (Atkins & Murphy, 1993; Hong & Choi, 2011; Langley & Brown, 2010). As such, reflection becomes a crucial tool for the formation of professional identity, which materializes in part from continuing, dynamic narratives and reinterpretations of relevant experiences in support of conceptions of the

professional self (Luehmann, 2007).

Schön (1983) also extended our understanding of reflection by locating it not only in the learning context but also as a key element of professional practice, and introduced the ideas of “reflection-in-action” and “reflection-on-action.” Reflection-in-action refers to ongoing internal dialogues that individuals have in the midst of a problem or experience as they interpret (and re-interpret) situational factors in light of personal experiences, beliefs, and knowledge to make decisions and work toward resolution of the problem (Schön, 1983). Reflection-on-action focuses on the construction and revision of narratives and explanations surrounding prior experiences, practices, and beliefs, which again are personal to the individual, and subject to ongoing reinterpretation as the individual encounters new experiences or gains new knowledge (Schön, 1983). McAlpine & Weston (2000) outline an additional category, reflection-for-action, which involves drawing on past experiences when considering future actions. As Luppicini (2003) describes it, reflection can be directed toward “what has happened already, what is currently happening, and what could happen” (p. 77). The last point, reflection on what could happen (or reflection-for-action), is particularly relevant, since the driving force of design is to create something new, to give shape to something that had not existed prior to the presentation of the design problem (Cross, 2011; Luppicini, 2003).

Thus, it is not surprising that reflective practice is a central, defining feature of design thinking, which positions design as the set of specialized activities and particular habits of thought used to solve ill-structured problems that involve uncertainty, instability, and novelty, as well as the possibility of conflicted values (Cross, 2011; Lawson & Dorst, 2009; Lowgren & Stolterman, 2004). Within the design space, designers use reflection to examine design situations with discipline, invent and re-invent processes, and take personal responsibility for the effects of their decisions rather than handing off responsibility for quality outcomes to a single process or theory (Nelson & Stolterman, 2012). Designers are established as integral to successful design through their role as active, influential change agents, who bring their own experiences, perceptions and interpretations to the situation, and who recursively refine both the design problem, potential solutions, and their own perspectives through the transactional process of reflection (Tracey & Boling, 2013). Reflection (before, during, and after the design situation) serves as the dialogic

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bridge between the problem and the designer's knowledge derived from their personal set of precedents and in doing so, provides a springboard for design judgments, decisions, and actions.

Incorporating reflection in ID curriculum

For novice instructional designers, opportunities to develop reflective thinking skills are important for professional development in alignment with design thinking. Not only is there merit in the knowledge constructed as consequence of reflection, but developing the skill of reflection is, in and of itself, a valuable learning outcome, especially for novice designers who will rely on reflective thinking to navigate their professional practice. One of the key benefits of reflection is its supportive connection to life-long learning; in other words, reflective learning should assist students in acquiring the metacognitive tools to construct knowledge and engage in critical analysis of their own thinking, actions, and experiences long after they leave the learning environment (Ada, 2010; Blaschke & Brindley, 2011; Bourner, 2003; Lin, Hmelo, Kinzer, & Secules, 1999).

The use of reflective thinking and writing as a pedagogical tool has a long tradition in the practice of education (again, dating back to Dewey), and journal writing in particular has been researched and implemented as a space for documenting reflection on experiences, beliefs, and knowledge (Pavlovich, Collins, and Jones, 2009). Dewey's original conception of reflection emphasized an open, holistic space for learners to engage in reflection, free from the imposition of outside structure, while other scholars have emphasized the value of prompts as scaffolding to support novices in acquiring reflective skills. As an example, Whipp (2003) found meaningful improvements in the levels of reflection among teacher education students after increasing the amount of scaffolding provided to students in an online course. Techniques that were found to be most effective in this study included tailored and general questions related to social, political, and moral issues as well as prompts to draw connections between course readings and student experiences. It is also important to consider scaffolding practices in relationship to student development in the course; in other words, as students progress in their reflective work, scaffolds should also align with this progress and continue to challenge students to improve the depth of their reflection (Ada, 2010).

While there has been some academic attention paid to reflection-in-

action as it relates to novice designers, particularly within studio-based training programs, there has been little research done on the role of reflection-on-action, which may be more suitable to emerging designers who are just starting to build design precedents and may not have as many opportunities to engage in reflection-in-action. Furthermore, it is possible that their ability to reflect in the design space may be enhanced if they have chances to practice and develop reflective skills outside of the new challenges and pressures they may face in the problem situation via reflection-on-action; even for professionals, the ability to articulate internal processes in the design space can be challenging (Atkins & Murphy, 1993; Cross, 2011). Research with teacher education students has demonstrated that reflection-on-action can have a positive effect on belief change, supporting students in assimilating and/or accommodating new experiences while providing a framework for the construction of professional knowledge (Tillema, 2000). Given this, we believe incorporating reflection-on-action in introductory ID courses will be a valuable tool to support novice designers in building design precedents and developing reflective thinking skills that can be used before, during, and after design events to improve their design judgment and actions.

Method

Developed within a design-based research framework, this qualitative research effort began with a pilot study in 2012, which was an initial exploration of how graduate students use reflection to explore designer identity (Tracey & Hutchinson, 2013). This study examined journal responses from two sections of an introductory course in instructional design, with a total subject pool of forty students. Because of the preliminary nature of this research line, we used an assessment process (Davis, 2006) that categorized responses as either productive (showing some attempt to reflect via examination, integration, or analysis of beliefs and/or ideas) or unproductive (also characterized as pre-reflection, a factual or surface-level response that becomes the foundation for building reflective capabilities). The research questions guiding our analysis focused on trends in productive reflection across the semester as well as trends in reflection in prompt domains (beliefs about design, experiences with design, and designer identity awareness).

The results indicated a persistent trend for students to become more reflective as the semester progressed: over 50% of first-week responses

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were considered pre-reflection, while 70% of the final responses were labeled as productive reflection. These results indicate that reflective skills can be improved with time, experience, and feedback (Tracey & Hutchinson, 2013). The results of our pilot study provided the impetus to move forward with our current research project, with the goals of a) developing a more sophisticated and nuanced understanding how graduate students in ID use reflection in relation to design precedents and professional identity, and b) establishing a more rigorous methodological framework for conducting this type of qualitative research, as described in the following subsections.

Participants and context

Participants included seventeen graduate students enrolled in an introductory course in ID offered online by a large, urban research university in the Midwestern United States. Most were beginning graduate study in ID (both master's and doctoral level), although others came from library and information sciences. Subjects varied in age from recent college graduates to retirees; ethnic backgrounds were similarly varied, including some international students.

The instructional design program at this university is aligned with the design thinking community of practice; thus, that was the framework used in this introductory course, a prerequisite for other design courses in the program. For the first seven weeks of the course, students learn about the principles of general design and design thinking; ID is not introduced until the second half of the course. The rationale behind this approach is to give students a foundation in the principles of design thinking as a framework to manage the complexities and challenges specific to ID. This course was held online using Google applications (such as Google Sites, Docs, Hangouts, etc.) within a constructivist approach that allowed students to explore concepts and build knowledge relating to design and instruction through reflective writing, case studies, and peer learning groups. As part of their participation in the course, students were required to establish and maintain a personal reflection journal in Google Docs, with access granted to the instructor for formative feedback and assessment. Students also contributed to a reflection journal that was established for each peer learning group. At the end of the semester, students were asked for permission to use their reflective journals in this research study; out of twenty students in the course, seventeen assented to

the inclusion of their journals in this project.

Because many of the students were new to reflective writing as well as to the design thinking approach used in the course, reflective writing assignments included specific prompts to provide students with scaffolding for exploring issues related to their identities as designers. As described earlier, this type of structured reflective writing can be a valuable support to students as they attempt to articulate and externalize beliefs, experiences, actions, ideas, and emotions that were previously internal and perhaps unconscious or unexplored (Lin et al, 1999). Across the semester, there were twenty-seven total reflection prompts for students' personal journal writing, covering course readings as well as beliefs and experiences relating to design and instruction. Reflective writing was assigned in eight out of the fourteen weeks of the course (weeks one through six, week eight, and week fourteen), with the number of reflection prompts per week ranging from a high of five (week five) to a low of one (week six).

Data sources

Because we were interested in how students use reflection to establish and develop professional identity through design precedents, our analysis of student journal responses focused on prompts that explored beliefs about design, experiences with design activities, and awareness of emerging designer identity. Selected prompts are listed in Table 1, along with the week they were assigned and their prompt number (e.g., Prompt 1.1 was the first prompt assigned during the first week; Prompt 3.2 was the second prompt assigned during the third week, etc.).

Data collection

At the end of the semester, student journals were exported from Google documents to master Word documents, each containing all the individual written work produced by a particular student over the course of the semester. After we selected the journal questions and responses to be analyzed for this project (see below), two sets of Word documents were created: one that organized relevant responses by student, and one that organized relevant responses by question. All journals were scrubbed of references to the students' personal identity in order to preserve anonymity during data assessment. A simple relational database was set up in Base, a database program included as part of OpenOffice, an open-

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Table 1. Reflection prompts

#	Prompt Text
1.1	What are your thoughts today about design based on watching the two videos? [Note: students were assigned to watch two short videos about well-known design firms, IDEO and Van Cleef & Arpels.]
1.2	According to Cross - "Everyone can and does design. We all design when we plan for something new to happen." Describe in detail a time when you designed something. How (if appropriate) was it - effective, efficient, creative, imaginative and/or stimulating? [Note: this prompt references the course text, <i>Design Thinking by Cross (2011)</i>]
1.3	Describe a time when you felt totally uncertain. Try to remember how that felt and the greatest challenges you faced because of the uncertainty. What did you do to handle it? Knowing that is part of being a designer is always dealing with uncertainty, how do you feel about being a designer?
3.2	Are you a Gordon Murray or a Kenneth Grange designer? Why? Which would you like to be as you ultimately develop as a designer? Why? [Note: this prompt references the course text, <i>Design Thinking by Cross (2011)</i>]
3.3	Describe a time when you had a 'sudden inspiration'. How do you let your mind relax (refer to slides 5 and 6 for this week) to help you guide this question.
5.1	Cross states that: "Design intelligence involves an intense, reflective interaction with representations of problems and solutions." Now that we are in week 5 of this course, how are you preparing to have constant, intense reflection in your daily design activities. What will work for you to make sure this happens? He also states that design intelligence is NOT simply a given 'talent' or 'gift' but can be trained and developed. How do you plan to train and develop your design intelligence? [Note: this prompt references the course text, <i>Design Thinking by Cross (2011)</i>]
6.1	As you completed the previous five tasks, what design ideas emerged for you? How did this happen? Reflect on and document your design ideas and how you came up with them. [Note: this prompt referred to a case study project also assigned during week six.]
14.4	You have now walked through 15 weeks of learning about design in general and designing instruction specifically. Reflect on this journey, what you have learned, your thoughts on designing in general, instructional design specifically, and you as a designer. Describe your future goals in design.

source productivity software suite. Each database record included fields for: student number, prompt number, full text of the student response, reviewer initials, reviewer assessments (based on the reflection rubric, which is described in more detail below), and reviewer comments. Fields were also established to allow for comparison among reviewers as well as fields for final assessment coding.

Assessment rubric

Evaluating qualitative data, particularly reflective writing, can be challenging as it requires judgment on the part of the reviewer in order to interpret meaning and assess quality. Achieving inter-rater reliability can also be difficult under these circumstances, yet adequate reliability is obviously crucial for developing substantive research results. In order to address these concerns, the research team conducted a literature search for existing approaches to the assessment of reflective writing. One of our first concerns was identifying rubrics that located reflection along a spectrum, with clearly distinguishable levels of reflective quality. This type of graded framework would generate a more nuanced understanding of our subjects' ability to reflect, beyond the binary yes/no approach used in our pilot study. Other criteria included acceptable reliability as well as explicit and meaningful guidelines for coding responses into particular levels.

This literature search uncovered the Reflection Evaluation for Learners' Enhanced Competencies Tool (REFLECT), which was developed as a rubric to assess reflective writing among medical students (Wald, Borkan, Taylor, Anthony, & Reis, 2012). As Wald et al (2012) point out, existing assessment schemes often fail to be explicit in outlining criteria for determining whether a response demonstrates reflection (or a particular level of reflection). At the same time, many existing rubrics have a deep focus on one type of reflection (such as reflection on meaning-making, as one example) rather than considering reflection in across a range of domains (such as authorial presence or emotion). As such, Wald et al (2012) designed REFLECT to address these concerns by providing clear criteria for placing a response on the reflection spectrum and by offering these guidelines across multiple areas of potential reflection (described below). After several design iterations, the final version of REFLECT achieved an ICC of 0.632 and a Cronbach alpha of 0.774 (Wald et al, 2012). Summaries of the reflection levels and reflection domains follow, and the REFLECT rubric as published in Wald et al (2012) is reproduced in Table 2.

The REFLECT rubric divides the reflective writing spectrum into four categories: habitual action, the first category, is associated with short responses typically characterized by basic, impersonal fact reporting and/or omission of important aspects of the response; thoughtful action, the next level, is characterized as more detailed and elaborate, but still

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remaining on the factual level without moving into meaningful reflection; the third level, reflection, is viewed as writing that demonstrates effort to move beyond description to incorporate exploration, questioning, analysis, or some other form of meaning-making; and critical reflection, the final level, represents a thorough and thoughtful critical approach in relation to any given reflection domain (Wald et al, 2012).

REFLECT applies these reflection categories across six domains of reflection: writing spectrum, which addresses the overall reflective quality; presence, which addresses authorial voice; description of conflict, which concerns the level of detail and insight in the description of a precipitating event or issue; emotion, which is related to the inclusion and exploration of emotion and emotional insight; analysis, which attends to the quality of meaning-making in the response; and finally, attention to assignment, an optional category that addresses how well the response aligns with the writing prompt or task. REFLECT's coverage of these domains was a particularly appealing aspect of this tool, as it permits a deeper understanding of reflective capacity, rather than relying on a single, overall assessment of reflection. By improving our understanding of what areas are more difficult for students to achieve reflection, it should follow that this information can inform and shape formative feedback in future instruction.

In addition to its spectrum-based approach and emphasis on different domains, the REFLECT rubric was designed to support formative assessment and feedback (Wald et al, 2012). This emphasis made REFLECT a natural fit for our research, which will involve the ongoing collection of student journal data and the refinement of reflective writing assignments in future course offerings within a design-based approach. Thus, REFLECT's ability to generate information that can guide subsequent formative feedback was an important consideration in selecting this tool for our research, which will incorporate explorations of the role of formative feedback in improving student reflection capabilities in subsequent studies.

Table 2. The REFLECT (Reflection Evaluation For Learners' Enhanced Competencies Tool) Rubric developed by Wald, et al (2012)

Criterion	Levels ¹			
	Habitual action (non-reflective)	Thoughtful action or introspection	Reflection	Critical reflection
Writing spectrum	Superficial descriptive writing approach (fact reporting, vague impressions) without reflection or introspection	Elaborated descriptive writing approach and impressions without reflection	Movement beyond reporting or descriptive writing to reflecting (i.e., attempting to understand, question, or analyze the event)	Exploration and critique of assumptions, values, beliefs, and/or biases, and the consequences of action (present and future)
Presence	Sense of writer being partially present ²	Sense of writer being partially present ²	Sense of writer being largely or fully present ³	Sense of writer being fully present ³
Description of conflict or disorienting dilemma	No description of the disorienting dilemma, conflict, challenge, or issue of concern	Absent or weak description of the disorienting dilemma, conflict, challenge, or issue of concern	Description of the disorienting dilemma, conflict, challenge, or issue of concern	Full description of the disorienting dilemma, conflict, challenge, or issue of concern that includes multiple perspectives, exploring alternative explanations, and challenging assumptions
Attending to emotions	Little or no recognition or attention to emotions	Recognition but no exploration or attention to emotions	Recognition, exploration, and attention to emotions	Recognition, exploration, attention to emotions, and gain of emotional insight
Analysis and meaning making	No analysis or meaning making	Little or unclear analysis or meaning making	Some analysis and meaning making	Comprehensive analysis and meaning making
Optional minor criterion: Attention to assignment (when relevant)	Poorly addresses the assignment question and does not provide a compelling rationale for choosing an alternative	Partial or unclear addressing of assignment question; does not provide a compelling rationale for choosing an alternative	Clearly answers the assignment question or, if relevant, provides a compelling rationale for choosing an alternative ⁴	Clearly answers the assignment question or, if relevant provides a compelling rationale for choosing an alternative ⁴

Notes:

¹The full REFLECT rubric also includes an optional Axis 2, which allows for further assessment of responses that are deemed as critical reflection for the writing spectrum criterion. The Axis 2 levels include transformational learning or confirmatory learning. Because of the low number of responses that were coded as critical reflection for the writing spectrum criterion in this study, we did not include Axis 2 in our results or analysis.

²The descriptions for habitual action and thoughtful action for the presence criterion are identical, so we collapsed these categories as thoughtful action for the purposes of this study.

³The descriptions for reflection and critical reflection for the presence criterion are not mutually exclusive, so we collapsed these categories as reflection for the purposes of this study.

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⁴The descriptions for reflection and critical reflection for the attention to assignment criterion are identical, so we collapsed these categories as reflection for the purposes of this study.

Assessment procedure

Our team of reviewers included five initial reviewers, all of who were PhD students in instructional technology. All student responses were assessed by two of the initial reviewers; one reviewer assessed sixteen subjects, one assessed fifteen subjects, and three assessed one subject each. Thus, every response (136 total; eight responses for each of seventeen subjects) was assessed by two initial reviewers across all six reflection domains as detailed by the REFLECT rubric. This resulted in 816 total assessments (136 responses multiplied by six reflection domains per response). If the two initial reviewers agreed on any given assessment, the review was considered final. If the initial reviewers disagreed, the response was sent to a third reviewer, the Principle Investigator. If the third reviewer agreed with one of the initial reviewers, then the assessment was then considered final. If the third reviewer did not agree with either of the initial reviewers, the assessment was sent back for adjudication. Our adjudication process involved the P.I. and the lead initial reviewer examining the response together, discussing and evaluating possible interpretations, and coming to a consensus on a final assessment.

Data management and analysis

Prior to the start of response evaluations, the team of reviewers met to discuss the rubric and the overall procedures. After approximately 25% of the evaluations had been finished, the lead and second initial reviewers met again to further discuss interpretations of the rubric, particularly the guidelines related to emotion as that was one area with higher rates of initial disagreements. The lead initial reviewer evaluated responses by question rather than by student; in other words, this reviewer assessed all responses to Question 1.1 before moving on to Question 1.2. All other initial reviewers evaluated responses by subject (assessing one student's complete response set before moving on to another). Any assessments sent to the third reviewer or to adjudication were considered by student. Assessment templates were created in Word and used to record reviewer evaluations. The lead initial reviewer entered all evaluations from other reviewers into the database, but two separate forms within the database were (one for each initial evaluator) in order to ensure segregation of data

and to avoid any contamination that might occur from seeing another reviewer's assessment prior to entering her own evaluation forms.

When both initial reviews were complete for a given student, a report was run in the database to determine any conflicts, which were then sent to the third reviewer and then adjudication as necessary following the procedures described above. When all 816 assessments had been deemed complete and final, reports were generated within the database to determine reflection levels across questions and results. These datasets were also exported to a spreadsheet program for further analysis.

Results

In alignment with our research questions, we approached our data from two angles: first, an analysis of what, if any, patterns emerged in student responses to prompts exploring design precedents and professional identity within a design thinking framework; and second, an evaluation of the performance of REFLECT as a tool for evaluating student reflection within the context of professional identity development, with an emphasis on inter-rater consistency in assessment of reflection levels.

Patterns of reflection in student responses

Aggregated reflection (across time and in total). With seventeen subjects providing answers to eight prompts, our data set included 136 responses. Each of these were assessed for reflection across the six criteria of the REFLECT rubric, resulting in 816 assessments total. Again, the reflection levels within the rubric include habitual action (HA), thoughtful action (TA), reflection (R), and critical reflection (CR). Table 3 includes assessment level results for each criteria and each reflection prompt. In looking at totals for the entire semester, 530 out of 816 responses (65%) were coded as reflection, which represents the most common overall assessment, followed by thoughtful action (21%), habitual action (9%), and critical reflection (5%); see Figure 1 for more detail.

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Table 3. Reflective assessments by reflection domain and prompt

CRITERION	LEVEL	Q1.1	Q1.2	Q1.3	Q3.2	Q3.3	Q5.1	Q6.1	Q14.4	TOTAL
<i>Writing</i>	HA	3	0	0	1	0	2	3	1	10
<i>Spectrum</i>	TA	3	3	2	1	2	3	4	3	21
	R	10	12	11	13	12	11	7	11	87
	CR	1	2	4	2	3	1	3	2	18
<i>Presence</i>	HA ¹	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
	TA	4	1	0	2	0	4	6	2	19
	R	13	16	17	15	17	13	11	15	117
	CR ²	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
<i>Conflict</i>	HA	1	0	0	0	0	1	1	2	5
	TA	6	3	2	5	4	3	8	5	36
	R	10	13	15	11	12	13	8	9	91
	CR	0	1	0	1	1	0	0	1	4
<i>Emotion</i>	HA	7	7	1	6	0	9	13	2	45
	TA	8	6	2	6	11	5	3	7	48
	R	2	3	14	5	5	3	1	7	40
	CR	0	1	0	0	1	0	0	1	3
<i>Analysis</i>	HA	2	0	0	0	0	1	1	1	5
	TA	3	3	1	4	4	2	3	0	20
	R	10	12	13	13	12	12	12	14	98
	CR	2	2	3	0	1	2	1	2	13
<i>Assignment</i>	HA	1	0	3	1	0	1	2	2	10
	TA	2	4	0	3	5	3	8	4	29
	R	14	13	14	13	12	13	7	11	97
	CR ³	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
TOTAL	HA	14	7	4	8	0	14	20	8	75
	TA	26	20	7	21	26	20	32	21	173
	R	59	69	84	70	70	65	46	67	530
	CR	3	6	7	3	6	3	4	6	38

Notes:

¹The descriptions for habitual action and thoughtful action for the presence criterion are identical (see Table 2), so we collapsed these categories as thoughtful action for the purposes of this study.

²The descriptions for reflection and critical reflection for the presence criterion are not mutually exclusive (see Table 2), so we collapsed these categories as reflection for purposes of this study.

³The descriptions for reflection and critical reflection for the attention to assignment criterion are identical (see Table 2), so we collapsed these categories as reflection for the purposes of this study

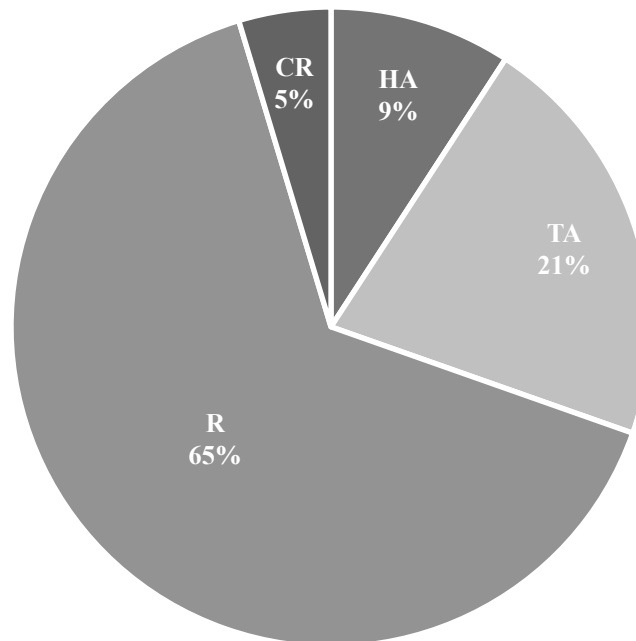


Figure 1. Aggregated reflection level percentages (totals for all prompts)

Figure 2 shows reflection aggregated by assessment level within each prompt across the semester. In general, patterns of reflection tended to remain stable as subjects moved through the semester with two exceptions. As Figure 2 demonstrates, Q1.3 (which prompted to students' to write about their experiences with uncertainty) showed the highest levels of reflection and critical reflection (R=84 and CR=7) and the lowest levels of habitual and thoughtful action (HA=4 and TA=7), while Q6.1 (prompting students to reflect on how their design ideas emerged in a case study experiment) showed the lowest levels of reflection (R=46) and the highest levels of habitual and thoughtful action (HA=20 and TA=32).

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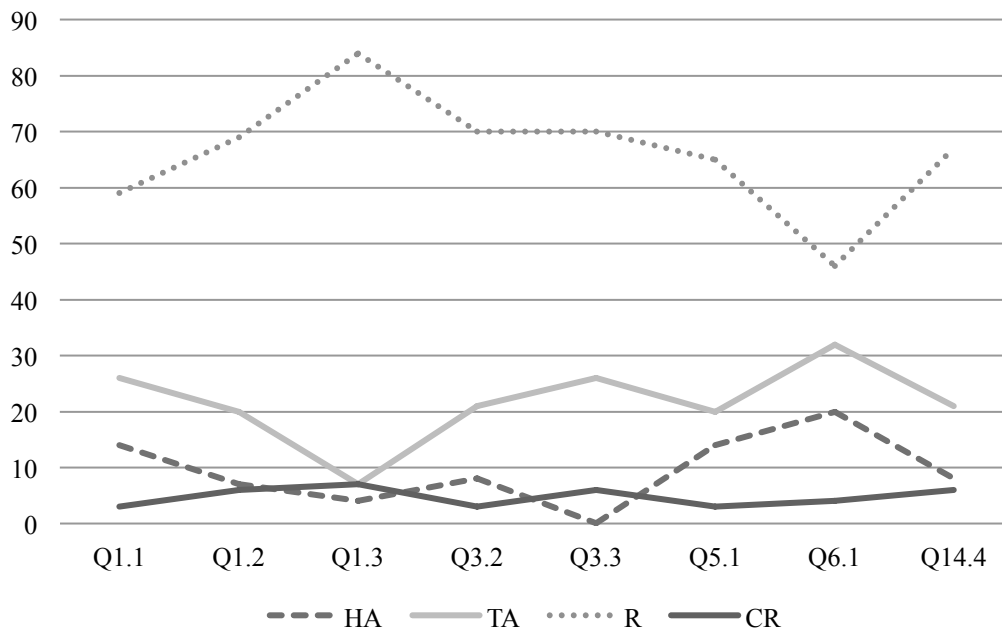


Figure 2. Aggregated assessment levels across the semester

Reflection with prompt domains Writing prompts were categorized according to domains in order to examine how subjects responded based on prompt content. The design concept domain included Q1.1 and Q14.4, both of which asked subjects to describe their thoughts on design in general. The design precedents domain included Q1.2 (reflect on a time when you designed something), Q1.3 (reflect on an experience with uncertainty), and Q3.3 (reflect on an experience with sudden inspiration). The third domain, designer identity, included Q3.2 (reflect on what type of designer you are), Q5.1 (reflect on developing your design intelligence), and Q6.1 (reflect on how your design ideas emerged). Figure 3 shows the aggregated assessment levels per prompt, organized by these domains. No domain appeared to outperform the others in any meaningful way.

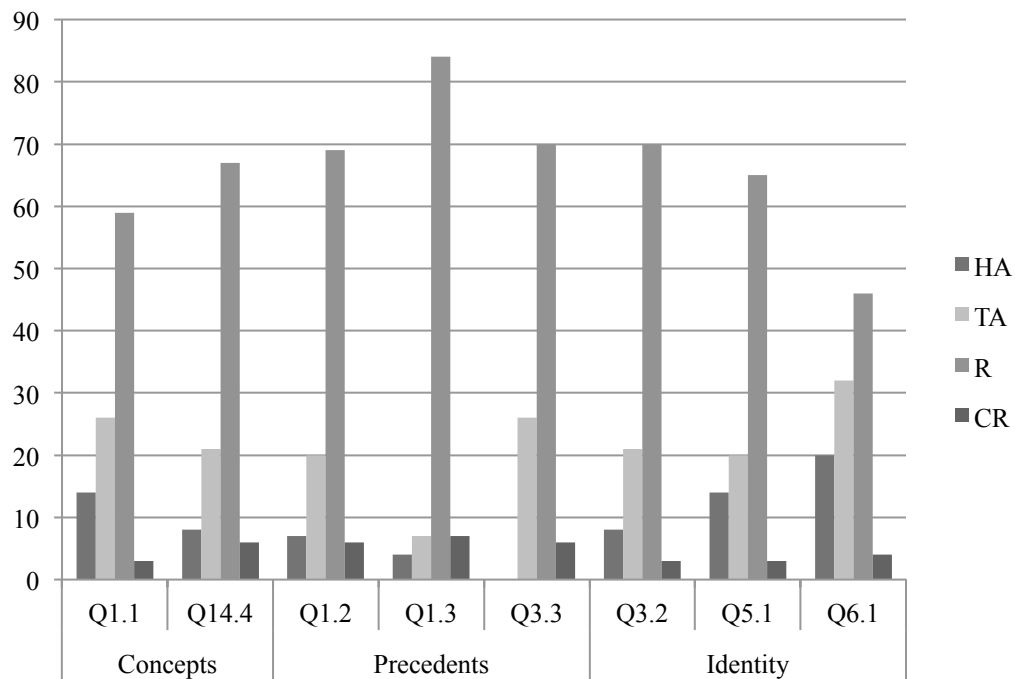


Figure 3. Aggregated assessment levels organized by domain

Reflection by criterion Next, we considered subject responses by criterion: writing spectrum, presence, conflict description, emotion, analysis, and attention to assignment (see Table 2 for more detail on the criteria). Figure 4 shows the aggregated assessments for each criterion. The presence criterion, indicating the degree to which the subject's presence was incorporated in a response, was the area with the highest levels of reflection (117) and lowest levels of thoughtful action (19); it should be noted that, due to the wording of the REFLECT rubric, the habitual action and critical reflection categories were not considered for the presence criterion; however, if assessment levels for the other criteria were similarly collapsed into reflection and thoughtful action, the presence criterion would still have the highest and lowest totals respectively. The emotion criterion had the lowest levels of reflection (R=40 and CR=3) and the highest levels of habitual and thoughtful action (HA=45 and TA=48).

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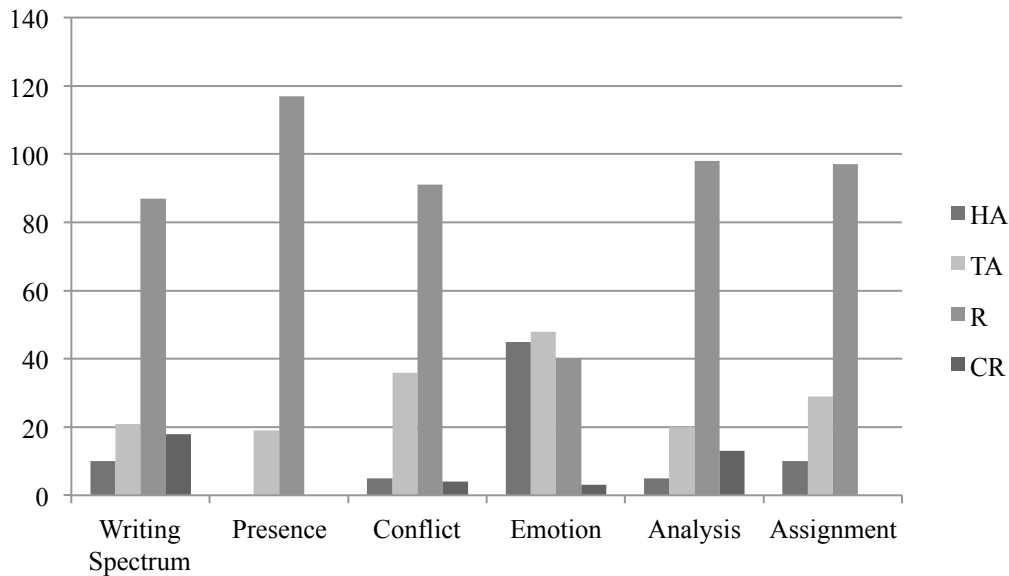


Figure 4. Aggregated assessment levels organized by criterion

Reflection by subject across the semester Assessment levels were organized by student and then converted to reflection percentages for each question; see Table 4. Reflection percentages represent the proportion of assessments for each of the six criteria per prompt that were coded as reflection (either R or CR). In other words, if a subject's response to a prompt was coded as R or CR for four of the six criteria from the REFLECT rubric, it was converted to 67% reflection rating for that response. Next, we organized subjects into performance bands based on 20% intervals; eight subjects achieved 81%-100% reflection, four subjects achieved 61-80% reflection, 3 subjects achieved 41-60% reflection, and 2 subjects achieved 21-40% reflection (no students scored below 20%). Each band was then displayed in a separate figure that charts performance across the semester for each subject in the band; see Figure 5. In general, the highest band showed the most consistent response pattern across the semester, with performance becoming more erratic in the lower ranges.

Table 4. Percentage of reflective assessments by subject across the semester

Subject #	Q1.1	Q1.2	Q1.3	Q3.2	Q3.3	Q5.1	Q6.1	Q14.4	Average %
F12-01	83	83	83	83	83	83	33	50	70
F12-02	0	83	100	67	50	83	33	67	63
F12-03	17	83	50	17	67	0	0	50	35
F12-04	67	100	100	100	83	100	100	83	92
F12-05	17	50	100	100	83	33	50	50	60
F12-06	83	100	100	50	100	100	33	100	83
F12-07	100	83	100	83	100	83	83	100	92
F12-08	83	67	67	67	17	67	0	17	48
F12-09	83	17	17	33	50	0	0	0	25
F12-10	83	83	100	100	100	100	67	100	92
F12-11	33	83	100	83	67	83	33	50	67
F12-12	0	17	100	67	100	67	83	83	65
F12-13	67	83	100	100	83	83	83	100	88
F12-14	83	83	100	100	83	83	83	100	90
F12-15	67	50	100	0	33	0	17	83	44
F12-16	83	100	100	83	83	67	83	83	85
F12-17	83	83	100	83	83	83	67	100	85

Note: We arrived at these figures by calculating the percentage of six criteria assessments performed for each response that could be considered reflection (either R or CR). For example, in response to Q1.3, Subject F12-03 had three assessments out of six that were coded either R or CR resulting in 50% reflection rate for that question.

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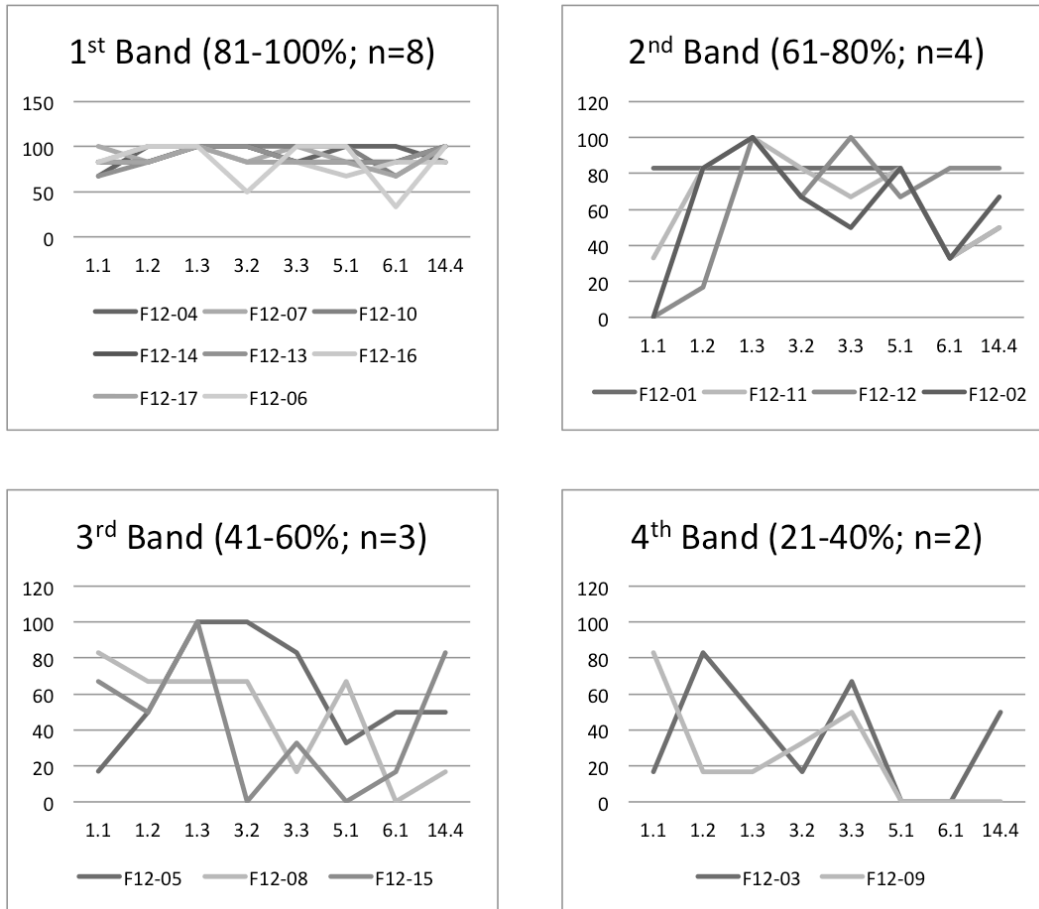


Figure 5. Reflection percentages by performance band across the semester

Reviewer agreements and conflicts

For the 816 initial reviews of Wave 1, there were 251 disagreements sent to the third reviewer, representing 31% of the total assessment pool (N=816). The domains with the lowest rates of disagreement were Presence (10% of 136 possible responses were disagreements) and Assignment Relevance (20% disagreements). The domains with the highest disagreement levels were Writing Spectrum (41% disagreements) and Analysis (46% disagreements). Conflict description (32% disagreements) and Emotion (35% disagreements) fell in the middle. For 251 Wave 1 disagreements that were sent to Wave 2 for a third review, 44 disagreements (18% of the set of initial conflicts, or 5% of the total set of responses) persisted after the

third assessment and were sent to adjudication to determine final reflection levels. In other words, 95% of all assessments achieved agreement among two out of three reviewers, with 5% requiring final adjudication on the part of the P.I. and lead initial reviewer. Table 5 includes raw numbers and percentages by criterion for Waves 1 and 2.

Table 5. Reviewer agreements and disagreements (Waves 1 & 2)

Criterion	Wave 1 Disagreements 31% of all assessments (N=816)		Wave 2 Disagreements 18% of Wave 1 disagreements (N=251) 5% of all assessments (N=816)	
	Total	% of response set (N=136) ¹	Total	% of response set (N=136) ¹
<i>Writing Spectrum</i>	56	41	9	7
<i>Presence</i>	14	10	4	3
<i>Conflict</i>	44	32	6	4
<i>Emotion</i>	47	34	13	10
<i>Analysis</i>	63	46	8	6
<i>Assignment</i>	27	20	4	3
TOTALS	251	N/A	44	N/A

Notes:

¹This indicates the percentage of the response set of 136 (17 subjects multiplied by 8 prompts) that was possible for any given assessment criteria.

Discussion and Conclusion

Subjects as reflective thinkers and writers With 70% of all assessments considered either reflection or critical reflection, these results clearly indicate that graduate students are able to respond to prompts covering design concepts, experiences, and identity attributes in ways that demonstrate the ability to examine, integrate, and analyze their beliefs, knowledge, and experiences. Contrary to our pilot study, this research did not reveal any patterns of improved performance over the course of the semester; instead, the highest reflection levels were seen in Week 1 (Q1.3), and the lowest in Week 6 (Q6.1). This may be attributable to individual differences in the subject pool, differences in the rubric used to assess reflection, or differences in the prompts that were examined (the studies examined slightly different sets of prompts).

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It should be noted that the development of reflective skills, much like other developmental patterns, is not necessarily a linear pathway (Luehmann, 2007). Individuals may be able to write reflectively about a subject at one point in time, then struggle to reflect on the same or related topics at a later date due to new experiences or knowledge that they are adjusting to in the interim period. The components that comprise design precedents and designer identity are always evolving in the individual, and it is not surprising that reflective skills may wax and wane over time as well. The contrast between Q1.3 and Q6.1 might shed some light on this. Q1.3 elicited reflection on a common emotional experience not necessarily related to design (describing a time the subject felt uncertain), gave students a specific structure to follow in their response, and also allowed them to choose an experience from any point in their personal history. Q6.1, on the other hand, asked subjects to document the origins of their design ideas in a case study completed that same week. Thus, subjects had less chronological and emotional distance from the event, and were attempting to articulate internal cognitive processes that are often a mystery even to expert designers (Cross, 2011). Even students who were reflective in earlier responses struggled to achieve reflection for this prompt, underscoring that reflective ability is situational and that regression does not necessarily signal a problem but is an expected consequence of a recursive, non-linear development pattern.

When considering reflection in terms of performance bands (Figure 5), an interesting pattern emerges: as overall reflective performance decreases, response patterns become more erratic over time. In other words, highly-reflective subjects were consistently reflective across the semester (which is not surprising), but even the lowest-performing subjects were able to demonstrate the ability to reflect at several points in the semester; in other words, they were not as consistently unreflective as the high performers were consistently reflective. This raises the question of how to support students who are novice reflectors (and designers) to build skills in this area, and what pedagogical elements will enable them to improve their performance and achieve steadier states of reflection.

Providing appropriate feedback is certainly an important avenue, and one of the strengths of the REFLECT rubric is that it is designed as a tool for providing formative assessments and feedback to students. It can be useful not only in the research context, but also in the classroom as a formative assessment rubric to guide feedback delivery. It may also be

helpful to provide a rubric (such as REFLECT) that details what it means to be reflective; research by Blaschke and Brindley (2011) indicated that student performance improved when they had a clear, transparent set of expectations to follow for reflective writing assignments. In a study of reflective learning in medical students, formative feedback was found to be a crucial factor in both the development of reflective skills as well as student engagement, whereas formal grading, i.e., summative evaluation, was not found to be an effective factor in fostering reflection (Vivivekananda-Schmidt et al, 2011). Peer feedback to support deeper reflection is an alternative also worthy of exploration; some studies have supported its use in fostering reflection (Hall & Davison, 2007; Maor, 2003; Vivivekananda-Schmidt et al, 2011) but there are also indications that peer feedback may be associated with reduced reflective quality when compared with private reflective assignments (Xie, Ke, & Sharma, 2008). Finally, feedback may need to be constructed differently for novices as compared to more capable reflectors; in other words, different types of feedback may be useful for moving a student from habitual action to thoughtful action, versus moving a student from reflection to critical reflection. Further research into the timing and nature of feedback, the source of feedback (instructor versus peer), and the interaction between feedback and student ability level will all shed more light on the role of feedback in fostering reflection.

The use of prompts to provide scaffolding to novice reflectors is also an area in need of future research, particular relating to the wording of prompts and the number of prompts in a given week or across the semester. As this current set of data is part of an ongoing, design-based research effort, we have already adjusted the wording of some prompts; for example, Q14.4 has been simplified and split into multiple prompts to cover a smaller number of topics per prompt. We are interested in exploring if this will support students by allowing them to focus their responses rather than trying to incorporate multiple ideas in one answer. Another topic in need of research is the number of prompts; for the course these subjects were enrolled in, they engaged in a significant amount of writing (27 individual reflection prompts in addition to case studies, peer group reflections, and a final project). It is possible this much reflective writing may actually end up diluting its purpose as the workload itself restricts the cognitive resources available to reflect by spreading student efforts across many prompts. Others have warned that excessive reflection will lead to it becoming an empty exercise with little meaning or

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connection for the student, or may result in students feeling overly monitored or under surveillance, limited their comfort with free expression of thoughts (Wear, Zarconi, Garden, & Jones, 2012). Additional research on the role of prompt structure and frequency will be necessary to understanding how to support development of reflective skills.

The performance of the REFLECT rubric Reviewer disagreement levels indicate that the REFLECT rubric provided a generally reliable and consistent framework for assessing subject responses in the research context. For 69% of the assessments, our two initial reviewers agreed on the assessment level; for the remaining 31%, disagreements were resolved by the third reviewer in 82% of the conflicts. In total, only 5% of all assessments were sent to adjudication (meaning that three reviewers disagreed on their assessments), so 95% of all assessments were achieved agreement by two out of three reviewers. Overall reviewer consistency rates were good, but when drilling down into the reflection domains, the aggregated score was likely inflated by high rates of agreement in presence and attention to assignment (both of which had overlapping criteria in reflection levels, thus fewer potential categories to assign, which boosts the probability of agreement vs. domains with four reflection levels).

One significant problem that arose when working with the rubric was three instances of identical or overlapping criteria for assessment levels. For the Presence criteria, habitual action & thoughtful action had identical descriptions, while reflection and critical reflection were not exclusive of each other (a response could conceivably be categorized as either, based on the rubric). It would also be helpful to spell out the difference between writing spectrum and analysis domains more clearly, as well as make the criteria for each more specific, as these were the areas of highest reviewer conflicts. Finally, there is no place where they clearly define each criterion (e.g., writing spectrum, emotion, etc.) in the article narrative; instead it must be inferred from the reflection category guidelines.

The strengths of the REFLECT rubric include a useful range of criteria, a strong description of the process the researchers used in developing and implementing the rubric, and its potential to generate meaningful formative feedback for use in the classroom. While the rubric has proved effective in the research context for this study, we believe it

also has important applications for instructors in the classroom environment that are worthy of further investigation to identify how best to use it to support the delivery of meaningful formative feedback.

We believe that it is essential to develop designers as reflective practitioners in an effort to support their professional identity development and their ability to solve complex design problems. Reflection serves as the dialogic bridge between the problem and the designer's professional identity. Tools such as the REFLECT tool can promote the design of meaningful reflection scaffold questions, effective instructor and peer formative feedback and rigorous analysis of qualitative research on reflection.

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