Feedback and Creativity in Interior Design Studio:

A Case study-mixed methods of a Junior Level Light Fixture Project

A dissertation

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Khanh Hoa Thi Vo

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DEDICATION

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ABSTRACT

Feedback plays a critical role in nurturing creativity. Current literature, however, indicates that feedback can enhance or impede students' creativity depending on its practices. Furthermore, theoretical framework and empirical evidence for effective feedback practices in interior design studios are insufficient. The present study, thus, built upon intensive reviews from the field of educational psychology on the relationship between feedback and creativity plus mediators such as feedback preferences and levels of interest. Via a case study-mixed methods approach, the study then explored effective feedback practices for students' creativity in an interior design studio at the University of Minnesota in fall 2020.

Data were collected from junior students ($n = 30$) in a five-week light fixture design project in a studio. Feedback sources included the studio instructor and the CEO of a lighting design organization. Two independent judges rated students' creativity using the Creative Product Semantic Scale (CPSS). Paired t-tests of CPSS ratings during the design process detected significant increases in Novelty of students. Pre-and post-surveys showed that students perceived the instructor's feedback as positive while they expected more from the CEO's feedback. No change was detected in students' levels of interest. Follow-up interviews with students of high creativity ($n = 10$) revealed that effective feedback practices came (a) in abundant quantity, (b) at the right timing, and (c) met students' expectations. Future research needs to explore the correlation between feedback experiences and students' creativity in multiple studio years, especially in terms of Resolution and Style, two other criteria of CPSS.

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OTHER ITEMS

List of Abbreviations

ACM	Association for Computing Machinery
ASID	American Society of Interior Designers
AUT	Alternative Uses Task
CAT	Consensual Assessment Technique
CFA	Confirmatory Factor Analysis
CFP	Creativity Feedback Package
CIDA	Council for Interior Design Accreditation
CPSS	Creative Product Semantic Scales
CS-MM	Case Study−Mixed Methods
FIT	Feedback Intervention Theory
FP	Feedback at process level
FR	Feedback at self-regulation level
FS	Feedback at self level
FT	Feedback at task level
GETM3	Global Entrepreneurial Talent Management 3
IDEC	Interior Design Educators Council

JID	Journal of Interior Design
MCT	Mathematical Creativity Test
NCIDQ	National Council for Interior Design Qualification
RAT	Remote Associates Test
SCT	Scientific Creativity Test
SDT	Self Determination Theory
TTCT	Torrance Test of Creative Thinking

CHAPTER 1: INTRODUCTION

1.1. Background

Creativity is fundamental to interior design and other design disciplines (e.g., architecture, product design, engineering, etc.), and creative design works instill economic and societal values (Borgianni et al., 2019; Cho & Suh, 2020; Doheim & Yusof, 2020). The United States gained $16.9 billion in 2015 by exporting creative design works (including architectural services, interior design products, and engineering), with this area continuing to grow by an annual average of $8.54 billion (UNCTAD., 2019). Specifically, the state of Minnesota also earned $2.167 billion in 2016 from local creative works, such as arts and design disciplines (Creative Minnesota, 2019). Likewise, society benefits from creative design works that tackle 21st-century challenges such as sustainability, health, and well-being (Eskelinen & Kanervo, 2019; Olszewski-Kubilius et al., 2016). For instance, architects and interior designers can help reduce the carbon footprint of new constructions by adapting creative uses to historical buildings (Plevoets & Van Cleempoel, 2019). Interior and product design students can respond to resource scarcity by developing creative furniture and fixtures from reclaimed materials (Asojo, 2013; Lee & Leong, 2019). Moreover, engineers and interior designers can also team up to address occupants' health and well-being in the indoor environment via creative lighting designs (Ali et al., 2019; Asojo et al., 2020).

Thus, creativity, with its evident benefits, is in high demand in design industries hiring. The Conference Board—a research organization on leadership in the United States, reported that 97% of employers (in design industries, arts, communications, etc.)

seek creativity in their hiring processes (Lichtenberg et al., 2008). The Global Entrepreneurial Talent Management 3 (GETM3) found similar patterns in the European Union and South Korea. Creativity ranked fourth among the most desirable qualities for design hiring after communication, teamwork, and organizational awareness (Bailey et al., 2018). Whereas the American Society of Interior Designers (ASID) and the Interior Design Educators Council (IDEC) identified creativity as the second most desirable quality for hiring after interpersonal skills (Gale et al., 2017). Huber (2018) too surveyed hiring preferences for interior designers via a 100-point scale with 0–20 denoting "not important," 50 "neutral," and 80–100 "very important"; ultimately, he found the score for creativity to be an average of 87.9 (pp. 27, 30). With an increase of 52% in hiring from 2010 to 2018, the interior design industry expects a high rise in the demand for creativity (ASID, 2019b).

Interior design programs accredited with the Council for Interior Design Accreditation (CIDA) respond to this demand by making creativity their educational focus. The CIDA Professional Standards 2020 states the following (CIDA, 2020, pp. II–2):

> *"Educational philosophies and goals should be applied in the development of a creative professional who can identify and analyze problems from many different perspectives and synthesize information."*

Students' creativity, indeed, has become a tangible asset of interior design programs. As of 2019, 70% of the hired employees had bachelor's degrees, while only 2% did not possess a degree (ASID, 2019a, p. 24). Creative interior designers with

university degrees can earn a median annual wage between $67,290 and $80,000 (ASID, 2019a, p. 25), higher than the national median annual wage of $53,370 in 2018 (Bureau of Labor Statistics, 2019). This emphasis on students' creativity remains the same across design disciplines and educational systems. Sawyer (2017) found rapid growth in studies to enhance students' creativity in design studios (e.g., architecture and interior design) between 2002 and 2016 in North America and Europe. Leung (2018) also reported a profound interest in theoretical and empirical studies on students' creativity in design studios around Asia.

As shown in Sawyer's thematic analysis of 65 journal articles (2017), providing feedback is a common practice to enhance students' creativity in design studios. Recent articles in interior design education have also stressed the role of feedback in preparing creative students for the United States' hiring industry (Hynes & Kwon, 2018; Makki et al., 2019; Smith & Lilly, 2016; Thamrin et al., 2019). Feedback, thus, is important for achieving creativity (Dingli & Baldacchino, 2018). As Senge et al. described (2012, p. 244):

> *"Creative people are open to criticism, they hold up their products for others to judge and seek feedback in an effort to refine their technique."*

Engineer students, in particular, utilize feedback (as well as prototyping, heuristics) to design creative products (Daly et al., 2012). Meanwhile, landscape architecture students rely on feedback to clarify studio requirements and boost their creativity (Smith & Boyer, 2015). Interior design students, likewise, use feedback to

navigate through complex design problems and come up with creative solutions (Cho & Suh, 2020). Feedback even gets regulated (to ensure creativity) via packages such as the Creativity Feedback Package (CFP) of Balchin (2008a) in the United Kingdom, CritViz (Sadauskas et al., 2013), and CritiqueKit (Fraser et al., 2017) in the United States.

1.2. Statement of the Problem

Researchers and educators in design disciplines recognize the critical role of feedback in enhancing creativity. However, they also voice concerns regarding its mixed results: Feedback can either enhance or impede creativity (Oh et al., 2013; Wooten & Ulrich, 2017) as well as evoke either positive or negative emotions (Dannels et al., 2011; Schrand & Eliason, 2012). According to Oh et al. (2013), contextual- and individual-customized feedback can enhance students' creativity in architecture studios. Nonetheless, Wooten and Ulrich (2017) found a negative main effect ($\beta = -0.567, p = 0.031$) of feedback on the scores of graphic designers' creativity. Similarly, Dannels et al. (2011) indicated that students in design studios felt stressed and vulnerable to feedback. On the contrary, Schrand and Eliason (2012, p. 55) found 81.3% of students across design studios rated feedback as "very helpful" via 373 surveys. Thus, Senge et al.'s quote on how creative people are open to criticism (2012) holds only on a case-by-case basis.

Findings across design disciplines designated the experts (e.g., tutors, instructors, and practitioners) as the core of feedback practices to enhance students' creativity (Ardington & Drury, 2017; Soliman, 2017; Yilmaz & Daly, 2015). However, feedback contents vary depending on the disciplines and student works. Yilmaz and Daly (2015)

and Ardington and Drury (2017) discussed these variances by analyzing multiple feedback videos from the Design Thinking Research Symposia and audio-recorded interviews of 22 architecture students in the University of Sydney, respectively. According to Yilmaz and Daly (2015), product design and engineering students received three to five feedback sessions with instructors during one project. Feedback was team-based and technical-oriented in engineering while one-on-one and explorative-oriented in product design studios. Ardington and Drury (2017) found feedback for first-year architecture students was more direct and frequent than that for later years. Overall, feedback that emphasized strengths and positive valence benefits creativity. When the valence was implicit, feedback became confusing, incoherent, and detrimental to creativity. Soliman's survey (2017) of 80 educators from ten universities in seven Arab countries confirmed the importance of feedback in architecture studios. However, educators cautioned that feedback should not mold students' thoughts and limit their creativity.

To address these concerns, researchers and educators across design disciplines have studied how to optimize this practice to enhance students' creativity (Balchin, 2008a; Fraser et al., 2017; McDonnell, 2016; Sadauskas et al., 2013; Tekmen-Araci, 2019). Balchin built the CFP (2008a) upon the consensus ($n = 14$) and interviews ($n = 19$) of teachers regarding effective feedback for creativity in design education (Balchin, 2008a, 2008b). Nonetheless, while aiming for higher-education applications, Balchin only tested CFP with secondary-school students ($n = 241$), whose ages were 12 to 14 (Balchin, 2008a). Except for Balchin's studies in 2005 and 2008, the CFP has hardly

been used by others since. CritViz (Sadauskas et al., 2013) is popular but only refers to peer feedback in engineering studios. While peer feedback is valuable, design students still rely on expert feedback (e.g., tutors, instructors and practitioners) to advance in creativity as shown in studies of architecture, product design, and engineering studios (McDonnell, 2016; Tekmen-Araci, 2019). The recently developed CritiqueKit (Fraser et al., 2017) is a corpus that uses machine learning to provide feedback for design students. As this approach uses fixed sets of general comments, it is counterproductive to the dynamic relationship of feedback and creativity in design studios. Overall, guidelines for feedback practices (to enhance creativity) are available but unsatisfactory. The second chapter (i.e., literature review) provides further discussions on these packages.

The above findings show that the needs for (expert) feedback, the variances in content, and frequencies in different studio levels are discipline-general. Nevertheless, studio characteristics and outcomes of students' creativity are discipline-specific (Goldschmidt et al., 2014). Therefore, an in-depth look into each discipline is vital and significant. However, studies on interior design studios are inadequate. From 1982 to 2003, the Journal of Interior Design (JID) discussed creativity and feedback in ten articles (Pedersen & Burton, 2009). The articles focused on defining creativity, briefly mentioning feedback to inform students of their developments in creativity. From 2003 to 2019, 14 articles in JID offered explicit and implicit discussions on feedback and creativity. Among those, three articles analyzed how feedback either enhanced or impeded creativity in interior design studios (Beecher, 2006; Ellis & Meneely, 2015; Oygur & McCoy, 2011). Computer scientists also have a growing interest in feedback for

interior design studios but in terms of web-based applicants rather than educational practices (Rashid & Rahman, 2014; Robb et al., 2017). These articles are insightful but insufficient for building holistic literature on feedback and creativity in interior design studios. This study, hence, aims to tackle this gap and enrich the current understanding of the subject matter in interior design studios.

1.3. Significance of the Study

As discussed above, a theoretical framework and empirical evidence for feedback practices to enhance students' creativity in interior design studios are unavailable. First, this study will contribute to the current theoretical framework by bridging creativity research and educational psychology views of feedback. Building upon the componential framework of creativity (Amabile, 1983) and the model of feedback (Hattie & Timperley, 2007), this study will elaborate on both explicit and implicit connections between feedback and creativity. Reviews of feedback practices in educational settings and (interior) design studios will provide a general understanding of how this tool affects students' performance/creativity. This understanding includes the relationship of feedback and creativity with mediators such as students' feedback preferences (Ellis & Meneely, 2015; Lipstein & Renninger, 2006) and studio levels (Dannels & Martin, 2008). This study, by bridging the fields of educational psychology and design education, will deliver holistic findings on feedback practices to enhance students' creativity in interior design studios.

Second, this study aims to explore effective feedback practices to enhance creativity in interior design studios via a case study-mixed methods approach (i.e.,

collecting, analyzing, and combining qualitative and quantitative data of a case study). The literature shows that the majority are qualitative approaches with questionnaires, interviews, and archives in the natural settings of (interior) design studios (Ellis & Meneely, 2015; Gunday Gul & Afacan, 2018; Kusumowidagdo, 2019; Oygur & McCoy, 2011; Soliman, 2017). Thus, The corresponding findings reflect the dynamic and complexity of feedback practices (Adams et al., 2016) but leave the relationship with creativity an open-ended question. Studies with quantitative approaches (Dow et al., 2012; Fraser et al., 2017; Wu & Bailey, 2017) provided strong empirical evidence for specific aspects (e.g., feedback valance and content) of the relationship in question at the expense of ecological validity. The researchers manipulated feedback with context-general and pre-determined statements, a practice that was less likely to occur in (interior) design studios. Altogether, this study will address the lack of research focus on interior design and enrich the prospective findings with both qualitative and quantitative data.

Lastly, this study will serve as a reference for feedback practices to enhance students' creativity in the CIDA-accredited interior design program at the University of Minnesota, its research venue. Emphasizing expert feedback (McDonnell, 2016; Tekmen-Araci, 2019), this study will first look for feedback practices that benefit students' creativity in a particular interior design studio (with one practitioner and one instructor). The prospective lessons (e.g., data collection and analysis) and findings then become guidelines for future follow-ups in different studio levels. In the long term, the collective findings from studios across interior design programs will help create a database for

instructors and practitioners, which they can use to review and develop their feedback practices to enhance students' creativity.

1.4. Research Questions

This study raises the following research questions:

RQ 1. What are the feedback practices of practitioners and instructors that enhance students' creativity in interior design studios?

RQ 1.a. What are the attributes of feedback practices that benefit the creativity of all students (e.g., contextual- and individual-free)?

RQ 1.b. What are the attributes of feedback practices that only benefit creativity when customized to specific students (e.g., contextually and individually customized)?

RQ 2. What are the mediators of the relationship between feedback practices and students' creativity in interior design studios?

1.5. Definition of Key Terms

Creativity: Creativity refers to a response that is new, unusual (i.e., novel), and useful (i.e., relevant) to the specific task at hand (Amabile, 1983). This study investigates individual creativity, not group creativity.

Componential framework of creativity: A framework that explains the process of achieving creativity via three components: (1) domain-relevant skills, (2) creativity-relevant skills, and (3) task motivation (Amabile, 1983).

Consensual Assessment Technique (CAT): Members of the corresponding disciplines will determine whether a task response is novel and relevant to their consensus of subjective criteria (Amabile, 1982).

Creative Product Semantic Scales (CPSS): A creativity assessment for products with seven-point Likert scales on three criteria: (1) novelty, (2) resolution, and (3) style (Besemer, 2006). Products mean ideas, proposals, processes, prototypes, or tangible products (O'Quin & Besemer, 2006).

Feedback: This study examines expert feedback (including instructors and practitioners), not peer feedback. Feedback, or critique/desk crit in design studios, is a means to help students achieve the desired performance (i.e., creative response) in given tasks and thus enhance their learning (i.e., creativity) (Hattie & Timperley, 2007; Oh et al., 2013).

Feedback content: What experts (i.e., instructors and practitioners) deliver via feedback, such as professional languages (e.g., terms and jargon), knowledge, strategies, directions/recommendations, explanations/interpretations, evaluations/judgments, comparisons, and incitation (Dannels & Martin, 2008).

Feedback preferences: Students' tendencies toward feedback based on their interest levels (Lipstein & Renninger, 2006).

Feedback valence: The affects/emotions incited by feedback that are either positive or negative (Wu & Bailey, 2017; Zhou, 1998).

Model of feedback: A guideline for giving effective feedback to enhance students' learning based on three questions and four levels. The three questions address (1) task-related goals, (2) current progress, and (3) future directions. The four levels include (a) the task, (b) process, (c) self-regulation, and (d) self (Hattie & Timperley, 2007).

CHAPTER 2: LITERATURE REVIEW

1.6. Creativity

1.6.1. Overview of Creativity

Creativity research has evolved through three movements: (1) personality (i.e., traits of creative individuals, 1950s–1960s), (2) the cognitive approach (i.e., the mental processes of creativity, 1970s–1980s), and (3) the sociocultural approach (i.e., social and cultural contexts that shape creativity, 1980s–1990s) (Sawyer, 2012). An individualist view of creativity (i.e., new combinations of thoughts that individuals express via tangible entities) dominated the first and second movements (Merrotsy, 2013). For instance, the *little c* definition (Stein, 1987) describes creativity as daily activities that are new to specific individuals. Conversely, the third movement featured a sociocultural view of creativity (i.e., products that specific social groups deem as novel and appropriate/useful/valuable) (Sawyer, 2012). For example, the *Big C* definition (Stein, 1987) refers to creativity as creations that are novel and crucial to particular societies. Thus, the definition of creativity exceeded individual boundaries and adapted to the surrounding sociocultural contexts.

Other prominent definitions from the three movements include Rhodes' 4Ps framework (1961), Amabile's componential framework of creativity (1983), and Csikszentmihalyi's constitution of creativity (1988). Despite their different timelines, these definitions all describe creativity as a multifaceted concept. Rhodes' 4Ps framework (1961) comprises of (1) *product* (i.e., socially novel and appropriate), (2) *person* (i.e., creative traits), (3) *process* (i.e., creative thinking processes), and (4) *press* (i.e., social

pressures or contextual conditions). This framework covers both views of creativity: *product* and *press* are sociocultural, while *person* and *process* are individualist. However, the Ps are not independent but interrelated. In particular, Runco (2007) argued that *person* influences *press* via individual interpretations of contextual conditions, whether individuals perceive the surrounding contexts as pressure varies. Additionally, *person* interacts with *process*, as certain personality traits are more beneficial for the cognitive process of creativity (e.g., flexibility) (Runco, 2007). Hence, the 4Ps framework captures creativity partially, not entirely.

Similarly, Amabile (1983) and Csikszentmihalyi (1988) agreed that creativity is not a product of individuals alone. Csikszentmihalyi called creativity the intersection of three systems: *individual*, *field* (i.e., sociocultural peers), and *domain* (i.e., sociocultural practices). Individuals challenge the status quo by making changes that are novel and appropriate to the salient criteria of their fields and domains. Each domain, with its distinctive knowledge, rules, and symbolic languages, can be either inviting or resistive to creative changes (Csikszentmihalyi, 1988). The constitution of creativity framework implies a holistic view of creativity via the systems and their interconnections. Moreover, Amabile even categorized the systems into components. The componential framework of creativity (1983) includes *domain-relevant skills*, *creativity-relevant skills*, and *task motivation*. Domain-relevant skills reflect individuals' understanding of their domains, creativity-relevant skills relate to creativity's cognitive processes, and task motivation represents how individuals perceive the contextual conditions at hand. Amabile completed this framework with the Consensual Assessment Technique (CAT), which

defines the criteria for creativity as the consensus between sociocultural peers in specific fields (Amabile, 1982, 1983). Overall, Amabile's approach to creativity embodies and enriches both the 4Ps and the constitution of creativity frameworks.

However, the definition of creativity is an ongoing debate (Glăveanu, 2018) with new interpretations and propositions (see Table 1). In general, these developments are different at either level (e.g., personal and professional) or domain (e.g., art and design). Nonetheless, the interrelated components and criteria of creativity remain unchanged. Among all, the 7Cs framework (Lubart, 2017) is a notable contribution, which expands the conception of creativity to teamwork and education. However, creativity education in the 7Cs framework is only an umbrella term without specific components or factors, and team creativity is not the interest of this study. Therefore, this study adopts the componential framework of creativity and CAT as the (classic yet comprehensive) definition and assessment of creativity. The next section will further this discussion.

Table 1. Multiple definitions of creativity

Classic creativity	… "novel/ new and useful/ appropriate" Guilford, 1950; Stein, 1953; Mednick, 1962; Torrance, 1966; Welsch, 1980; Amabile, 1982, 1983; Mumford & Gustafson 1988; Csikszentmihalyi, 1996; Sawyer, 2006; Runco, 2007; Kudrowitz & Wallace, 2010; etc. (Kampylis & Valtanen, 2010, as cited in Leung, 2018)
4Ps creativity	… "Creative Person, Creative Product, Creative Process & Creative Press…" (Rhodes, 1961, as cited in Leung, 2018)
7Cs creativity	Creators (i.e., individuals), Creating (i.e., processes), Collaborations (i.e., teams), Contexts (i.e., physical and social conditions), Creations (i.e., products), Consumption (i.e., adoptions of products) and Curricula (i.e., education). (Lubart, 2017)

H-creativity	Historical Creativity – "…where novelty is assessed in relation to the history of humankind…" (Runco, 210; Runco & Pritzker, 2011, as cited in Leung, 2018)
P-creativity	Psychological Creativity – "…P-creativity implies novelty with respect to the history of an individual…" (Boden, 2004; Runco & Pritzker, 2011, as cited in Leung, 2018)
S-creativity	Situated Creativity – "…Relative to the situation that pertains during the process of designing." (Runco & Pritzker, 2011, as cited in Leung, 2018)
E-creativity	"…the application of information and communication technology to support and enhance human creativity…" (Eales & Sophie Nichol, 2006, as cited in Leung, 2018)
Big C creativity	Eminent creativity – novel and useful on the large scale of societies and withstands the test of time. (Stein, 1987)
Pro-C creativity	Professional creativity – novel and useful activities in the scope of specific fields. (Kaufman & Beghetto, 2009)
little-c creativity	Everyday creativity – found in the lives of most people. (Stein, 1987)
mini-c creativity	First-time learnings for individuals. (Kaufman & Beghetto, 2009)
Artistic creativity	"…Technical skill could be conceptualized as an enabling basis for creative artistic performance." (Runco & Pritker, 2011, as cited in Leung, 2018)
Design creativity	"Novel, to be useful, to be surprise" (Sarkar, 2011; Taura, 2010; Li, 2006, as cited in Leung, 2018)

Note. Adapted with updates from The Paradigm Shift of Creativities: What is creativity means for designers and design educators? by Leung, H., 2018, *Proceedings of the International Conference on Creativity and Innovation 2018*, 202 – 218.

1.6.2. The Componential Framework of Creativity

Amabile built the componential framework of creativity (1983) upon her conceptual definition of creativity: the response to an open-ended task that appropriate judges (i.e., familiar with the domains) perceive as creative (1982). The task nature is *heuristic* (i.e., exploration-based without determined outcomes) instead of *algorithmic* (i.e., rule-based with specified results). The criteria for a creative response include novelty and appropriateness to specific tasks and salient standards of the domains. Hence,

the components of creative response (see Figure 1) comprise *domain-relevant skills* (i.e., knowledge, technical skills, and talents), *creativity-relevant skills* (i.e., cognitive styles, heuristics, and work styles), and *task motivation* (i.e., task attitudes and perceptions).

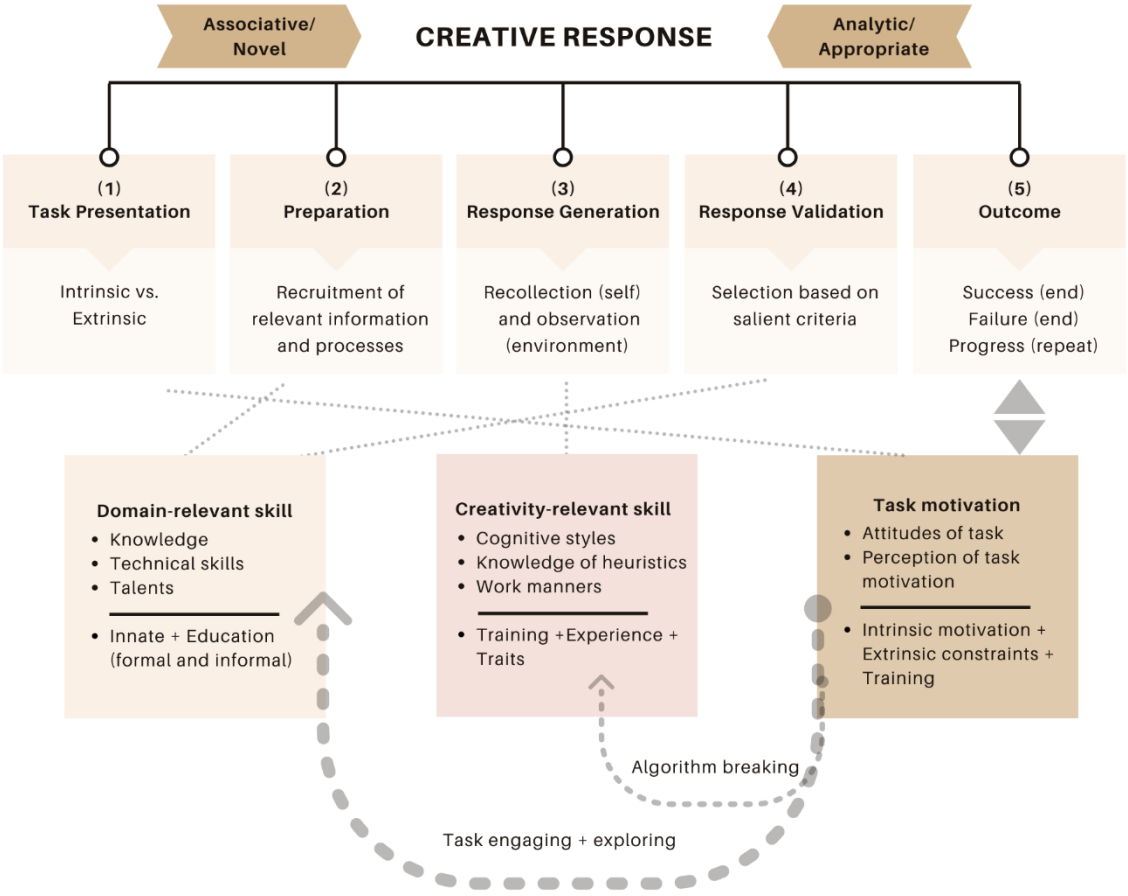

Figure 1. The Componential Framework of Creativity

Note. Adapted and modified from The social psychology of creativity: A componential conceptualization by Amabile, T. M., 1983, *Journal of Personality and Social Psychology*, *45*(2), 357–376; Revenge of the "Neurds": Characterizing creative thought in terms of the structure and dynamics of memory by Gabora, L., 2010, *Creativity Research Journal*, *22*(1), 1–13.

These components reflect the personal, cognitive, and sociocultural aspects of creativity (Amabile, 1983, 1985). First, individuals learn about the domains via education

(with or without structured curricula) to develop knowledge (to understand terminologies, salient standards, etc.) and technical skills (to demonstrate their understanding). Additionally, talents refer to innate abilities that make individuals compatible with the domains. Cognitive, perceptual, and motor abilities, overall, also affect the mastery of knowledge and technical skills. Second, individuals need specific cognitive styles, heuristics, and work manners to be creative. Creative cognitive styles include flexible (a) perception and (b) cognition, (c) openness, (d) judgement deferment, (e) diverse categorization, (f) information retainment, and (g) unconformity (Newell et al., 1962; Getzels & Csikszentmihalyi, 1976; Osborn, 1963; Cropley, 1967; Campbell, 1960; Schank & Abelson, 1977, as cited in Amabile, 1983). Overall, being free from defined concepts and procedures, receptive to changes, non-judgmental, susceptible to implicit connections, retentive of information, and unwilling to use to algorithms are the traits of creativity. Heuristics, on the other hand, are principles/methods that aid the delivery of creative task responses. TRIZ, for example, helps engineers to achieve creativity via novel and task-based combinations of universal technical principles (Ilevbare et al., 2013). Work manners refer to both perseverance and willingness to abandon ineffective task-solving directions or temporarily set aside complex tasks. Individuals can attain both heuristics and work manners, either via learning or exposure to the task-solving process. Thus, domain-relevant and creativity-relevant skills rely on innate cognitive abilities and traits of individuals plus their education and training.

Last but not the least, task motivation depends on how intrinsic motivation copes with extrinsic constraints of sociocultural environments. Individuals match tasks with

their current interests to form a baseline attitude. Task perception, likewise, indicates individuals' reasons for engaging in the tasks. These two elements contribute to task motivation, which is contingent on the salience of extrinsic constraints and the ability to minimize constraint-taxing. Intrinsic motivation is beneficial to creativity, as individuals who enjoy engaging in tasks experience minimal effects of extrinsic constraints (Hennessey & Amabile, 1998). Extrinsic constraints, such as rewards, facilitate algorithmic tasks but undermine the heuristics ones. For instance, in a poem writing task, the creativity of participants with intrinsic motivation (e.g., enjoyment) was significantly higher than those with extrinsic motivation (e.g., recognition) ($t\ (45) = 2.94, p < 0.01$) (Amabile, 1985). Participants who received intrinsic motivation training (e.g., watching tapes of peers discussing interesting, enjoyable aspects of tasks) downplayed extrinsic constraints and heightened their creativity (Hennessey, Amabile, & Martinage, 1989, as cited in Hennessey, 2019). Hence, creativity can be enhanced via training for constraint-coping despite the influence of innate traits.

The three components (i.e., domain-relevant skills, creativity-relevant skills, and task motivation) need to be present for a creative task response to take place. Amabile (1983) explained the interrelationship between these components in a five-stage process of creativity (see Figure 1): (1) Individuals determine their reasons for engaging in the tasks (i.e., intrinsic vs. extrinsic). (2) Individuals recruit domain-relevant skills that apply to the tasks (including information to explain and processes to accomplish the tasks). The higher the level of mastery, the greater are the advantages. Nevertheless, task motivation prompts individuals to acquire new skills as well for further task explorations. (3)

Creativity-relevant skills help individuals generate (many) possible responses, and task motivation encourages them to deviate from the algorithmic/conventional ones. (4) Individuals, once again, rely on domain-relevant skills to confirm the appropriate responses to the tasks at hand. (5) If individuals come up with creative responses, the process is completed with increased intrinsic motivation. When individuals achieve no response, the process terminates with decreased intrinsic motivation. In case individuals make some progress, the process restarts or terminates depending on the state of intrinsic motivation.

Currently, research supports and has expanded Amabile's componential framework of creativity. Creativity is *domain-specific* in terms of knowledge, skills, abilities, and the criteria of specific domains. However, it is *domain-general* in terms of the shared cognitive processes among individuals (Huang et al., 2017; Julmi & Scherm, 2015). According to neural research, creativity results from the shift between *associative* and *analytic* modes of thinking in response to certain constraints (e.g., tasks, individual and environmental conditions) (Gabora, 2010; Sowden et al., 2015). The associative mode activates a wide range of memory encoded in different groups of neurons and associates them into new, unusual (i.e., novel) interpretations of constraints. This mode resembles *divergent thinking*, once favored as the single process of creativity (J. Guilford, 1950; Torrance, 1974). *Analytic mode* refines associations that are strongly relevant (i.e., appropriate) to constraints and deactivates others. This mode represents *convergent thinking*, now recognized as another process of creativity (Sawyer, 2012; Simonton, 2015). During this process, individuals constantly seek external information regarding the scope of

constraints and the appropriateness of their responses. In short, they learn to cope better with constraints and optimize their creative responses (Koutstaal & Binks, 2015a, 2015b). To demonstrate, a study of 187 sixth-grade Taiwanese students showed that domain knowledge and divergent thinking explained 15.02% and 15.32% variance, respectively, in the scientific creativity test (SCT) (Huang et al., 2017). Therefore, to tackle heuristic tasks (e.g., solving imaginative problems on Mars and designing unique bicycles), participants relied on their understanding of the domain and the general processes of creativity.

1.6.3. Creativity Measurement

Creativity needs to be measured to show whether it can be enhanced after certain feedback practices. Overall, the measurement of creativity evolves with the development of creativity research. In general, three prominent approaches are (1) *indirect measurement*, (2) *global judgments*, and (3) *criterion-based measurement* (Horn & Salvendy, 2006; O'Quin & Besemer, 2011). Indirect measurement refers to nominations (of professionals or peers), self-report achievements, and creative individuals' eminence in their field. Hence, this approach implies the first movement of creativity research. Whereas, global judgments indicate the consensus among judges regarding creative outcomes (e.g., responses and products). With the inclusion of sociocultural groups (i.e., judges), global judgments mirror the third movement. Amabile's CAT (1982) is representative of this approach. Criterion-based measurement focuses on the attributes of creativity. Measurements in this approach are either specific to domains or applicable to many. The Mathematical Creativity Test (MCT) for math (Haylock, 1997) and SCT for

science (Hu & Adey, 2002) are domain-specific examples. The Guilford's Alternative Uses Task (AUT) (1967), Torrance Test of Creative Thinking (TTCT) (1974), and Besemer's Creative Product Semantic Scale (CPSS) (2006) are examples applicable for design, art, education, and other domains. Judges are necessary for these measurements, but the defined criteria (i.e., attributes of creative processes or outcomes) differentiate them from global judgments. Therefore, this approach embodies the second and third movements of creativity research (i.e., cognitive and sociocultural approaches). Except for CPSS, measurements such as the AUT, TTCT, MCT, and SCT are task-based and compliant with the divergent process of creativity. The *fluency* (i.e., quantity), *flexibility* (i.e., variance), *originality* (i.e., frequency) of task responses are the shared criteria (Guilford, 1967; Haylock, 1997; Hu & Adey, 2002; Torrance, 1974).

Across the board, the CAT and CPSS are most likely to capture creativity by accounting for the multifaceted nature of this construct. The AUT and TTCT, despite being the early and eminent measurements, only capture the divergent aspect of creativity and disregard the convergent one. This limitation is due to the lack of a holistic definition (i.e., novelty and appropriateness) and the emphasis on the potency (i.e., generation/divergent), not the outcome (i.e., validation/convergent) of creativity (Amabile, 1982; Cortes et al., 2019; Goldschmidt, 2016). One counterargument is using separate measurements to capture both processes—for instance, the AUT for divergent and the Remote Associates Test (RAT) (Mednick, 1962) for convergent. Nevertheless, creativity is the dominance-shift between the two concurrent processes: divergent and convergent. Goldschmidt (2016) found that, in task response generation, designers made

80% *forelinks* (i.e., created future moves/were divergent) and 20% *backlinks* (i.e., evaluated past moves/were convergent). In task response validation, the pattern reverses. This evidence echoes the neural research of Gabora (2010) and Koutstaal & Binks (2015a, 2015b) discussed above.

In short, capturing creativity via concurrent processes is complicated, and the available measurements are ineffective. An alternative is relying on the attributes of creative outcomes backed with a sound conceptual definition. Henceforth, this study employs both the CAT and CPSS to measure creativity. The CAT has specific requirements for judges, evaluative dimensions, and instructions for unbiased agreements (Amabile, 1982). Thus, the judges, whose familiarity with a discipline can vary, are able to work independently without compromising their subjective perspectives beforehand. Besides creativity, the CAT also requires judges to evaluate task response on multiple dimensions, such as technical goodness and likeability, which change with the tasks at hand. Additionally, the task responses and evaluative dimensions should be in random orders as well. The CAT showed high interjudge reliability (0.73 to 0.93) and a strong correlation (0.70 to 0.77) between creativity and other evaluative dimensions. These results were consistent across psychology, art, poetry, and choreography (Amabile, 1982; Clements et al., 2018; Kaufman et al., 2008).

The drawback of CAT is the inconclusive dimensions (vary by tasks) with no generalizable criteria (O'Quin & Besemer, 2011). A study using CAT to measure digital poetry creativity got only 0.18 for interjudge reliability because experts disagreed on what made a poem creative (Lamb et al., 2016). Hence, how much CAT measures

creative variances versus dimensional differences remains a concern of internal reliability (Cseh & Jeffries, 2019; Horn & Salvendy, 2006). Thus, the CPSS, due to its generalized dimensions and defined criteria, complements CAT (see Table 2). The CPSS contains three dimensions: (1) *novelty* (i.e., newness), (2) *resolution* (i.e., appropriateness), and (3) *style* (i.e., appearance). Novelty comprises *originality* (i.e., infrequent) and *surprise* (i.e., unexpected). Resolution has the following features: *logical* (i.e., abiding by domain-specific criteria), *useful* (i.e., practical uses), *valuable* (i.e., meeting needs), *understandable* (i.e., communicative presentation). Style implies whether a product is *organic* (i.e., completeness), *well-crafted* (i.e., optimization), and *elegant* (i.e., refinement). Under each criterion, multiple semantic pairs are available with the seven-point scale from low to high. In total, CPSS has three dimensions, nine criteria, and 55 rating pairs (Besemer, 2006; O'Quin & Besemer, 1989).

Table 2. CPSS and CAT

CPSS	CAT
Derived from literature of creative domains (art, writing, science, product, etc.), used lay judges (Besemer, 2006).	Based on the conceptual definition of creativity – the agreement among appropriate judges who are familiar with the domains (Amabile, 1982).
▪ Seven-point scale. ▪ Mean score for each dimension. ▪ High interjudge reliability (0.87 to 0.97). ▪ Construct validity relied on theoretical literature. (Besemer, 1998; Taylor & Sandler, 1972, as cited Horn & Salvendy, 2006)	▪ Five-point scale. ▪ Mean score for each dimension. ▪ High interjudge reliability (0.78 to 0.98). ▪ Construct validity confirmed by the conceptual definition of creativity. (Amabile, 1982; Baer, 1994; Brinkman, 1999; Chen et al., 2002, as cited in Horn & Salvendy, 2006)
Simplified CPSS with 15 items (Wei et al., 2015). ▪ Novelty Original	Open dimensions that change with tasks, no defined criteria for each dimension (Amabile, 1982).

	Overused – Fresh Predictable – Novel Usual – Unusual Ordinary – Unique Conventional – Original	▪ Technical goodness ▪ Likeability ▪ Silliness ▪ Aesthetic ▪ Etc.
▪ Resolution Logical	Illogical – Logical Senseless – Makes Sense Irrelevant – Relevant Inappropriate – Appropriate Inadequate – Adequate	
▪ Style Well-crafted	Bungling – Skillful Botched – Well Made Crude – Well Crafted Sloppy – Meticulous Careless – Careful	

Note. Adapted with updates from Consumer-based assessment of product creativity: A review and reappraisal by Horn, D., & Salvendy, G., 2006, *Human Factors and Ergonomics in Manufacturing & Service Industries*, *16*(2), 155–175; Teaching based on augmented reality for a technical creative design course by Wei et al., 2015, *Computers and Education*, *81*, 221–234.

The dimensions and criteria in Table 2 have been derived from 90 sources (e.g., creativity, business, and art) and supported by empirical evidence (Besemer & O'Quin, 1999; O'Quin & Besemer, 2011). A study using the CPSS to measure the creativity of three chairs with a Norwegian sample ($n = 128$) showed sufficient internal consistency between criteria in each dimension (0.78 to 0.85) (Besemer, 1998). Moreover, exploratory factor analysis indicated that the three dimensions accounted for 74.9%, 77%, 79.3% variance in the creativity of the chairs, respectively. A subsequent study with an American sample ($n = 185$) displayed the same results. The internal consistency ranged from 0.69 to 0.86, and confirmatory factor analysis was high (0.91 to 0.94) (Besemer & O'Quin, 1999).

However, rating 55 semantic items is time-consuming (Thang et al., 2008). Additionally, not all items of the CPSS resonate with Amabile's conceptual definition of creativity (1983) presented above. Hence, this study uses a simpler CPSS with 15 items (Wei et al., 2015; White & Smith, 2001). Wei et al. (2015) used this 15-item CPSS to assess students' creativity in an interior design project and found a satisfactory internal consistency for items in each dimension ($\alpha > 0.72$). A Likert scale of five to seven points (as in CAT and CPSS) is optimal for interjudge reliability and discriminatory power (Preston & Colman, 2000). Nevertheless, the use of lay judges (i.e., nonexperts) for the CPSS poses questions. Having users with minimal expertise as judges is beneficial for domains such as product design and marketing (e.g., for reducing cost and risk and increasing the visibility of new products) (Deckert, 2017; Miceli & Raimondo, 2020). Conversely, current research suggests that the reliability of nonexpert judges is unstable (e.g., encounter greater difficulty, uncertainty, and spend more time) when evaluating complex task responses. In design education, expert judges are preferable (Galati, 2015; Goncher et al., 2017; Görzen et al., 2019). Combining the defined criteria (CPSS) with expert agreements (CAT), thus, makes a holistic and reliable measurement of creativity.

1.7. Feedback

1.7.1. Overview of Feedback

Feedback is information from external (e.g., teachers, peers, materials) or internal sources (e.g., knowledge, experience) that signifies appraisals of individuals' task performance or understanding. The purpose of feedback is to reduce the discrepancies between individuals' current performance or understanding and the desired ones (Hattie

& Timperley, 2007). As a result, the content of feedback varies depending on domain knowledge, metacognition, self and task beliefs, and cognitive strategies. In short, feedback helps individuals move toward a set goal and improve their learning along the way (Hattie & Timperley, 2007; Shute, 2008; Winne & Butler, 1994). Twelve meta-analyses (comprising 196 studies) from 1981 to 1996 showed that feedback had a medium-to-large average effect size (0.79) on learning (Hattie, 1999; Hattie & Timperley, 2007). However, Kluger and DeNisi (1996)'s meta-analysis (of 131 studies) found that performance improved in two-thirds of the cases and decreased in the other one-third. The researchers explained this finding via the feedback intervention theory (FIT), which emphasizes that the focus of feedback should be on the tasks at hand. According to the FIT, the moderators of feedback variances are (a) *valence* (i.e., correspondent emotion), (b) *content* (i.e., embedded information), (c) *frequency* (i.e., quantity), (d) *task complexity* (i.e., difficult vs. easy), (e) *goal setting* (i.e., high vs. low), and (f) *self-esteem* (i.e., perceptions of self-worth) (Kluger & DeNisi, 1996). These moderators present the complexity of feedback practices as drawn from educational psychology literature. The following paragraphs elaborate on each of them, while the section titled Feedback in Educational Settings discusses empirical evidence. Furthermore, the Feedback in Design Studios section shows moderators that manifest in design disciplines.

For valence, the control-value theory proposes that feedback elicits emotions corresponding to successful or failed appraisals of prospective (i.e., hope versus anxiety) and retrospective (i.e., pride versus shame) performance (Pekrun, 2000). In general,

positive feedback leads to pleasant emotions, and negative feedback leads to unpleasant ones (Pekrun, 2006). Current research indicates that pleasant and unpleasant emotions occur regardless of feedback valence (Fong et al., 2016, 2018), with the salient appraisals (i.e., success/approval versus failure/disapproval) determining the dominant emotions. Constructive feedback, being task-specific and improvement-oriented, initiates a balance in emotions with an emphasis on hope.

Feedback content differs depending on its purposes: signifies progress, mends discrepancies, and recommends future directions (Hattie & Timperley, 2007; Voerman et al., 2012). Hattie and Timperley's model of feedback (2007) offers a comprehensive view of this topic and is discussed in Section 2.2.2. Bond et al. (2000) studied the certification system of the American National Board for Professional Teaching Standards and found that giving feedback made teachers accomplished and distinguishable. Nonetheless, feedback frequency in classrooms is insufficient, and the majority of it is praise (e.g., "Well done!") (Pauli, 2010; Roslan et al., 2018; Voerman et al., 2012). The given positive feedback lacks task-specific content and is a mere acceptance of correct task performance. For example, in a primary science classroom, 43% of teachers' feedback was accuracy confirmation, while only 1% was task clarification and performance elaboration (Roslan et al., 2018). Although the task required 51% memorization, there were still 30% of hypothesis and 12% of evaluation of the learned information. Hence, feedback frequencies were inadequate for learning improvements.

Another feedback moderator is task complexity, which resonances with the self-determination theory (SDT). According to the SDT (Ryan & Deci, 2000, 2017),

individuals pursue set goals to fulfill the three basic needs of *competence* (i.e., being in control), *relatedness* (i.e., connecting to others), and *autonomy* (i.e., having choices). Intrinsic motivation, from the SDT perspective, is the tendency of seeking novelty and challenges to expand one's competencies. In other words, individuals are motivated to explore themselves and learn about the surrounding environments. Thus, positive feedback that induces the feeling of competence increases persistence with novel and challenging tasks (i.e., higher complexity) (Krenn et al., 2013; Viciana et al., 2007).

Similarly, the interplay between goal setting and feedback has specific implications on performance. Individuals align their performance and set goals to reduce the discrepancies between the two. Feedback that signifies negative discrepancies (i.e., failures in goal attainment) leads to low goal setting (i.e., reducing the desired levels of performance or understanding/standards). On the contrary, feedback that represents positive discrepancies (i.e., excesses in goal attainment) results in high goal setting (Ilies et al., 2010). Both low and high goal setting benefits from feedback that contains specific information on task performance (Shute, 2008). A single-case design study on a reading program suggested that planning necessary materials, setting goals, and receiving feedback improved students' performance. These practices had strong effect sizes that ranged from -0.95 to -1 ($p < 0.01$) on the completion time, which meant that students could resolve the assignments faster (Stevenson & Mussalow, 2019).

Moreover, feedback should not pose a threat to self-esteem. Kluger and DeNisi's meta-analysis (1996) noted that the effect sizes of task-specific feedback (including accuracy checks and improvements), low-threat (to self-esteem) feedback, and praise on

task performance were medium (0.55, 0.47) and very small (0.09), respectively. Feedback also worked well with high goal setting (0.51) and low task complexity (0.55) (Kluger & DeNisi, 1996, as cited in Hattie & Timperley, 2007). With a substantial sense of self-worth (i.e., high self-esteem), individuals become more persistent when facing negative feedback and failures in difficult tasks (i.e., high complexity). Therefore, positive feedback helps individuals with high self-esteem improve, while negative feedback hinders those with low self-esteem. (Brown, 2010, as cited in Krenn et al., 2013). Results from a study by Velez and Hanus (2016) revealed the main effect of self-esteem on task credibility (i.e., whether the tasks are reliable in reflecting individuals' abilities). Regardless of feedback valence, higher self-esteem meant higher task credibility ($b = 0.95, se = 0.25, t = 3.78, p < 0.001$). Low self-esteem increased task defensiveness (i.e., discrediting), especially with negative feedback ($b = -1.03, se = 0.36, t = -2.88, p < 0.01$). The implication was that individuals with high self-esteem are willing to address inaccuracies and improve performance (Velez & Hanus, 2016).

Within valence and task complexity, *sources* (i.e., where feedback comes from) and *timing* (i.e., when to give feedback) are important. Source credibility positively correlates to feedback accuracy (Kinicki et al., 2004; Podsakoff & Farh, 1989). The more credible the sources (e.g., status and expertise in the domains), the better feedback acceptance and performance (Collins & Stukas, 2006; Fedor et al., 2001). With highly credible sources, even negative feedback had a positive correlation with feedback satisfaction (0.34, $p < 0.01$) (Steelman & Rutkowski, 2004) and the main effect on performance improvements ($F = 4.63, p < 0.018$) (Holderness Jr et al., 2017). Thus,

these findings highlight the importance of expert feedback on learning and performance. Regarding timing, immediate feedback improves performance when task complexity is high and vice versa (i.e., delayed feedback for low complexity) (Clariana et al., 2000; der Kleij et al., 2015; Lechermeier & Fassnacht, 2018). Prior knowledge of individuals plays an important role as well (Shute, 2008). Results of a study by Fyfe and Rittle-Johnson (2016) indicated that students with substantial prior knowledge showed no difference in mean correct responses ($p = 0.42$), whether they received immediate feedback ($M = 1.3$) or not ($M = 1.4$). In another study by Attali and van der Kleij (2017), when prior knowledge was minimal, both immediate (after each response) and delayed (after all responses) feedback improved performance, especially with explanations for correct/incorrect responses ($b = 0.351, se = 0.068$ and $b = 0.183, se = 0.055$, respectively, $p < 0.01$). The Feedback in Educational Settings subsection elaborates on selective empirical evidence for the discussions above.

1.7.2. The Model of Feedback

This study applies the model of feedback of Hattie and Timperley (2007) from educational psychology in interior design studios. The model views feedback as a bidirectional means (i.e., received and built upon) that helps students achieve the desired performance and thus enhance their learning (Brooks et al., 2019; Hattie & Gan, 2011; Hattie & Timperley, 2007). Interior design studios share the same approach to feedback practice. Each studio centers around one or many design projects/tasks. Invited practitioners and/or instructors help students reach the desired project performance (i.e., novel and appropriate task responses) via feedback. This practice takes place as

conversations between feedback providers and recipients regarding project performance throughout the design process. Feedback recipients (i.e., students) respond to, verify, modify, and elaborate on the given information (Scagnetti, 2017). The result is creativity (from low to high), as reflected via students' performance quality (Makki et al., 2019). Hattie and Timperley's model (2007) captures the dynamic of feedback practice (i.e., provide and receive) across domains and, therefore, will guide the research design and explain the prospective findings of this study. Further discussions of the design process are available in the Feedback and Creativity section.

According to Hattie and Timperley (2007), effective feedback should address three task-focused questions at four different levels (see Figure 2). The questions are as follows:

(1) *Goal* or what is the desired task performance?

(2) *Progress* or how close is the current performance to the goal?

(3) *Direction* or what are the next steps to achieve the goal?

Upon receiving feedback, students will determine whether to increase effort, detect errors, seek better strategies (i.e., aim for better performance), reduce effort (i.e., accept lesser performance), or even abandon the task altogether. Thus, the goal should be specific, task-related, and challenging. Goal specificities, task relations, and challenges offer a clear demonstration of the desired performance (i.e., successful criteria/expectations/standards). As students try to match the (challenging/high) goals with self-relevant attainment levels, their learning improves. Feedback that signifies

progress allows students to track, evaluate their self-relevant attainment process to adjust effort and strategies accordingly. After certain attainment levels, students use feedback as directions to set future levels and advance their learning. Teachers can induce goal commitment using their authority, incentives, etc., which eventually reinforce feedback-seeking behaviors (Brooks et al., 2019; Hattie & Gan, 2011; Hattie & Timperley, 2007).

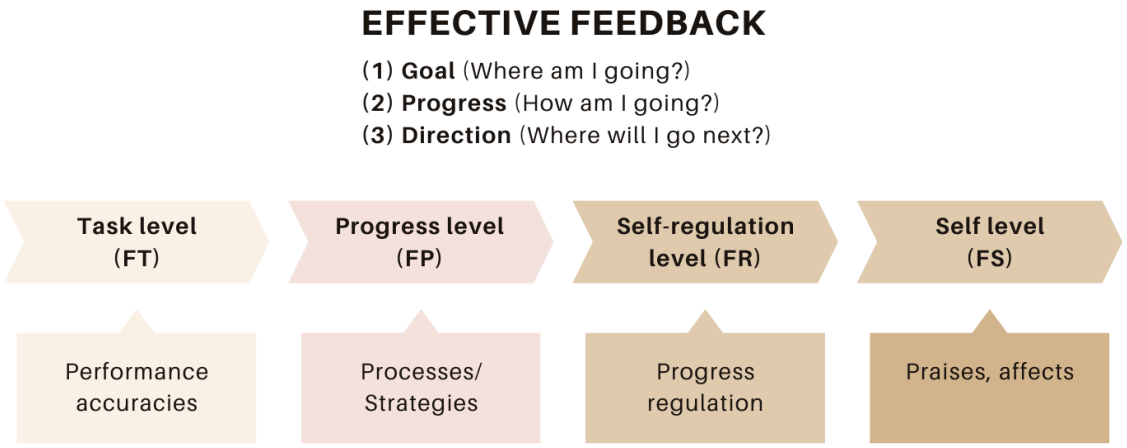

Figure 2. The Model of Feedback

Note. Adapted from The power of feedback by Hattie, J., & Timperley, H., 2007, *Review of educational research*, *77*(1), pp. 81–112.

Each of the above questions occurs at four levels: (a) *task*, (b) *process*, (c) *self-regulation*, and (d) *self*. At the task level, feedback focuses on how accurate students understand/perform the given tasks. For the process level, feedback means whether students have the right cognitive strategies to accomplish the tasks. At the self-regulation level, feedback directs students' attention back to task goals and informs them of their attainment progress. Henceforth, students monitor and regulate how they proceed toward the goals. At the self level, feedback refers to evaluations about students that are personal, emotional, and often unrelated to the tasks. Each feedback level has different

influences on learning. Feedback at the task level (FT) is prevalent, powerful, but limited to specific tasks. Feedback at the process level (FP) makes an effective pair with FT and relies on students' willingness to accomplish the tasks. Feedback at the self-regulation level (FR) is productive when students actively seek and perceive feedback. Moreover, feedback at the self level (FS) is the least effective (even counterproductive), as it distracts students from tasks and misleads self-evaluations (Da Costa et al., 2015; Hattie & Timperley, 2007).

Brooks et al. (2019) expanded the model of feedback of Hattie and Timperley (2007) using a thematic analysis of recorded verbal feedback in a seventh-grade classroom with 28 students. In line with the discussed model of feedback, in the study, feedback addressed all the three questions of goal (31%), progress (49.8%), and direction (19.2%). Feedback at task, process, and self-regulation levels were 77.8%, 15.9%, 6.3%, respectively. Specifically, feedback on goals was aimed at the whole class on task level and individual students on the process level. On the self-regulation level, this type of feedback challenges students to take a different perspective toward the goal (i.e., redirection of goal setting). Process feedback (mostly accuracy confirmation and strategic guidance) was dominant and top-down from the teacher to students. Direction feedback was direct and specific at the task level in terms of the next steps and corresponding strategies. Brooks et al. then combined the model of feedback and the presented findings into a guideline for effective feedback concerning students' learning stages (see Table 3). This study considers the matrix an additional tool to explain the prospective findings together with the original model of feedback.

Table 3. The guideline for effective feedback

Stage of feedback recipient	Level	Goal	Process	Direction
Novice	Task	▪ Reduce complexity. ▪ Use exemplars/ models. ▪ Identify misconceptions. ▪ Use diagnostic assessments for goal setting.	▪ Avoid over emphasis of error analysis. ▪ Feedback must be immediate. ▪ Match feedback to success criteria.	▪ Use language from the success criteria. ▪ Use scaffolding. ▪ Must be timely. ▪ Use challenge. ▪ Direct to goals.
Proficient	Process	▪ Use graphical organizers (i.e., summarize and analyze information). ▪ Reduce scaffolding (i.e., supports based on individual needs). ▪ Increase complexity. ▪ Use mastery goals (i.e., emphasize the mastery vs. demonstration of knowledge and skills).	▪ Feedback amount can start to increase. ▪ Feedback complexity can increase. ▪ Use prompts or cues (instead of direct suggestions).	▪ Amount can start to increase. ▪ Complexity can increase. ▪ Use prompts or cues. ▪ Use challenge.
Advanced	Self-regulation	▪ Reduce emphasis on exemplars. ▪ Mastery and performance goals.	▪ Delay feedback. ▪ May only require verification feedback.	▪ Delay feedback. ▪ Reduce teacher reliance. ▪ Develop self-regulated learners.

Note. Adapted from A matrix of feedback for learning by Brooks, C., Carroll, A., Gillies,

R. M., & Hattie, J. (2019). *Australian Journal of Teacher Education*, *44*(4), 2.

1.7.3. Feedback in Education Settings

A meta-analysis of 435 feedback studies by Da Costa et al. (2015) revealed that among 994 effect sizes, only 17% was negative (i.e., hindered learning/performance). In general, feedback was beneficial with an average effect size of 0.55 and a confidence interval of 0.48–0.62 (indicating a medium effect on learning/performance). Moreover, feedback improved performance in cognitive (e.g., academic achievements and retention) better than motivational (e.g., intrinsic motivation and persistence) measures. Feedback effectiveness on cognition increases with the amount of information on task (FT), progress (FP), and self-regulation (FS) it contains. For motivational measures, 21% of the effect sizes were negative, and 86% of the given feedback comprised reinforcements (e.g., praise on desirable performance or FS) with minimal or no task-related information. These findings can be explained via the SDT (Ryan & Deci, 2000). Adverse effects on motivation exist too; feedback reduces autonomy (i.e., the availability of choices) and self-efficacy (i.e., control) when it comes in a controlling, negative, and uninformative manner (Da Costa et al., 2015). Thus, Da Costa et al.'s meta-analysis supports the model of feedback with the positive effects of FT, FP, and FR on performance and a reversed pattern for FS evident.

The following paragraphs will dive into particular aspects of the Overview of Feedback section. Constructive feedback (Fong et al., 2016), in contrast to positive and negative appraisals of performance, contains domain knowledge (FT), suggests cognitive strategies (FP), and induces self- and task-related beliefs (FR). Delivered in a kind

manner and with emphasis on performance strengths, constructive feedback becomes a productive means for improvements. On the other hand, findings on praise (FS) are inconclusive. From four-year-olds to adolescent students, praise (FS) on intelligence (i.e., an innate ability) followed the consistent pattern of discouraging effort and, subsequently, learning (Dweck, 2007). Praise gave an instant boost of confidence and fosters a fixed mindset (i.e., ability is unmalleable via effort) in students. The belief that ability alone is sufficient leads to abandonment and retreat when facing challenging tasks. As the brain stops making new neural connections by processing unfamiliar information, learning declines.

Similarly, Amemiya and Wang (2018) indicated that adolescent students perceived praise (FS) on ability or effort as indications of fixed (i.e., cannot improve) or low ability (i.e., have to compensate by effort). Instead, challenging goals (i.e., high expectations for performance) and praise for strategies undertaken (i.e., FS in the process level) help avoid the misinterpretation of FS and facilitate students' learning as well. A recent study on adolescences ($n = 108$) argued that praise for intelligence or effort taken makes no difference to goal orientation and task performance (Glerum et al., 2020). Most students who were praised on their intelligence (76.9%) and effort (59.5%) chose mastery goals over performance (i.e., learning vs. demonstrating) ($\chi^2\,(2, n = 108) = 15.1, p < 0.001$). No significant difference was found in task performance between the praised students and the control group ($F(2, 105) = 1.10, p = 3.36$). Thus, the effectiveness of praise (FS) remains a significant topic for future research.

In terms of goal setting, Viciana et al. (2007) studied a secondary physical education (PE) classroom ($n = 95$) and found that after receiving feedback, regardless of the valence (i.e., negative, positive), references for easy tasks decreased (i.e., high goal setting) ($F = 4.41, p < 0.04$). Nonetheless, Koenig et al. (2016) found no significant interaction between goal setting and feedback on elementary writing tasks ($n = 115$). With feedback (i.e., fluency checks) alone, students gained an average of 2.11 correct writing sequences per task session, while their counterparts with goal setting (i.e., writing fluency standards) got 1.84 ($t(332) = -0.75, p = 0.45$). Taking the two studies together, feedback valence seems to interact with goal setting by inducing emotions in students. Feedback in Koenig et al.'s study was a mere accuracy check without information on the process and future direction.

According to Krenn et al. (2013), self-efficacy (i.e., belief in one's ability), self-esteem (i.e., self-worth), and locus of control (i.e., attributions of success/failure) explained 60.11% of the feedback variances on task performance. Factor loadings for self-efficacy, self-esteem, and locus of control were 0.82, 0.84, and 0.73, respectively. All presented positive correlations with feedback effects on task performance. Krenn et al. denoted the combination of these traits in a single factor as core self-evaluations. Self-esteem was the most significant trait among others ($F(2, 438) = 3.40$, $p = 0.03$), echoing the moderators mentioned in the FIT of Kluger and DeNisi (1996). Students with high core self-evaluations (including generalized self-efficacy, self-esteem, and locus of control) improved significantly after positive feedback, given the same task complexity. Whereas, those with low core self-evaluations demonstrated no improvement when

receiving negative feedback. Those who set higher attainment levels (i.e., goal setting) also performed better ($F(2,461) = 5.15, p = 0.01$).

Intrinsic motivation (i.e., task enjoyment) also positively correlates with task performance (Augustyniak et al., 2016). According to Weidinger et al. (2016), negative feedback reduced ability self-concept (i.e., perceptions of academic competence) and intrinsic motivation. Whereas, task complexity and students' personalities (i.e., the Big Five) had significant interaction with feedback (Swift & Peterson, 2018). The difficult task (i.e., finding outlined shapes among visual distractors) evoked mostly irritation (51%). The neutral task (i.e., finding particular symbols among similar distractors) showed no dominant emotion. The playful task (i.e., "spot the difference") induced pleasantness (49%). Negative feedback influenced students through conscientiousness (i.e., being sensitive to competence-threats) ($F(1, 233) = 11.29, p = 0.001$) and neuroticism (i.e., being sensitive to threats in general) ($F(1, 233) = 14.82, p < 0.001$). On the other hand, positive feedback impacted students in terms of agreeableness (i.e., being communicative) ($F(1, 253) = 8.62, p = 0.004$). The playful task countered negative feedback for conscientiousness and neuroticism by being motivative (with pleasantness). Even with positive feedback, the playful task was more motivating for agreeableness. Additionally, extraversion and openness showed insignificant results, and in the neutral task, feedback had no significant interaction with students' personalities (Swift & Peterson, 2018).

1.7.4. Feedback in Design Studios

Feedback is a vital part of design studios that transfers domain knowledge and fosters students' creativity (Scagnetti, 2017; Visser et al., 2017). Students across disciplines acknowledge the value of feedback either from experts (i.e., practitioners, instructors/teachers) or peers. The design education literature offers a unique set of feedback moderators aside from those in the educational settings above. In this context, this subsection discusses the following: (1) *feedback format*, (2) *content*, (3) *frequency*, (4) *number of ideas*, (5) *feedback perception*, and (6) the *perceived personalities* of design students. Although research works on peer and crowd feedback for individual and group creativity are outside the scope of this study, they will be considered as references for research methods and designs. Some notable studies are presented in Table 4.

Table 4. Selective research works on feedback (including expert, peer, crowd) and creativity (including individual and group)

Article	Sample size	Participants, tasks, and feedback sources
(Dow et al., 2010) Association for Computing Machinery (ACM)	33 *Experiment*	College students. Conditions: *parallel* (n = 16) and *serial prototyping* (n = 17). A digital banner design task. Pre-developed neutral feedback statements.
(Oygur & McCoy, 2011) Journal of Interior Design (JID)	14 *Case study*	Senior interior design students, 3 teams. A design studio of an interactive structure for a local community. Feedback from community experts.
(Huber et al., 2012) College Student Journal	36 *Exploratory study*	Senior interior design students. A two-week mini-course to design a small-scale mock-up lounge chair. Reflective journals (n = 20) on instructors' feedback.

(Orthel, 2015) JID	106 *Mixed methods*	Senior high-school students, design and non-design. Team-based design (n = 55, creating things from scrap materials) and non-design classes (n = 51, making peers laugh). Peer feedback in class.
(Ellis & Meneely, 2015) JID	66 *Mixed methods*	Sophomore (n = 21), junior (n = 23), and senior (n = 22) interior design students. Different studios within a CIDA accredited program. Instructors' feedback.
(Wu & Bailey, 2017) ACM	270 *Experiment*	Amazon Mechanical Turk workers. A story for children (8 – 12 year-olds, 200 – 2000 words) from an illustration. Pre-determined feedback statements.
(Yen et al., 2017) ACM	90 *Experiment*	Design institutions and Facebook groups. Designed a marathon race flyer. Conditions: *reflect-only* (n = 20), *feedback-only* (n = 14), *reflect-before-feedback* (n = 18), *reflect-after-feedback* (n = 18), and *control* (n = 20). Crowd feedback.
(Suh & Cho, 2018) JID	50 *Exploratory study*	Senior interior design students. A design workshop (creating a light screen partition from scrap materials using annotated sketches).
(Gunday Gul & Afacan, 2018)	84 *Mixed methods*	Purposive sampling of interior architecture seniors. Survey on feedback perception. Expert and peer feedback.
(Giloi et al., 2019) Art, Design & Communication in Higher Education	11 *Case study*	Purposive sampling of freshmen and sophomores (with unique manifestations) from different design courses. Repurposed a used chair into manifestations of personal stories. Instructors' feedback.
(Cho & Cho, 2019)	27 *Case study*	Junior interior design students, 12 teams.

Cognition, Technology & Work		A team-based course to design a share house for 20 – 30 people. Peer feedback.
(Kusumowidagdo, 2019) Humaniora	100 *Mixed methods*	Systematic sampling of interior architecture students in different studio levels. Survey and interview on feedback perception. Expert feedback.

1.7.4.1. Feedback format

Feedback is either written or verbal (Karlsen, 2017; Smith & Lilly, 2016). Beecher (2006) viewed written feedback as a means to help interior design students evaluate and expand their creative progress. Smith and Boyer (2015) found verbal feedback helped clarify practitioners'/instructors' intentions and boosted students' creative performance in landscape architecture studios. Likewise, a study conducted in graphic design studios ($n = 30$) revealed a similar preference for expert rather than peer feedback (83% gave expert feedback a high value vs. 64% for peer feedback). The graphic design students deemed verbal feedback more beneficial (58% very helpful and 29% somewhat helpful) to their creative performance (Visser et al., 2017). Architecture and interior students credited written feedback (i.e., overlay drawings, notes) for better recollections of the feedback content (Gunday Gul & Afacan, 2018; Oh et al., 2013). Overall, written and verbal feedback help students improve creative performance in different ways. One offers long-term records and the other instant clarifications.

1.7.4.2. Feedback content and frequency

Dannels and Martin (2008) categorized the feedback of practitioners and instructors across design studios (i.e., landscape architecture, art and design, graphic, industrial) into *judgment* (25.4%), *process-oriented* (20.8%), *brainstorming* (13.8%), *interpretation* (12.4%), *direct recommendations* (9%), *investigation* (5.1%), *free association* (3.7%), *comparison* (2.8%), and *identity invoking* (2.5%). These categories' frequencies varied according to studio levels: *freshman* (judgment, direct recommendations, and free association) and *juniors*, *seniors*, and *graduates* (process-oriented, brainstorming, and investigation). Dannels and Martin's findings both relate to the model of feedback (Hattie & Timperley, 2007) and the componential framework of creativity (Amabile, 1983). Judgments, comparisons, and direct recommendations are appraisals (FT) that inform students of their current performance with respect to the desired one. These feedback categories are beneficial for students at the introductory level, as they build up domain-relevant skills. Process-oriented feedback, free association, and brainstorming are cognitive strategies and heuristics (FP) that enhance students' creative process. Investigation and interpretation (FR) guide self-evaluations, as students explain their responses to the practitioners and instructors. Identity invoking (FS) aims to motivate students by questioning their identity as a designer. This category was infrequent and insignificant across studio levels (Dannels & Martin, 2008). Students in advanced levels need these feedback categories as they develop their creativity-relevant skills and task motivation.

Karlsen (2017), based on the model of feedback, proposed another classification of feedback in design studios. This classification mostly introduced design-adaptive terms of Hattie and Timperley's original framework. Overall, feedback in design studios has eight forms, four focuses, three purposes, and two temporalities. The forms (i.e., content) include corrections, explanations, judgments/appraisals, suggestions, emotive, brainstorming, questions, and interpretations. The focuses are product (i.e., task response), process, self-regulation, and person. The purposes are cognition, affection, and psychomotor (technical) skills. Furthermore, the two temporalities are current progress and future direction. This classification is elaborative yet confusing. The eight forms of feedback are actually FT/accuracy check (i.e., correction, explanation, and appraisal), FP/strategy (i.e., brainstorm), FR/progress monitor (i.e., questions and interpretations), and FS/emotion (i.e., emotive). As the model of feedback is straightforward and relatable to the categorizations of Dannels and Martin, this classification is referential only.

1.7.4.3. Number of ideas and feedback perception

Having more ideas (i.e., initial responses to design tasks) to get feedback on is important. Dow et al. (2012) found that students with a high number of ideas viewed feedback positively, and their creativity improved. Those with a low number viewed feedback negatively, and their creativity declined. For feedback perceptions, Oygur and McCoy (2011) identified two patterns in interior design students: *inspiration* and *constraint*. Feedback perceived as inspiration led to highly creative performance, while feedback perceived as a constraint resulted in low creative performance. Likewise, Huber et al. (2012) emphasized that interior design students who perceived feedback as a

resource (e.g., information to explore a task better and inspiration) enhanced in creativity. Conversely, students who perceived feedback as a constraint (e.g., indications of technical issues, reminders of time limitation) declined in creativity.

Kusumowidagdo (2019), similarly, measured the perception of interior architecture students ($n = 100$) toward feedback from invited practitioners. Positive perceptions occurred when feedback provided task-related (1) improvements, (2) regulations, (3) knowledge and ability, (4) accuracy checks, (5) direct suggestions, and (6) future directions. The numerical order represents the importance of each category, respectively. Students disregarded feedback that came as praise or confirmations of their superiority to peers. These findings resonate with those of Oygur and McCoy (2011), Huber et al. (2012), Hattie and Timperley (2007), and Brooks et al. (2019). Students relied on feedback to check performance accuracy and seek direct suggestions for task completion (FT). They accumulated relevant knowledge and ability (FP) to regulate task execution, improve task performance, and plan future steps (FR). In addition, students viewed praise (FS) as trivial (Kusumowidagdo, 2019). Thus, students perceive feedback as positive when it is a resource for task completion and better task performance (i.e., mastery vs. demonstrations of knowledge and skills).

1.7.4.4. Perceived personalities of design students

Students' perceived personalities also determine their feedback preferences, including frequency, valence, and content. According to Ellis and Meneely (2015), interior design students who perceived themselves as safe-keepers (i.e., rule-compliant/convergent-oriented) preferred frequent, positive feedback with direct

recommendations. Those who saw themselves as risk-takers (i.e., rule-breaker/divergent-oriented) preferred occasional, critical feedback with challenging judgments. Smith and Lilly (2016) argued that a majority of students (71%) in interior design studios ($n = 59$) appreciated that feedback helped increase creative performance but felt uncomfortable, even irritated, by negative feedback (61%). Giloi et al. (2019) also found risk-taking students to be more tolerant of negative feedback and even dismissive toward feedback in general.

Nevertheless, tailoring feedback to students' risk-taking/safe-keeping tendencies can undermine creativity by overemphasizing divergent or convergent thinking. Wu and Bailey (2017) recommended giving critical feedback only after a reassuring one. Ellis and Meneely (2015) and Giloi et al. (2019) both suggested using a mix of supporting and challenging feedback to benefit students' creativity regardless of their risk-taking/safe-keeping tendencies. By inducing negative emotions, critical/challenging feedback encourages revisions and evaluations of current ideas as per salient criteria (i.e., convergent). Whereas, through positive emotions, reassuring/supporting feedback inspires new interpretations of constraints or the exploration of ideas (i.e., divergent).

1.8. Feedback and Creativity

1.8.1. Overview of Feedback and Creativity

Scholars in creativity research, including Amabile, once deferred the need for feedback in favor of intrinsic motivation. Eisenberger and Cameron (1996) and Hennessey and Amabile (1998) deemed feedback as undermining intrinsic motivation by taking away the autonomy in task engagement as reinforcements for desirable

performance or evoking competition as evaluative judgments. As intrinsic motivation is a component of creativity (see Figure 3), feedback inherently impedes creativity. This perspective resonates with the earlier work of Osborn (1963), which defers judgments in support of the divergent process of creativity (i.e., reducing the salience of constraints to expand the scope of potential responses). However, current research argues otherwise. Hattie (2009) denoted feedback as an intangible reward (e.g., verbal encouragement and praise) for desirable performance that reinforced intrinsic motivation (d ranged from 0.21 to 0.38) as opposed to a tangible reward. Among other interventions (i.e., autonomy and challenging goals, etc.), feedback improved motivation with average effect sizes from 0.54 (medium) to 1.24 (large) (Hulleman et al., 2016).

Taken together, Hattie and Timperley's model of feedback (2007) and Amabile's componential framework of creativity (1983) demonstrate an inclusive relationship between feedback and creativity (see Figure 3). FT informs individuals whether they accurately respond to the tasks and offers relevant knowledge and technical instructions to reach the desired performance. FP provides cognitive strategies that benefit the associative (e.g., heuristics and brainstorming) and analytic modes (e.g., critical thinking). FR helps individuals build an active attitude (task-directed reminders and self-regulation strategies) to navigate through extrinsic constraints (i.e., task-related and environmental) to accomplish the tasks. FS (i.e., praise), however, results in indecisive effects on motivation and performance (as shown in the Feedback in Educational Settings

subsection). As a result, FS is excluded from the proposed relationship below.

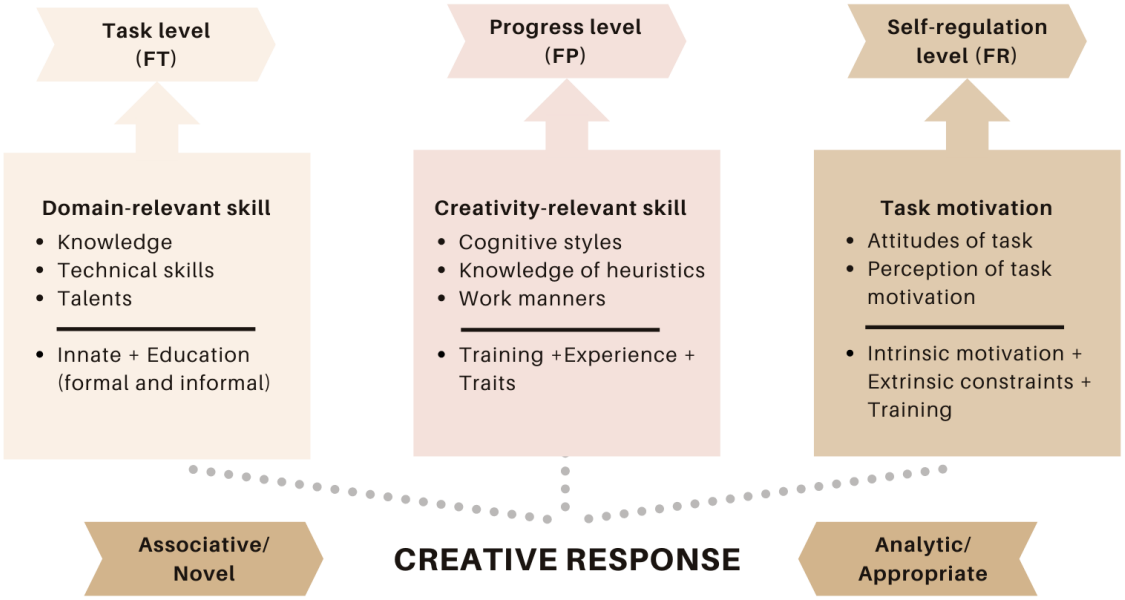

Figure 3. Feedback and Creativity

Note. Adapted and modified from The power of feedback by Hattie, J., & Timperley, H. (2007), *Review of Educational Research*, *77*(1), 81–112; The social psychology of creativity: A componential conceptualization by Amabile, T. M., 1983, *Journal of Personality and Social Psychology*, *45*(2), 357–376.

Runco and Chand (1995) proposed that extrinsic motivation benefited creativity as well. The argument provided here was that intrinsic motivation facilitated autonomy in framing and exploring potential task responses (i.e., divergent) via the enjoyment of task engagement. Extrinsic motivation built competence in evaluating and selecting appropriate responses (i.e., convergent) through paying attention to constraints and success criteria. Even Amabile (1997) introduced the concept of motivational synergy or the addictive effect of intrinsic and extrinsic motivation on creativity. Feedback, which induces the feeling of (task-related) competence or provides information for improvement, is a positive *extrinsic motivator*. Feedback that poses constraints on the

procedure of task completion is a negative one. Amabile's proposition reflects both Ryan and Deci's SDT (2000, 2017) and Hattie and Timperley's model of feedback (2007). Accordingly, feedback is beneficial when prompting competence and detrimental when violating autonomy. FT and FP, therefore, develop competence with accuracy confirmations and improvement cues. FR, likewise, promotes autonomy in regulating the task completion process. In line with Runco and Chand's argument (1995), Amabile emphasized that feedback is more favorable during the convergent process of creativity rather than the divergent one. Bear et al.'s study (2017) also suggested that praise (i.e., FS) heightened both extrinsic ($b = 0.91, p < 0.001$) and intrinsic motivation ($b = 0.90, p < 0.001$).

Kachelmeier and Williamson (2010) and Lam (2018) illustrated the influence of extrinsic motivation on creativity. Paying participants for being creative or productive in a puzzle task resulted in an equal number of highly-rated responses (Kachelmeier & Williamson, 2010). On average, those who got paid for productivity had 10.28 responses that scored 5.7 over 10. The number of those who got paid for creativity was 9.17 with a marginal dominance in performance ($t = 1.98, p = 0.05$ two-tailed). Lam (2018) replicated Kachelmeier and Williamson's (2010) study with both tangible (i.e., paying for creativity) and intangible rewards (i.e., praises such as "Great job!"). Tangible rewards yielded similar results with Kachelmeier and Williamson's study (2010), while intangible rewards, being an extrinsic motivator, could be positively correlated to the creativity of participants ($\beta = 0.22, t = 1.64, p < 0.1$). Intrinsic motivation, as determined via the Work Preference Inventory (Amabile et al., 1994, as cited in Lam, 2018), was found to be

negatively correlated with creativity ($\beta = -0.37, t = 2.98, p < 0.01$). Hennessey (2019), using the established literature on intrinsic motivation and creativity, argued that the baseline task interest differentiates the positive and negative effects of intangible rewards on creativity. This argument is further explored in the Feedback Preferences subsection.

1.8.2. The Design Process

Practitioners/instructors frame the purpose and content of their feedback by each phase of the design process (Oh et al., 2013). Feedback, early in the process, prepares students with fundamental information for understanding and exploring the given task. In the middle of the process, feedback turns into questions and suggestions for alternative approaches to task completion. Later in the process, feedback presents relevant exemplars as indications of desired performance (i.e., success criteria). A delay in the presentation of exemplars encourages the divergent process (the beginning) and reinforces the convergent process (the end) of creativity. Practitioners/instructors also rely on students' levels of expertise/learning stages (i.e., novice, proficient, or advanced) to adjust feedback accordingly. Milovanovic and Gero (2018) observed four feedback sessions (throughout the design process) in an Architecture and Construction design studio to identify the trend of interaction between instructors and students. Overall, students' interaction with instructors remained constant (20.9 to 21.3%), while the one from instructors reduced (.3 to 12%). A slight increase from both ends occurred during the third session (the late middle of the design process), with 28.2% for students and 19% for instructors. Feedback in design studios is bidirectional; hence, instructors' intention

and students' perception regulate the effects of feedback on creativity. The following paragraphs will elaborate on the design process. The next subsection will touch on how students perceive feedback.

Huber et al. (2012) described the design process in interior design studios as five phases: (1) problem seeking, (2) analysis, (3) generation, (4) testing, and (5) reflection (See Figure 4). The first phase, problem seeking, means task exposure (i.e., receiving the task and asking for clarifications). Subsequently, the next stage, analysis, involves task exploration (i.e., interpreting task constraints, collecting relevant information, determining necessary skills, and looking for exemplars). Generation then occurs as the analysis results evolve into potential responses. Testing refers to the evaluation of potential responses to pick the most appropriate one (i.e., to salient task constraints, set goals/levels of attainment, and success criteria). Reflection concludes the process with in-depth reviews of the final response (i.e., whether further improvements are needed) and gathers insights to inform future tasks (Huber et al., 2012). Huber et al.'s five-phase design process corresponds with Amabile's five-stage process of creativity (1983), each phase/stage resonates with each other (also in Figure 4). Moreover, problem seeking, analysis, and generation reflect the associative mode/divergent process. Whereas, testing and reflection replicate the analytic mode/convergent process. FR will occur at the beginning and the end of the design process (i.e., initiate). Following this, FT will facilitate the analysis and testing phases (i.e., performing an accuracy check and paying attention to constraints and standards), while FP (i.e., heuristics and brainstorming) will

be important for the generation phase. FS remains an open question that depends on the prospective data of this study.

The National Council for Interior Design Qualification (NCIDQ) offers a more concise process (Ballast, 2013), which is common among interior design and architectural studios (AboWardah, 2020). The process includes (1) creation of a concept and schematic, (2) design development, (3) documentation. The first phase, concept and schematic, is similar to Huber et al.'s problem seeking and analysis. Students conduct task research (i.e., accumulate knowledge, facts, and skills), set primary goals/levels of attainment for their performance. They also downplay, interpret, or reorganize task constraints and salient domain standards to form potential responses. The second phase, design development, encompasses both Huber et al.'s generation and testing. Students create and revise drawings that demonstrate the sizes, characteristics, materials, etc. of the appropriate response. The last phase, documentation, is equivalent to Huber et al.'s reflection. Students produce technical drawings of how to execute the finalized task response (AboWardah, 2020; Ballast, 2013). The same process is applicable for interior design studios at all levels. Gunday Gul and Afacan (2018) surveyed 84 interior architecture seniors and learned that they preferred peer feedback for the beginning (i.e., concept and schematic) and expert feedback for the rest of the design process (i.e., design development and documentation). Participants deemed peer feedback inspiring for ideation (i.e., associative/novel) yet confusing for task comprehension (i.e., whether the solution is analytic/appropriate). They still considered expert feedback to be more useful

for understanding and responding to creative tasks.

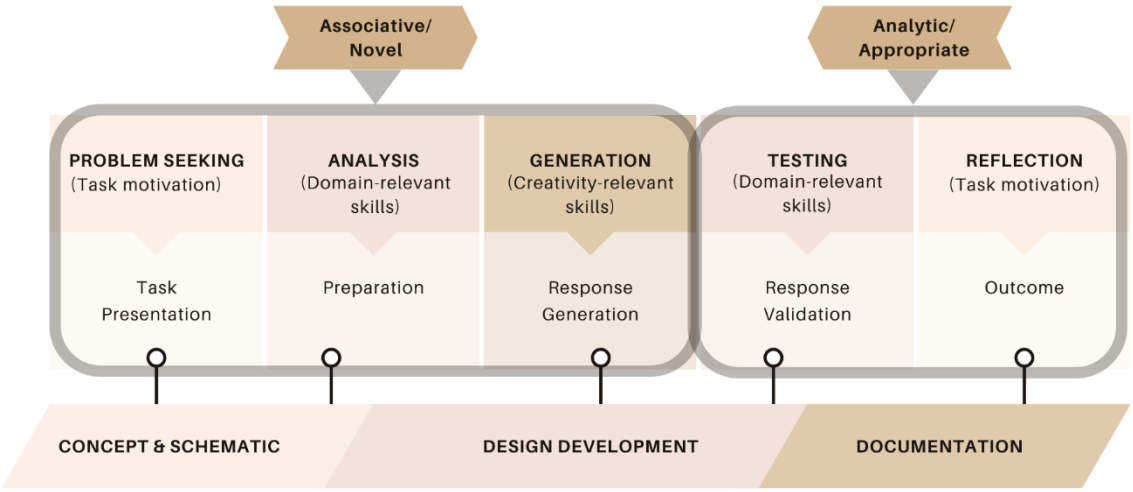

Figure 4. Feedback in the Design Process

Note. Adapted and modified from Creativity Processes of Students in the Design Studio by Huber, A., Leigh, K., & Tremblay, K. (2012). *College Student Journal*, *46*(4), 903–913; The social psychology of creativity: A componential conceptualization by Amabile, T. M., 1983, *Journal of Personality and Social Psychology*, *45*(2), 357–376; Interior Design Reference Manual: Everything You Need to Know to Pass the NCIDQ® Exam by Ballast, D. K. (2013). Retrieved from www. ppi2pass. com.

1.8.3. Feedback Preferences

Interest, as a motivational variable, dictates the preferences of individuals toward feedback (Hennessey, 2019). In educational settings, interest-based motivation is favorable due to the effects of enhanced attention, effort, concentration, and positive emotion during task engagement (Dewey, 1913; Linnenbrink-Garcia et al., 2016). The results are understandable, given that interest presents when the brain reward circuitry activates (Renninger & Hidi, 2011). As students view interest as a reward for task engagement, they become motivated to sustain and advance the activities, eventually improving their learning. Generally, interest is a psychological state that fluctuates and

stabilizes via four phases: (1) triggered situational, (2) maintained situational, (3) emerging individual, and (4) well-developed individual interest (Hidi & Renninger, 2006; Renninger & Hidi, 2015; Renninger & Su, 2012).

Triggered situational interest is short-term and relies on external supports. Tasks that are novel, surprising, complex, or ambiguous (e.g., creative and problem-solving) will catch individuals' attention and trigger the process. If these tasks are appealing and meaningful, maintained situational interest will follow. During this phase, individuals foster task persistence and engagement. Re-engagement in tasks is either voluntary or environment-induced (e.g., mandatory), and individuals need supports to bridge their prior experience with the current task learning (i.e., new knowledge and skills). Next, emerging individual interest is stable, with task engagement self-initiated using vicarious models (e.g., peers and experts). Individuals experience positive emotions, seek task clarification (i.e., acquire knowledge), and internalize the task value (i.e., the tasks must be meaningful and at a personal level) in this phase. Finally, well-developed individual interest is personal and long-lasting. Individuals commit to tasks, sustain positive emotions, and accumulate more knowledge.

As individuals' interest evolves through the four phases, their references for feedback change (Lipstein & Renninger, 2006, 2007). Lipstein and Renninger's study (2006) on K-12 students ($n = 75$) with writing tasks revealed feedback preferences for each interest phase (see Table 5). Overall, the findings echoed Ryan and Deci's SDT (2000). In the early phases of interest, the expression of approval and positive feedback (with modest and manageable suggestions of changes) were preferable. In the later

phases of interest, challenging conversations and even criticisms were desirable. The need for feedback remained across the phases, which might suggest a sense of relatedness (i.e., communicating with others on task performance). Feedback valence runs in reverse with the level of interest. In short, the higher the interest, the better is the resistance to negative feedback. Feedback specificity reduced with an increase in interest. In other words, students with high interest preferred autonomy (i.e., being independent in making decisions) versus authority (i.e., relying on teachers' standards). Renninger and Riley (2013), in a single-case study on the Science-for-Kids workshops, indicated the same patterns.

Table 5. Phases of interest and feedback preferences

Interest	Triggered Situational	Maintained Situational	Emerging Individual	Well-developed Individual
Feedback Preferences	Want to be heard; feedback includes few changes and manageable; avoid disapprovals and ego threats.	Want positive feedback; specific directions for improvements; seek teachers' standards of performance.	Want appreciation; accept open-ended reactions; avoid specific directions and questions regarding their decisions.	Want honest feedback; accept both reactive (i.e., emotion-laden) and constructive feedback on content; seek feedback about techniques.

Note. Adapted from "Putting Things into Words": The Development of 12-15-Year-Old Students' Interest for Writing by Lipstein, R. L., & Renninger, K. A. (2006), In *Writing and motivation* (pp. 113–140). Brill.

Referring back to Hattie and Timperley's model of feedback (2007), FT, FP, FR, and FS might have their distinctive roles in different interest phases (see Figure 5). For instance, FS (e.g., positive competence appraisals) is suitable for students with low task interest. Providing encouragement can initiate triggered situational interest in them. FT is

relevant for all phases, more specifically (e.g., task clarifications, instructors' expectations) for students with situational and open-ended for individual interest (i.e., to promote autonomy). FP and FR are more beneficial for high-interest students due to their focus on performance improvements (e.g., cognitive strategies and self-regulation for goal attainment). Although both are intangible rewards, feedback is an extrinsic motivator, while interest is an intrinsic one (Amabile, 1997; Hattie, 2009; Renninger & Hidi, 2011). To internalize interest, individuals need the supports of others (i.e., relatedness). As feedback helps develop interest, motivational synergy occurs, and creativity thrives.

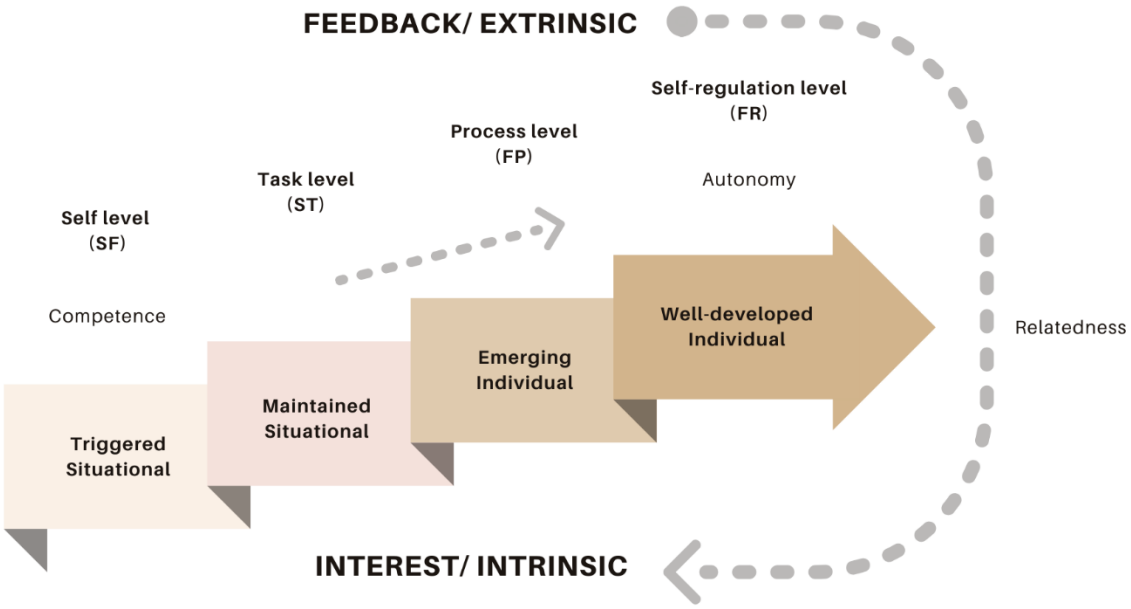

Figure 5. Feedback references and Interest

Note. Adapted and modified from "Putting Things into Words": The Development of 12-15-Year-Old Students' Interest for Writing by Lipstein, R. L., & Renninger, K. A. (2006), In *Writing and motivation* (pp. 113–140). Brill; The power of feedback by Hattie, J., & Timperley, H., 2007, *Review of educational research*, *77*(1), pp. 81–112.

Feedback preferences, based on interest (Lipstein & Renninger, 2006, 2007) and perceived personalities of risk-taking and safe-keeping (Ellis & Meneely, 2015; Giloi et al., 2019), are similar. Low-interest and safe-keeping students both prefer positive and specific feedback. High interest and risk-taking students go for the negative and general one. An intuitive explanation for this similarity is that safe-keeping students have a low interest in tasks and aim for adequate and criteria-compliant performance. Whereas, risk-taking students have a high interest in tasks and seek performance that goes beyond salient criteria. Hofer (2010) and Renninger et al. (2014) offer a more comprehensive explanation. Feedback can constitute the development of interest (Sansone & Smith, 2000; Silvia, 2005, as cited in Hofer, 2010). Positive feedback on competencies raises the level of interest. That is, once individuals become competent in a certain task, they find it more interesting and vice versa (Hofer, 2010). Renninger et al. (2014) studied multiple Science-for-Kids workshops ($n = 36$) and confirmed the above proposition. For low-interest participants, feedback communicated the meaning of tasks and helped improve performance (i.e., transferring them into the maintained situational phase). For high-interest participants, feedback signified competence and cued more challenging goals (i.e., shifting them into the well-developed individual phase). Thus, interest might explain most moderators (i.e., feedback content, frequency, perception, and perceived personalities) in the Feedback in Design Studios section.

1.8.4. Feedback Packages

The literature review indicates several feedback packages that aim to enhance creativity. Balchin's Creativity Feedback Package (CFP) (2008a) and CritiqueKit (Fraser

et al., 2017) are two that focus on expert feedback and, thus, call for discussion in this study. The CFP suggested that feedback should facilitate the creation of (1) a creative climate, (2) creative moments, and (3) a creative product. Feedback that is both supportive (evokes positive emotions) and challenging (pushes current boundaries) produces a creative climate. Feedback that directs students to task requirements and encourages them to reflect on their performance creates creative moments. Feedback that emphasizes the conceptual uniqueness and practical feasibility results in a creative product. Balchin proposed the above guidelines based on ratings of different indicators from K-12 teachers and students. A creative climate, for instance, includes openness, freedom, risk-taking and idea-supporting, ideation time, humor, acceptance, debate, challenges, and involvement. Creative moments change according to how individuals report their most current creative experiences. Additionally, a creative product contains uniqueness, idea associations, risk-taking, potential, operability, well-craftedness, attractiveness (Balchin, 2005, 2008a, 2008b).

One caveat of CFP is how it defines creativity: a combination of imagination, insight, intelligence, and emotions that bring ideas into an unexplored state (Plsek, 1996, as cited in Balchin, 2008a). Despite naming the related constructs of creativity, this conception is unable to explain the cognitive processes or characteristics of creative embodiments (e.g., products). Similarly, Balchin's use (2008b) of the indicators cited from Amabile's CAT (1982) and Besemer's CPSS (2006) is questionable. The indicators of creative climate and creative product overlap, and no clear criteria have been formulated for the self-reported indicator of the creative moment. Further statistical

assessments (e.g., factor analyses) are necessary to confirm the reliability of CPF besides the sole ratings of K-12 teachers and students. The feedback guidelines are also general (i.e., one-size-fits-all) and fail to account for differences in feedback valence, learning stages, levels of interest, and so on. Hattie and Timperley's model of feedback (2007), which provides clear typologies of feedback (including content, specificity, and predictive effects), is a more comprehensive guideline. Thus, as a feedback package to enhance creativity, the contribution of the CPF is minimal.

CritiqueKit (Fraser, 2018; Fraser et al., 2017; Ngoon et al., 2018), a more current package, uses machine-learning to distribute existing expert feedback from a corpus to webpage and application developers. Derived from Hattie and Timperley's model of feedback (2007), feedback criteria for the corpus are that the design should be (1) specific, (2) actionable (i.e., manageable changes), and (3) justified (i.e., reasonable, meaningful). The package has a web interface (see Figure 6) to collect (to corpus) and distribute feedback (to individuals/users of the interface). Experts review and comment on exemplars (i.e., creative webpages and applications) that follow the three criteria above. A classifier then analyzes and categorizes the comments into (a) positive, (b) problem, and (c) solution feedback. A text processor removes task-specific content to make the comments generally applicable. A recommendation engine then assigns the collected feedback to users based on the relevance between their tasks and the exemplars.

Ngoon et al.'s studies (2018) showed favorable results for CritiqueKit in design studios and controlled experiments. Eight teaching assistants (TAs) produced 526 comments (92 positive, 312 problem, and 122 solution feedback) for an undergraduate

design course. Half of the TAs reused 9.7% comments (60% was problem feedback) across seven assignments in the course. Forty-seven Psychology and Cognitive Science students ($n = 24$ for CritiqueKit and $n = 23$ for control), reviewed application designs of novice developers. Those using CritiqueKit provided more specific, actionable, and justified feedback ($F(1, 3) = 3.21, p < 0.005$). CritiqueKit is based on a robust theoretical framework and, thus, improves the feedback practice (i.e., is less ambiguous, identifies problems, and offers solutions). Nevertheless, whether CritiqueKit feedback enhances users' creativity remains a question (no creativity measurements included in the above studies).

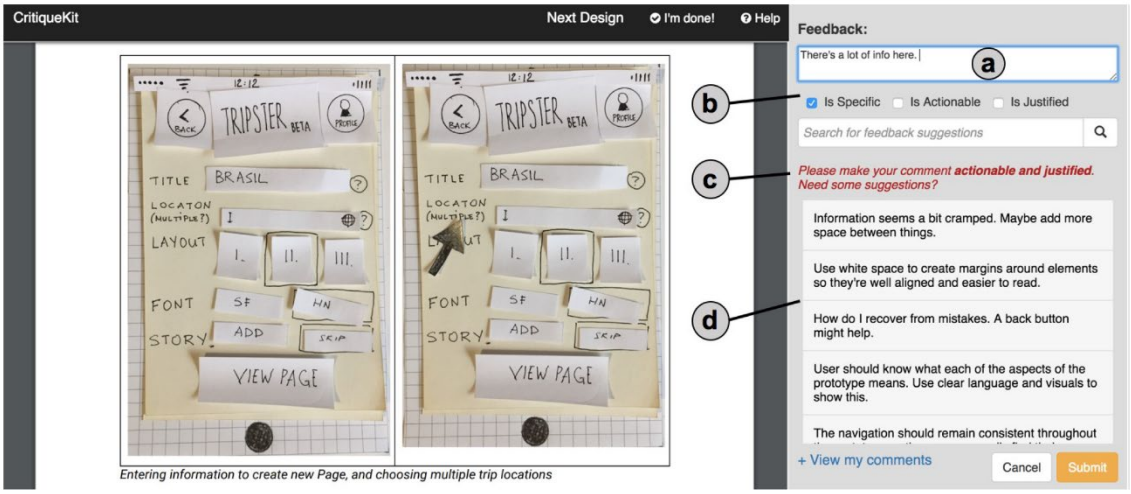

Figure 6. CritiqueKit interface

Note. Adapted from Interactive guidance techniques for improving creative feedback by Ngoon, T. J., Fraser, C. A., Weingarten, A. S., Dontcheva, M., & Klemmer, S. (2018). *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, 1–11.

CHAPTER 3: METHODOLOGY

1.9. Research Design

This study adopted the *case study−mixed methods* (CS–MM) approach (Bloomberg & Volpe, 2008; Guetterman & Fetters, 2018; Yin, 2017). Guetterman and Fetters (2018) described CS–MM as a research design with quantitative and qualitative data collections, analyses, and interpretations nested in either a single- or multiple-case study. The goal was to develop an in-depth understanding of the *activity* (feedback practices) that enhanced students' creativity in the *bounded system* of the light fixture project in a junior-level interior design studio at the University of Minnesota. This decision responded to the nature of interior design studios and their feedback practices and involved multiple data sources such as documents, survey interviews, and artifacts (Creswell & Plano Clark, 2017; Plano Clark et al., 2018). A sufficient background knowledge/literature review helped determine the case or cases (Yin, 2017). Prevalent theoretical frameworks helped validate data interpretations and facilitate generalizations (Walton et al., 2019).

Moreover, feedback practices vary over time (that is, over multiple weeks per design project) in the natural and diverse environment of interior design studios (different studio levels and project types). Thus, this study selected a junior lighting design studio as a *single-case study* to explore the dynamic between expert feedback (from practitioners and instructors) and students' creativity. The Context of the Case Study section explains this choice. The *mixed methods* component followed the *concurrent embed* strategy of simultaneous collection of quantitative and qualitative data, subsequent

analyses, and comparison of results within the primary case study design (Creswell, 2009). This study also employed a *holistic analysis* of the studio to generalize its corresponding characteristics (Guetterman & Fetters, 2018; Yin, 2017).

The *independent variable* was feedback from the chief executive officer (CEO) (written comments on Facebook) and the instructor (verbal communications in the studio). The *dependent variable* was students' creativity, as reflected in the final design with one scale model and one presentation board. A possible *intervening variable* was the interest of students toward the light fixture design project. This variable explained students' preferences of feedback content, frequency, and perception (Hofer, 2010; Lipstein & Renninger, 2006, 2007; Renninger et al., 2014). Other feedback moderators, as discussed in the Feedback in Design Studios section, were not prominent in the selected case. For instance, creativity declines when students only have *few ideas* to get feedback on (Dow et al., 2010). In the selected studio, all students started with 10 sketches/ideas. This number was sufficient, as Kudrowitz and Wallace (2013) found that individuals had more novel ideas after their 10^{th} one. *Task difficulty* (Swift & Peterson, 2018) was not salient in the selected case. The light fixture design project only required new applications of learned knowledge and skills. The technicians in the fabrication labs also assisted students with the scale models. With such a neutral task (i.e., accessibility to knowledge and availability of support), students' Big Five personalities were less likely to interfere with their perceptions of feedback (Swift & Peterson, 2018). Figure 7 illustrates the research design.

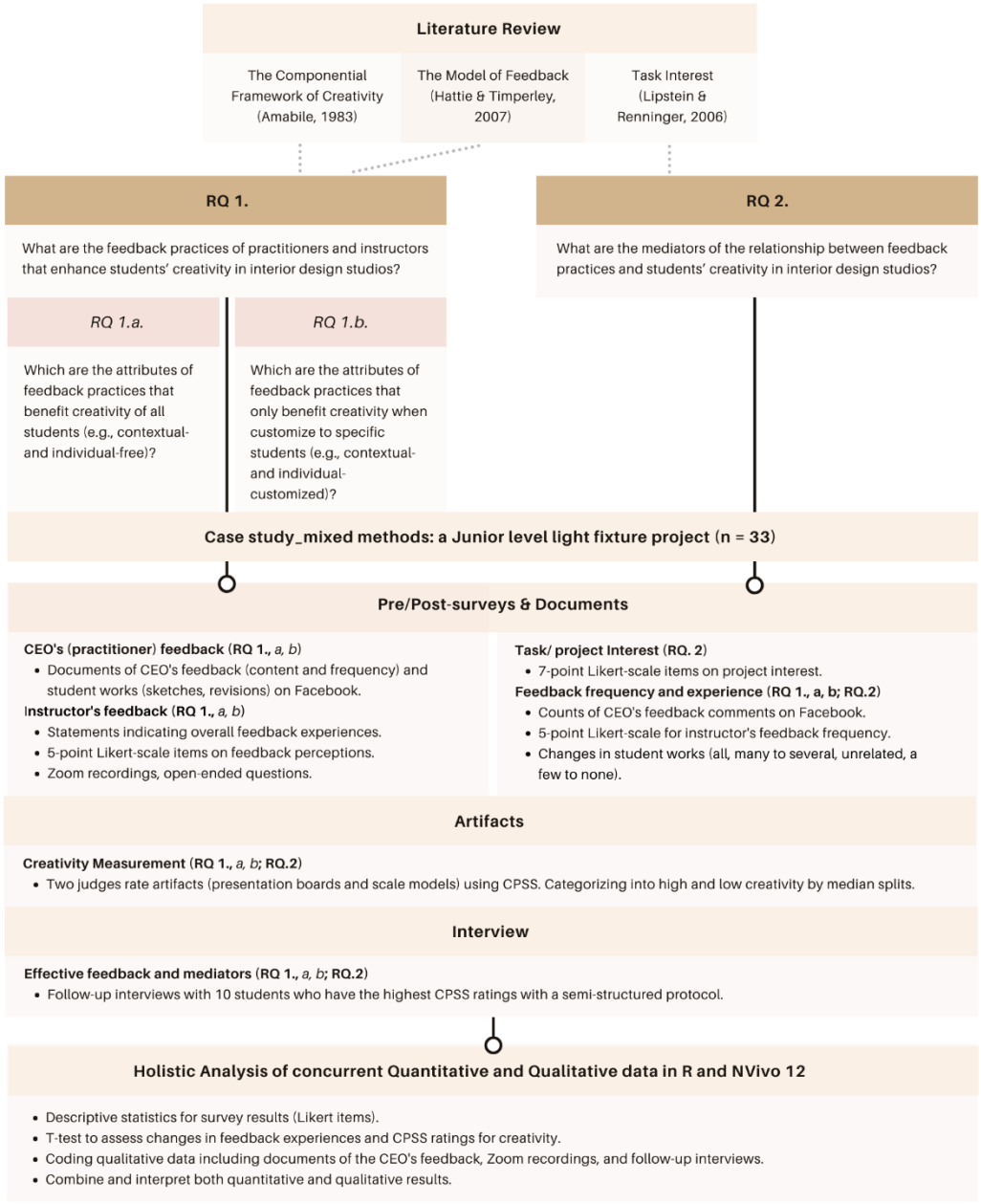

Figure 7. Research design

1.10. Case Study Context

The study used *purposeful sampling* to pick a representative case (Creswell, 2009). The CIDA accredited interior design program at the University of Minnesota has a

homogenous cohort of students in terms of gender, race, and annual enrollments. Being female- and Caucasian-dominant, the enrollment remained stable between 2015 and 2019 with a minimum of 120 students and a maximum of 137 students (Office of Institutional Research, 2020). The 2018–2019 academic year, for example, included 41 freshmen, 32 sophomores, 25 juniors, and 25 seniors with 94% being female and 91% Caucasian (Interior Design Program, 2018a). During the freshman and sophomore years, students learn domain knowledge (e.g., structures and materials), technical skills (e.g., drawing/sketching, three-dimensional modeling, and rendering), cognitive strategies, and heuristics (e.g., design thinking and process). They are also exposed to client research, space planning, etc. particularly in interior design projects (Interior Design Program, 2018b). Junior students, while having sufficient familiarity with the domain, still need to accumulate experience and enhance creativity. As the selected studio took place early in the junior year, it was advanced but flexible enough for feedback with different attributes that could occur and potential mediators that could emerge. Hence, it was a representative case for studying feedback practices and creativity in interior design studios. Junior students enrolled in the studio as part of their interior design degree process. The selected studio included 32 students in Fall 2020.

In the junior studio (IDES 3612), students designed a light fixture for a specific client in five weeks. The light fixture design project was an annual collaboration of the interior design program and Groovystuff, a Dallas-based furniture and fixture manufacturer (Asojo, 2013). In 2018, Groovystuff became the University Hall of Innovation, a non-profit organization aiming to connect interior design students with experts in the industry

(University Hall of Innovation, 2020). The project's goal was to design a *novel* and *appropriate* light fixture for the residential furnishings market from a single sheet of 4'x8' birch plywood ¾" thick (Asojo, 2020). The studio instructor was a faculty member, and the invited practitioner was the CEO of Groovystuff (later on is University Hall of Innovation). The CEO gave students *written* feedback (comments) via a private Facebook group. The instructor provided *verbal* feedback (communication) in the studio twice a week. As the studio went remote due to the COVID-19 pandemic, the instructor conducted studio hours via Zoom meetings and gave synchronous feedback to students. Figure 8 below explains the project schedule.

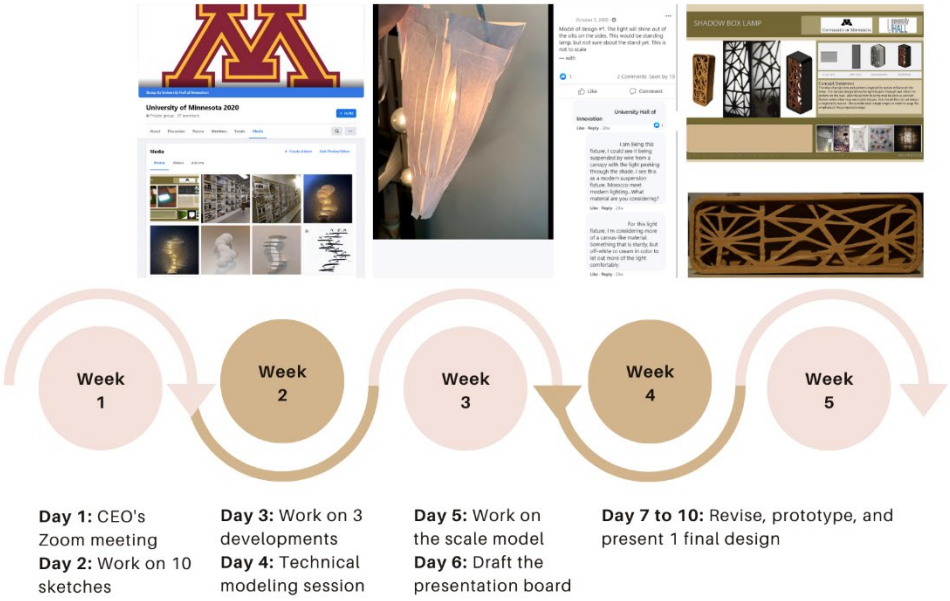

Figure 8. The light fixture design project schedule

On the first studio day, the CEO participated in a Zoom call, introduced himself, discussed his background and expertise, and answered questions regarding the light fixture

design project. The second studio day was a workday where students spent time creating 10 sketches for the light fixture and uploaded them to the private Facebook group. After the CEO gave them feedback on the sketches, the students selected and developed their three best sketches/ideas further. They also actively asked for feedback from the CEO (by tagging on Facebook) and discussed any concerns that arose (in the comments). After the three revisions, the feedback cycle was repeated. The same procedure applied to the instructor's feedback in the studio. Students selected, revised, and completed one final design via a scale model and a presentation board (including inspirational images and technical drawings). During this process, students either advanced current ideas or came up with new ones. They prototyped the scale model in three-dimensional modeling software (i.e., Fusion 360) with the help of technicians from the fabrication labs (on Zoom) when applicable, then with cardboard at home. At the end of the project, students presented the models and boards to the CEO, the instructor, and their peers in the studio. Due to the COVID-19 pandemic, the models were not on display at the High Point Market, North Carolina. However, the CEO selected and featured the 10 top light fixtures from the class on the private Facebook group.

1.11. Data Collection

The data collection procedures were approved by the Institutional Review Board (IRB) on December 9th, 2020 (see Appendix A). Bounded to specific studio activities (i.e., giving feedback and working on a design project) for an educational purpose (i.e., enhancing students' creativity), the study was classified as social-behavioral research with an exempt review. Therefore, the HRP-580 protocol and an information form for consent

(see Appendix B) were filled (IRB, 2020). Data collection included pre- and post-online surveys, documents, artifacts, and follow-up interviews. Online surveys captured students' perceptions of the instructor's feedback throughout the design process of the light fixture design project in the Fall 2020 studio ($n = 32$). The instructor incorporated the two surveys as a pre-project check-in and an end-project evaluation into the studio upon the IRB's approval. The documents of the CEO's feedback, together with corresponding students' comments on the private Facebook group, revealed the patterns in the feedback format, content, and frequency. Effective feedback practices emerged through comparisons of the perceptions and patterns in students' creativity, as evidenced through their sketches, revisions (documents), and final designs (artifacts). The researcher who conducted this study remained objective without any connections to the 2020 studio.

Due to the COVID-19 pandemic, the Fall 2020 studio took place online via Zoom, and the video communication was sponsored by the University of Minnesota. The researcher attended the first studio day to introduce the study and hand out the information sheet (embedded in a Google Forms survey) to students via the Zoom chat. The purpose was to recruit a pool of participants for the *follow-up interviews* (Lichtman, 2012; Yin, 2017), as discussed in the next section on Data Analysis. According to Laguilles et al. (2011) and Hsieh and Kocielnik (2016), incentives boost participation rates. Those selected for the interviews (top 10 participants with highest creativity ratings) received $25 Amazon eGift cards. Students gave consent by entering their emails and granting information-disclosure permissions to the third party (i.e., Amazon, for eGift card delivery) in the

Google Forms survey. At the end of each interview, the Amazon eGift cards arrived via email to the corresponding participant.

Overall, students experienced a complete design process (AboWardah, 2020) with 10 sketches, three revisions, a scale model, and a presentation board. The researcher accessed these documents and artifacts via the private Facebook group. Details on these are presented in the following subsection of Documents and Artifacts from the 2020 Studio. No identifiable information of students was available for the instructor, the CEO, and the related personnel in the data collection and analysis. Moreover, during the pandemic, university-owned computers (i.e., secured passwords and an internal network) were inaccessible. Therefore, the researcher kept collected and analyzed data in the Box Encrypted Storage of the University of Minnesota in private mode and under the Cisco virtual private network (VPN). The digital information sheet, the Qualtrics survey, and samples of the CEO's feedback and students' works from the 2020 studio are presented in the Appendices.

1.11.1. Survey for the 2020 Studio

As per the *Hawthorne effect* (Adair, 1984; Nguyen et al., 2018), the instructor and students in the activity of interest (feedback practices in the studio) might change their behaviors under direct observations. Consequently, the researcher collected *feedback perceptions* from students via online surveys as the studio began (pre-project check-in/pre-survey) and once the studio ended (end-project evaluation/post-survey) (Fong et al., 2016; Yin, 2017). The pre-project check-in/pre-survey gauged the baseline feedback perceptions in students before the Fall 2020 studio. The end-project evaluation/post-

survey revealed the changes in perceptions with respect to the instructor's feedback. Both the pre- and post-surveys had three parts: (1) demographic information, (2) feedback perception, and (3) project interest. In demographic information, students provided their date of birth and pet name to help match responses between the pre- and post-surveys. In the post-survey, they also gave the light fixture names to help match responses with the creativity ratings. For the feedback perception, the pre- and post-surveys featured different portions of a combination of Likert-scale items from Gunday Gul and Afacan (2018) and Kusumowidagdo (2019). Both studies examined expert feedback (i.e., instructors or invited practitioners) in interior architecture studios. While the samples were non-Caucasian, the authors tested the items for internal reliability using Cronbach's alpha and construct validity using confirmatory factor analysis (CFA). Appendices E and F contain further details of the pre- and post-surveys.

1.11.1.1. Feedback perception

Gunday Gul and Afacan (2018) built their items upon a literature review of feedback practices in fine art and architectural studios (Belluigi, 2016; Kent, 2001; Oh et al., 2013 as cited in Gunday Gul & Afacan, 2018). The pre- and post-surveys adapted six statements on overall feedback experiences and six Likert items on expert feedback perceptions from 1 (*strongly disagree*) to 5 (*strongly agree*) from their items. The overall experiences indicated how students utilized expert feedback. The perceptions referred to whether expert feedback was beneficial to students' learning, emotion, project interest, and the design process. Among the Likert-scale items, one statement emphasized the consistency of having feedback from the same instructor. As the pre- and post-surveys

collected feedback reflections for only one instructor, this statement was removed. Two open-ended questions were present, which asked students for inputs regarding effective feedback practices. The authors reported a Cronbach's alpha of 0.926 (i.e., high internal reliability) with a sample of 84 Turkish interior architecture juniors.

Kusumowidagdo (2019) used ten items from Christina and Purwoko (2015) in entrepreneurial education to explain the feedback perceptions of students in interior architecture studios. The items are statements of purposes for seeking expert feedback and vary on a five-point Likert scale similar to Gunday Gul and Afacan (2018). Christina and Purwoko built the items upon their literature review on educational psychology and examined them with 700 students studying entrepreneurship. The results of the CFA showed that the items reflected a unidimensional construct with high factor loadings (0.499 to 0.803) and significant p-values (< 0.05). Construct/composite reliability was 0.89, which indicated high internal reliability. Christina and Purwoko included mastery and performance goals (i.e., knowledge/skill acquirement and demonstration, respectively) in their items. Nevertheless, only statements of purposes that reflected Hattie and Timperley's model of feedback (2007) were significant to students. Hence, this study excluded two statements of mastery and performance goals. The Feedback in the Design Studios section contains more details on Kusumowidagdo's findings (2019).

An additional question on feedback frequency completed the second part of the survey. During the design process, students got feedback from the instructor in the same phases as the CEO. Hence, the frequency question included the sub-categories of 10 sketches (concept schematic) and three revisions (design development). The Likert scale

also adapted the five-point descriptors from Brown (2010) to maintain consistency with the items from Gunday Gul and Afacan (2018) and Kusumowidagdo (2019). Table 6 presents all the questions for feedback reflection in the pre- and post-surveys. While the pre-survey only adapted 14 items in the feedback perception category, the post-survey included all the items listed below.

Table 6. Feedback items

Feedback reflection	Item	Scale
Overall experience (Gunday Gul & Afacan, 2018)	Please indicate the one statement that represents your feedback experience in the studio. 1. I reflect what I hear from the instructor and try to combine my ideas and instructor's feedback on my design. 2. I understand the instructors' feedback; however, I cannot come with an applied design. 3. I am skeptical regarding the instructor' comments about the design and I have tendency to discount the feedback I receive. 4. I misunderstand the instructor' feedback and apply what I want to hear. 5. I remember and apply the instructor' concrete feedback. 6. I assume that the instructor has the same idea with my ideas.	N/A
Feedback perception (Gunday Gul & Afacan, 2018)	Please indicate whether you agree or disagree with the following statements. 1. I have positive attitude toward feedback in the studio. 2. Feedback in the studio is helpful. 3. I learn more with feedback in the studio. 4. I feel comfortable asking questions while receiving feedback in the studio. 5. Receiving feedback in the studio is better for the design process.	1 (*strongly disagree*) to 5 (*strongly agree*)

	6. I prefer having feedback in the studio.	
(Kusumowidagdo, 2019)	1. I request feedback in the studio so that I can determine the target of my future project. 2. I request feedback in the studio because I want to hear praises that make me happy. 3. I request feedback in the studio because I want to know how to solve problems in the project. 4. I request feedback in the studio because I want to be more capable in finishing a project. 5. I request feedback in the studio because I want to learn to improve the quality of my project. 6. I request feedback in the studio to ensure my design project is fine. 7. I request feedback in the studio to improve my knowledge and ability for my design project. 8. I request feedback in the studio to ensure I am able to finish my design project.	
Feedback frequency	How often do you seek feedback from your instructor in the studio? During concept schematic (10 sketches) During design development (3 revisions)	1 (*never*) to 5 (*almost always*) (Brown, 2010)
Feedback input (Gunday Gul & Afacan, 2018)	1. What will be your suggestions for the instructor's feedback in the studio? 2. How can the instructor's feedback in the studio be more effective?	N/A

1.11.1.2. Project interest

The third part, project interest, adapted the *individual interest scale* (Linnenbrink-Garcia et al., 2010; O'Keefe & Linnenbrink-Garcia, 2014; Schrader et al., 2018) to the light fixture design project in the Fall 2020 studio. When tested on college students ($n =$

$858, n = 1\ 53$, respectively), the scale showed high internal reliability, with Cronbach's alphas ranging between 0.61 and 0.97. Researchers in educational psychology use this scale to assess interest as the accumulation of experiences in the classroom. The scale includes 17 items, each varying on a seven-point Likert scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Based on the literature review, this study considered project interest as a potential intervening variable in the relationship between feedback practices and creativity. To avoid overemphasizing this variable and straying from other emergent mediators, a general indication of students' low or high interest was sufficient for exploration in the context of this study.

Consequently, the survey adapted only eight items from the individual interest scale (see Table 7) to better fit the light fixture design project in the 2020 studio. O'Keefe and Linnenbrink-Garcia (2014) and Schrader et al. (2018) used the same approach of selective items with respective Cronbach's alphas of 0.97 (five items) and 0.91 (eight items). The interest phases reflect the four sets of eight items are as follows: (1) triggered situational—affect, (2) maintained situational—perceived value, (3) emerging individual—personal value, (4) well-developed individual—reengagement (Hidi & Renninger, 2006; Linnenbrink-Garcia et al., 2010; Renninger & Hidi, 2015; Renninger & Su, 2012). The general indication for low interest is one standard deviation (SD) below the mean, whereas for high interest, it is one SD above the mean (O'Keefe & Linnenbrink-Garcia, 2014). The scores on each set of items also pointed to where the student stands in each phase of interest development.

Table 7. Interest items

Set of items	Item	Scale
Triggered situational *Affect*	I think the light fixture project in this studio is interesting. I enjoy working on the light fixture project in this studio.	1 (*strongly disagree*) to 7 (*strongly agree*)
Maintained situational *Perceived value*	I'm excited about the light fixture project in this studio. I think the light fixture project in this studio is important.	
Emerging individual *Personal value*	I think what I learned from the light fixture project in this studio is useful for me to know. I find the light fixture project in this studio personally meaningful.	
Well-developed individual *Reengagement*	I see how I can apply what I learned from the light fixture project in this studio to real life. What I learned from the light fixture project in this studio is practical for my study in interior design.	

1.11.2. Documents and artifacts from the 2020 Studio

Upon the IRB's approval and the instructor's permission, the researcher gained access to the private Facebook group (named University of Minnesota 2020) as a guest without the ability to change or disclose the content. The 10 sketches and three revisions of the students and the Facebook comments between the CEO and students will be referred to as the *documents*. *Artifacts* implied the scale models and presentation boards. The 10 sketches were images of numbered hand drawings (either black and white or colored) to indicate each sketch/idea's chronological order, whereas the three revisions were computer-generated renderings with materials. The final design contained the scale model's images and the presentation board with written and pictorial explanations.

Feedback practices were reflected through the CEO's and students' Facebook comments for the 10 sketches (concept and schematic) and three revisions (design development). The Facebook group also displayed the 10 top light fixtures chosen by the CEO.

The CEO gave feedback by commenting first on the 10 sketches and then on the three revisions. Each time, students had the opportunity to respond (e.g., explain, elaborate, and even withhold their design decisions) or ask for further clarification. Comment quantity (i.e., the number of responses between the CEO and each student) informed the feedback frequency. Counting excluded comments that are unrelated to the sketches and revisions. The researcher tabulated the counts in an Excel spreadsheet with the CEO's total responses and those of each student in separate columns. The comment content indicated the attributes of the CEO's feedback. The researcher organized the comments into a Word document, with the headers being the CEO and each student's name. Comparisons between the comment content and the changes between the 10 sketches, the three revisions, and then the final design revealed how the feedback translated into student works. Appendix C shows samples of student works and the CEO's feedback in the Fall 2020 studio.

To unpack students' experiences with the CEO's feedback, the researcher matched the changes in their works with the six items from Gunday Gul and Afacan (2018). Student works that manifested *all* changes as suggested in the CEO's feedback resonated with the fifth item, *remember and apply*. Those displayed *many to several* suggested changes signified the first items, *reflect and combine*. However, changes that were unrelated to the CEO's feedback demonstrated the fourth item, *apply*

misinterpretation, and the sixth item, *assume consensus*. Student works with *a few to none* changes (concerning the CEO's feedback) indicated the second item, *understand but cannot apply*, and the third item, *skeptical and discount*. Table 8 illustrates the alignments between students' works (regarding the CEO's feedback) and Gunday Gul and Afacan's items (2018). Table 6 has more details on Gunday Gul and Afacan's scale and items.

Table 8. Alignment for student experiences of CEO's feedback

CEO's feedback experiences				
Gunday Gul and Afacan (2018)	Item (5) *remember + apply*	Item (1) *reflect + combine*	Item (4) *apply misinterpretation* Item (6) *assume consensus*	Item (2) *understand + cannot apply* Item (3) *skeptical + discount*
Changes in student works *1 (none) to 4 (all)*	Changes (*all*)	Changes (*many* to *several*)	Changes (*unrelated*)	Changes (*a few* to *none*)

Despite the remote approach, students still developed their final designs with structures and materials (via technical drawings and digital renderings, respectively). These information sources were available either in printed presentation boards or images uploaded on Facebook. Photos of the scale models were available upon the instructor's approval. The CEO voted for the top 10 light fixtures with no regard to the instructor's grades. While the voting results helped determine highly creative students, the critical determination of students' creativity was the CPSS rating. As a means to measure students' creativity, two appropriate judges were invited to rate 10 sketches, three

revisions, and the final designs of students using a shortened version of CPSS with 15 items, as shown in Table 9 (Wei et al., 2015; White & Smith, 2001). The appropriate judges (i.e., jurors, as preferred in interior design studios) were alumni of the interior design program with experience in lighting design.

Table 9. CPSS with 15 items

Dimension	Subscale	7-point Likert scale (*score is mean of items*)
Novelty	Original	Overused – Fresh Predictable – Novel Usual – Unusual Ordinary – Unique Conventional – Original
Resolution	Logical	Illogical – Logical Senseless – Makes Sense Irrelevant – Relevant Inappropriate – Appropriate Inadequate – Adequate
Elaboration & Synthetic (Style)	Well-crafted	Bungling – Skillful Botched – Well Made Crude – Well Crafted Sloppy – Meticulous Careless – Careful

Note. Adapted from Teaching based on augmented reality for a technical creative design course by Wei et al., 2015, *Computers and Education*, 81, 221–234.

The judges were not affiliated with the Fall 2020 studio. The researcher of this study also refrained from the rating process. Each judge/juror viewed the artifacts of the students in a random order and rated them independently. Students' creative performance was reflected via the average of the scores between the two judges in each dimension of the CPSS (i.e., novelty, resolution, and style). Table 10 explains the rating procedures and score computations. Images of the presentation board and scale model of each student were available on each slide of two separate PowerPoint files. With two Excel

randomized student lists, the researcher assigned the slides to the corresponding order. The judges received two PowerPoint files (with different randomization) via their specified Box Encrypted Storage links. They then accessed the online 15-item CPSS on Qualtrics. Once the judges finished rating them, the scores were downloaded and categorized into high and low creativity based on median splits (Hüsser, 2017). The judges' access to the PowerPoint files on Box Encrypted Storage was subsequently terminated.

Table 10. Rating procedures of appropriate judges

CAT	Judge 1	Judge 2
15-item CPSS	Dimensions	
Presentation board and Scale model	Novelty Resolution Style	Novelty Resolution Style
	Averages of Judge 1 and Judge 2	
Creative performance	Novelty Resolution Style	M_N M_R M_S

Note. M_N: average of judge 1 and judge 2 in Novelty, M_R: average of judge 1 and judge 2 in Resolution, M_S: average of judge 1 and judge 2 in Style.

1.12. Data Analysis

The analysis process involved both quantitative and qualitative data. Regarding quantitative data (i.e., Likert-scale results and creativity scores), the researcher performed statistical analyses and generated graphs in R, an open-source statistical software (R Core Team, 2017). All the Likert scales in this study ranged from five to seven points, which are optimal for interrater reliability and discriminatory power (Preston & Colman, 2000; Simms et al., 2019). For qualitative data (i.e., open-ended questions, feedback documentations, and records), the researcher performed *content analysis* or finding the

meanings of the texts within the context of communication (Neuendorf, 2017) in NVivo 12 (QSR International Pty Ltd., 2018). The researcher utilized a codebook from Weisen et al. (2021) and developed from the model of feedback (Hattie & Timperley, 2007) to explore the feedback levels (i.e., FT, FP, FR, FS) in the qualitative data. Theoretical frameworks from the literature review, such as interest-based feedback preferences (Lipstein & Renninger, 2006), guided the process of combining and interpreting the quantitative and qualitative results (Casssell et al., 2017; Yin, 2017).

1.12.1. Quantitative data analysis

Results of the pre- and post-surveys included indications of overall feedback experiences (6), five-point Likert items on feedback perception (14), feedback frequency (2), and project interest (8). The descriptive statistics, that is, means (M) and standard deviations (SD) for each category represented the general trends of feedback practices (of the instructor) in the Fall 2020 studio. These results echoed the literature review of feedback in design studios. For instance, they pointed to how students handled feedback (i.e., applied, combined, or disregarded), whether they perceived feedback as beneficial for their creative performance, and how active they were in feedback seeking. While responding to the surveys was voluntary, 30 over 32 students completed both the pre- and post-surveys with no skipped item. The results were tabulated into Excel spreadsheets in their entirety.

Documents on the private Facebook group indicated student experiences and frequencies of the CEO's feedback. Descriptive statistics for the number of comments between the CEO and students in each phase of the design process (10 sketches and three

revisions) reflected the frequencies. Changes in students' works represented their experiences with the CEO's feedback via four categories: *a few to none*, *unrelated*, *many to several*, and *all*. Likert values got assigned to the categories as well (from 1 to 4, respectively). As students also received the instructor's feedback via Zoom meetings, the same categories applied to the *overall experience* results in the survey (see Table 8). Overall, this study looked for effective feedback practices from experts, including both the instructor and the CEO. Thus, the data analysis for both sources complemented one another. Appendix G and H contain research consents from the CEO and the instructor.

Paired t-tests between the pre- and post-surveys were used to assess changes in feedback experiences and the project interest of students in the Fall 2020 studio. As t-tests indicate whether the difference between the means of the two data sets is significant (Lock et al., 2013), these analyses revealed if (a) students' perception of the instructor's feedback differed from their baseline and (b) their project interest wavered. With 30 students completing both the pre- and post-survey, the t-test assumption of having a sample size equal to or larger than 30 was fulfilled (Lock et al., 2013). For the creativity ratings, the judges only rated 20 out of the 30 students. These students uploaded their works on the private Facebook group and received feedback from both the CEO and the instructor. Shapiro-Wilk tests, which are superior in detecting nonnormality in data (Yazici & Yolacan, 2007), were conducted in place of the sample size assumption. Thus, paired t-tests between M_N, M_R, and M_S from 10 sketches to three revisions were performed. In case of nonnormality, a Wilcoxon signed-rank test took place (Lock et al., 2013).

Non-parametric correlations (Spearman's Rho) between feedback experiences and CPSS scores (Xiao et al., 2016) revealed if feedback correlated with creativity. The *cor.test()* function in R was performed on mean scores for novelty (M_N), resolution (M_R), and style (M_S) with assigned Likert values of feedback experiences from the survey and Facebook documents, respectively. Cronbach's alpha, computed via the *alpha()* function, helped assess the internal reliability (or rating consistency) of the two appropriate judges (Wei et al., 2015). Graphs (e.g., histograms, boxplots, and pie charts), composed in R and Nvivo, described feedback frequency trends and changes in feedback experiences as well as students' creativity across the design stages.

1.12.2. Qualitative data analysis

Open-ended responses in the post-survey, Facebook documents of the CEO's feedback, transcripts of the instructor's feedback, and follow-up interviews helped explore the practices that benefit students' creativity. The analysis process focused on attributes of the feedback given to students with high creativity. Based on the CPSS scores, students got categorized into either *high* or *low creativity* tiers (median splits). Votes from the CEO for the top 10 light fixtures were another basis for adjusting students between categories. Open-ended responses in the post-survey were transferred into a Word document with students' names as headings. Likewise, Facebook comments, transcripts of instructor's feedback, and follow-up interviews were kept in separate Word documents. These data sources revealed the shared feedback patterns among students with high creativity.

This study employed the strategy of content analysis via NVivo 12, which involved *coding*, *categorizing*, and *abstraction* (Bloomberg & Volpe, 2008; Creswell, 2014; Elo & Kyngäs, 2008; Neuendorf, 2017). The above Word documents were imported into NVivo 12. The codebook from Weisen et al. (2021) was used for the Facebook comments and transcripts of the instructor's feedback. Nvivo-generated word frequency queries and word clouds were used for the open-ended responses and transcripts of the follow-up interviews to gain a general idea of the data. These techniques, while taking the frequently used words out of their contexts, served as pinpoints for the (open) coding process. The researcher then revisited the Word documents, reflected on the literature review, and noted the similarities and differences between the codebook-based findings and the open-coded emergences.

The next steps were summarizing, organizing, and labeling these notes with respect to the instructor's/CEO's feedback, students' high/low creativity, and project interest. Categorizing was followed by grouping related or repeated information from the notes into representative categories. Abstraction completed the content analysis process, where the categories were generalized into feedback attributes for the 2020 studio, focusing on students with high creativity. Levels of project interest and attributes that are associated with low creativity indicated the mediators for feedback practices in the selected case. The literature review also guided the final step of combining and interpreting the quantitative and qualitative analyses to answer the research questions.

1.12.3. Interpretation

This final step involved combining and then comparing the quantitative and qualitative analysis results with the literature review to come up with interpretations (Sinkovics, 2018; Yin, 2017). The model of feedback (Hattie & Timperley, 2007), the literature on feedback in design studios, and interest-based feedback references (Lipstein & Renninger, 2006) were the frameworks for comparing and interpreting the analyses above. The extent to which these frameworks support the interpretations of analysis results determines this study's (internal) validity (AERA et al., 2014; Creswell, 2009). Specifically, the model of feedback helped determine if the found attributes resembled FT, FP, FR, FS. First, it was determined whether feedback from the CEO focused on task accuracies (FT), process/cognitive strategies (FP), goals and progress (FR), or praise (FS). Second, whether FT, FP, FR, FS reflected on the transcripts of instructor's feedback was assessed. Feedback attributes that were similar across students in the high creativity group answered RQ 1.a.

Likewise, the literature on feedback in design studios helped unpack RQ 1.b or variances in feedback perception and frequency between students. The focus was on looking for differences (if there were any) in how students with high creativity perceive feedback and their desired frequencies. Potential differences in feedback format (verbal/instructor vs. written/CEO) and performance-beneficial perceptions (FT, FP, and FR vs. FS) were found. Descriptive statistics and correlation results (i.e., rho and p value) from the quantitative analysis showcased the extent to which empirical evidence

supported these pattern-matching conclusions. Together, the shared and distinctive feedback attributes that correlate with high creativity answered RQ 1.

Third, the levels of project interest helped explain the discrepancy in feedback preferences between students. The researcher compared the survey results of project interest, desired feedback frequencies, and perceptions with the percentages of FT, FP, FR, and FS to see whether these results matched Lipstein and Renninger's findings (2006). The researcher also generated word clouds and categories with labels in Nvivo 12 to demonstrate the feedback preferences of students with low and high creativity (based on the open-ended responses and transcripts of the follow-up interviews, respectively). The combined interpretations of the quantitative and qualitative results also revealed the mediators in the relationship between feedback practices and students' creativity, and, thus, answered Q R2.

Internal reliability (i.e., if findings are congruent with reality) and *validity* (i.e., the extent to which theoretical frameworks/literature review support the interpretations of empirical data) are accountable via *triangulation* and *reducing researcher's bias* (Lichtman, 2012; Merriam, 2002; Zohrabi, 2013). This study triangulated data from different sources (surveys, documents, and artifacts), theoretical frameworks, and literature from different fields (educational psychology, psychology, and design). To reduce bias, the researcher remained as nonjudgmental as possible when interviewing students and analyzing data. Interview questions were worded to signify the same meaning for all participants and avoid leading them to give only positive feedback experiences (see Appendix C). Moreover, the researcher adhered to the codebook and the

literature review to analyze the data, not her beliefs of what feedback practices benefited students' creativity.

As a CS–MM, this study aimed for *analytic generalization*, not *statistical generalization* (Yin, 2016). The match between the results of the analysis and theoretical frameworks/literature review helped hypothesize feedback attributes that can enhance students' creativity beyond the study's setting. These hypothesized attributes will form the groundwork for further research in freshmen, sophomore, and senior studios. The attributes with supporting findings from across studios will serve as references for feedback practices in the interior design program at the University of Minnesota.

CHAPTER 4: RESULTS

This chapter discusses the quantitative and qualitative results with respect to the data sources. This study had two purposes. First, exploring effective feedback practices that enhance students' creativity in a five-week light fixture design project of a junior-level studio. Second, identifying the potential mediators of the relationship between feedback and creativity. As mentioned in Chapter 3: Methodology, 30 students completed the pre- and post-surveys. That said, sufficient documents and artifacts (i.e., 10 sketches, three revisions, a final solution including the scale model, and the presentation board) came from 20 of them. Those students received and/or asked for feedback from the CEO via Facebook comments as well. Others either missed posting one or two stages of the design process or did not interact with the CEO on the private Facebook group. Hence, only these 20 students received creativity ratings (on an online 15-item CPSS) from the two judges. The 10 follow-up interviewees, thus, were selected among this cohort. Table 11 shows the number of students in each data source.

Table 11. Number of students by data sources

Pre-project check in End-project evaluation	Documents and Artifacts Creativity ratings	Follow-up interviews
$n = 30$	$n = 20$	$n = 10$
Completed the pre-and post-surveys on Qualtrics.	Posted 10 sketches, three revisions, a final solution and interacted with the CEO on the private Facebook group.	Consented and selected for the interviews due to high creativity ratings and CEO's votes.

Note. The fall 2020 studio (IDES 3612) has a total of 32 students.

1.13. Overview of Participants

The majority of the students who participated in this study were Caucasians (73.4%). Additionally, there were equal percentages of Asian Americans (13.3%) and international students (13.3%). Participants included both women (90%) and men (10%). Most were juniors who majored in interior design. There was, however, one female student who majored in product design and one male student who majored in Architecture. Both had chosen IDES 3612 as an elective studio. Another male student who majored in Art was excluded from the data set for missing stages of the design process and interactions with the CEO on the private Facebook group. A summary of the students' demographic information in each data source is available in Table 12.

Table 12. Demographic information of students by data sources

		Pre-and post-surveys		Documents Artifacts		Follow-up interviews	
		$n = 30$		$n = 20$		$n = 10$	
		N	%	N	%	N	%
Background	Caucasian	23	73.4	12	60	7	70
	Asian American	4	13.3	4	20	1	10
	International students	4	13.3	4	20	2	20
Gender	Female	27	90	17	85	9	90
	Male	3	10	3	15	1	10

Note. The fall 2020 studio (IDES 3612) has a total of 32 students.

One male and nine female students from product design (10%) and interior design (90%) were selected for follow-up interviews. All got high creativity ratings (15-item CPSS scores) from the two independent judges. Among them, four students were on the list of top 10 light fixtures voted by the CEO (see Figure 9). Voting criteria focused on whether the novel light fixtures were appropriate for the residential furnishings market and the designated material of a 4'x8' birch plywood sheet (¾" thick) as represented by

cardboard (Asojo, 2020). Interview orders reflected students' schedule availability with no particular meaning.

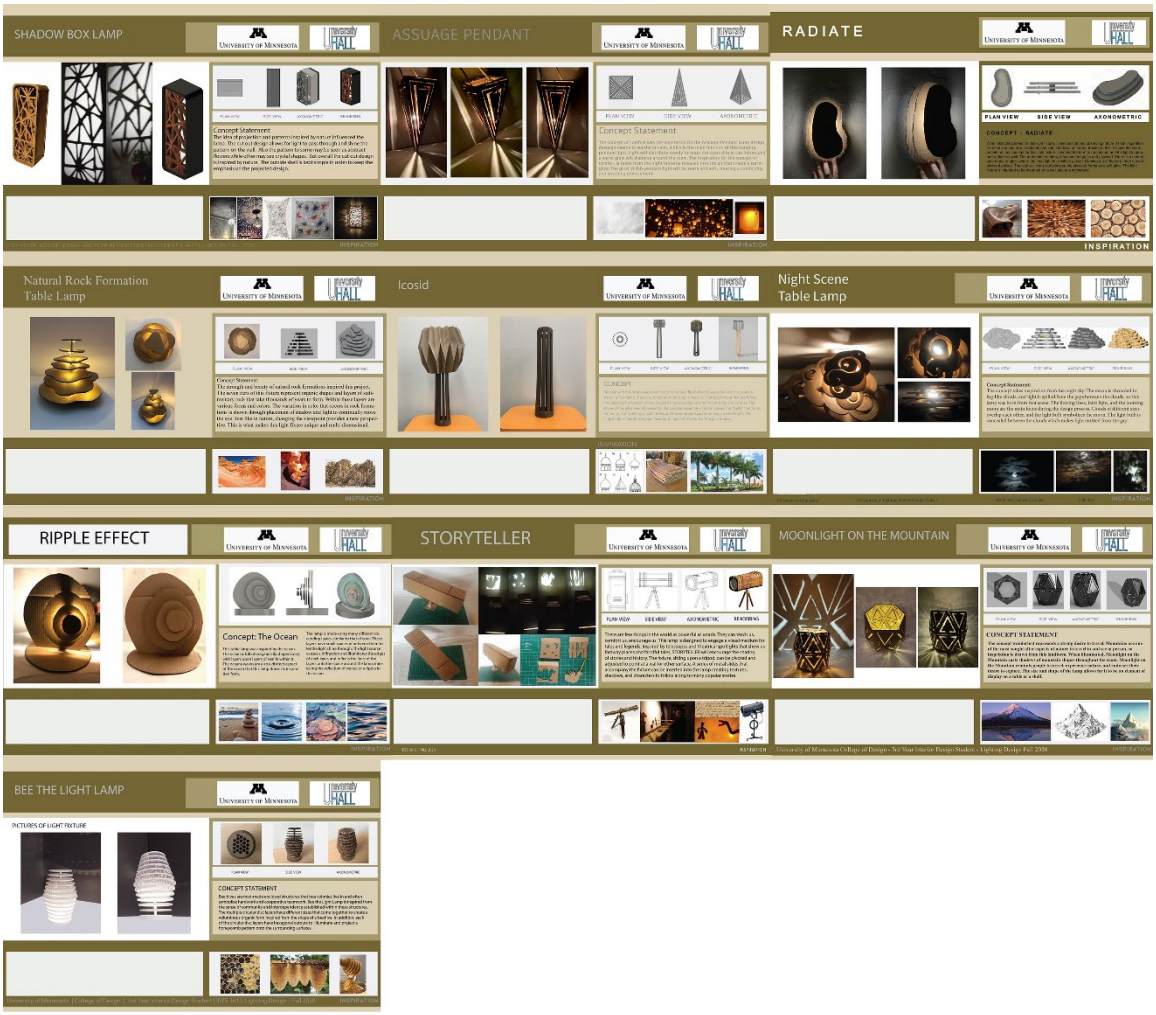

Figure 9. Top 10 Student light fixture design project voted by the CEO in no particular order (Source: Asojo IDES 3612/5612: Lighting Design Course, Fall 2020)

Student #1 got equally high CPSS scores in all dimensions (novelty, resolution, and style) but was not in the top-10 list. Student #2 shared similar CPSS scores and the top-10 list status. Student #3 was also tied in CPSS scores yet placed 4th in the top-10 list. Student #4, again, scored high in all CPSS dimensions and placed 3rd in the top 10 list.

The scores of student #5 resonated with those of students #1 and #2. Student #6 scored lower in style and was not a member of the top 10 list. Student #7 tied with students #1, #2, #3, #4, and #5 in CPSS scores but placed 2nd in the top 10 list. Whereas, student #8 scored lower in novelty and was not in the top 10 list. Student #9 had equally high scores in all CPSS dimensions and also placed 6th in the top 10 list. Student #10 was on par with student #9 in terms of CPSS scores but did not make the list.

1.14. Quantitative Results

This section presents the quantitative results of Likert items in the pre- and post-surveys ($n = 30$), interaction frequencies between students and the CEO on Facebook, and their creativity ratings ($n = 20$). Regarding the pre- and post-surveys, descriptive statistics indicated the trends, while a set of paired t-tests revealed changes in students' feedback perception and project interest. The number of Facebook comments between students and the CEO signified their interaction frequencies. Creativity ratings were the average CPSS scores (M_N, M_R, and M_S) of two independent judges for each student. Descriptive statistics also described the general creative performance of students. Mean splits classified them into high and low creativity categories. Paired t-tests of CPSS scores between the 10 sketches and three revisions and then between the three revisions and the final solution showed how students' creativity had changed.

1.14.1. Feedback perception and project interest from the pre-and post-surveys

Results from the pre- and post-surveys described how students perceived the instructor's feedback and their interest level in the light fixture design project during the

five-week studio in Fall 2020. The pre-project check-in (pre-survey) included 14 Likert items (five-point scale) on baseline feedback perception and eight Likert items (seven-point scale) for baseline project interest. Cronbach's alpha values were also computed for baseline feedback perception ($\alpha = 0.84$) and baseline project interest ($\alpha = 0.86$), with each item treated individually. These alpha values indicated the high internal reliability for the items in each component of the pre-survey. The end-project evaluation (post-survey) included six statements on overall feedback experience, 14 Likert items (five-point scale) on feedback perception, two Likert items (five-point scale) on feedback frequency, two open-ended questions on feedback input, and eight Likert items (seven-point scale) on project interest. Cronbach's alpha values were computed for feedback perception ($\alpha = 0.90$) and project interest ($\alpha = 0.97$) and indicated the high internal reliability of these items in the post-survey as well.

Overall, the baseline feedback perception was positive. The means of the items ranged from $M = 3.20$ to $M = 4.60$ with the smallest and largest standard deviations of $SD = 0.45$ and $SD = 0.91$. Thus, the means were higher than the middle split 2.5 of a five-point scale. The coefficient of variations ($\frac{SD}{M}$) ranged from $CV = 0.11$ to $CV = 0.28$ (the standard deviations were 11% to 28% of the means), which showed moderate dispersions of item ratings (Abdi, 2010). In terms of Likert categories, students strongly agreed that they learned more with feedback (56.67%) and found feedback made the design process better (60%). Students also agreed that they had a positive attitude toward feedback (76.67%), received helpful feedback (60%), and were comfortable with feedback (56.67%). Moreover, all students agreed (50%)/strongly agreed (50%) that they

preferred feedback. Their reasons included planning for future projects (93.33%), problem-solving (100%), becoming more capable (100%), improving project quality (96.66%), checking project progress (83.33%), improving design knowledge and ability (96.67%), and completing the project (83.34%). These percentages represented agreement and strong agreement. Students, however, either disagreed (26.67%) or disregarded (33.33%) that they sought feedback for praise.

Feedback perception at the end of the light fixture project reduced in item ratings and exhibited more variations among students. Overall, 73.33% of the students reflected and incorporated feedback into their design solutions, 10% applied feedback, another 10% made assumptions about feedback, 3.33% of them were unable to applied feedback, and the rest 3.33% were skeptical about feedback. The means of the feedback perception items ranged from $M = 3.27$ to $M = 4.47$ with the smallest and largest standard deviations of $SD = 0.54$ and SD =1.14. While the means were still higher than the middle split 2.5 of a five-point scale, the standard deviations also increased compared to the baseline. Coefficient of variations ($\frac{SD}{M}$) ranged from $CV = 0.12$ to $CV =$ 0.33 (standard deviations were 12% to 33% of the means), which demonstrated a notable dispersion of item ratings (Abdi, 2010).

At the end of the light fixture project, students strongly agreed that feedback was helpful (33.33%) and preferable (50%). They also agreed on having a positive attitude toward feedback (60%), learning more with feedback (43.33%), being comfortable with feedback (46.67%), and perceiving feedback as better for the design process (46.67%). Their reasons/goals for seeking feedback included planning for future projects (80%),

problem-solving (93.33%), becoming more capable (93.34%), improving project quality (96.67%), checking project progress (90%), improving design knowledge and ability (96.67%), and completing the project (86.66%). These percentages represented agreement and strong agreement. Also, while 33.33% of the students still disregarded that they sought feedback for praise, 43.33% of them agreed and strongly agreed with this reason. Tables 13 summarizes the pre- and post-survey results for feedback perception.

Table 13. Feedback perception in pre-and post-surveys

		Pre-survey			Post-survey		
		$n = 30$			$n = 30$		
		M	SD	%	M	SD	%
Overall feedback experience	Reflect and combine						73.33%
	Understand but not apply						3.33%
	Skeptical and disregard						3.33%
	Misunderstand						0%
	Remember and apply						10%
	Assume the same idea						10%
Feedback perception (5-point scale)	Positive attitude	4.17	0.45	96.67%	4.20	0.75	93.33%
	Feedback is helpful	4.40	0.49	100%	3.97	1.14	73.33%
	Learn more with feedback	4.50	0.62	93.34%	4.10	0.91	80%
	Comfortable with feedback	4.00	0.86	83.34%	4.17	0.78	83.34%
	Better for design process	4.60	0.49	100%	4.27	0.85	90%
	Prefer having feedback	4.50	0.50	100%	4.47	0.56	96.67%
	Plan future project	4.20	0.65	93.33%	4.0	0.73	80%
	Praises	3.20	0.91	40%	3.27	1.09	43.33%
	Problem solving	4.47	0.50	100%	4.37	0.60	93.33%
	Becoming more capable	4.53	0.50	100%	4.30	0.59	93.34%
	Improving project quality	4.60	0.55	96.66%	4.33	0.54	96.67%
	Checking project progress	4.13	0.76	83.33%	4.13	0.67	90%
	Improving knowledge	4.47	0.56	96.67%	4.33	0.54	96.67%
	Completing project	4.17	0.78	83.34%	4.17	0.73	86.66%
Cronbach's alpha		$\alpha = 0.84$			$\alpha = 0.90$		

Note. Reported percentages combined agree and strongly agree responses. The discussions above separate these responses to emphasize differences in importance of each item.

Paired t-tests for 14 Likert items regarding feedback perception between the pre- and post-surveys were conducted. As 30 students completed both surveys, the t-test assumption of a large enough sample size was met (Lock et al., 2013). Among the 14 Likert items, mean differences were statistically significant for two items: (a) whether feedback helped with learning and (b) whether students sought feedback to improve the quality of their projects. For (a) whether feedback helped with learning, feedback perception ($M = 4.10, SD = 0.91$) was significantly lower than baseline ($M = 4.50, SD = 0.62$), $t(29) = 1.82, p < 0.05$. For (b) whether students sought feedback to improve the quality of their projects, feedback perception ($M = 4.33, SD = 0.54$) was significantly lower than baseline ($M = 4.60, SD = 0.55$), $t(29) = 2.28, p < 0.05$. Table 14 describes the paired t-tests as discussed above.

Table 14. Paired t-tests for feedback perception with statistically significant results

	Pre-survey		Post-survey			
	$n = 30$		$n = 30$			
	M	SD	M	SD	ΔM	t
Learn more with feedback	4.50	0.62	4.10	0.91	0.40	1.82*
Improving project quality	4.60	0.55	4.33	0.54	0.27	2.28*

Note. $*p < 0.05$.

Generally, baseline project interest was high. The means of the items ranged from $M = 5.20$ to $M = 5.90$ with the smallest and largest standard deviations of $SD = 0.80$ and $SD = 1.28$. The means were also higher than the middle split 3.5 of a seven-point scale. The coefficient of variations ranged from $CV = 0.14$ to $CV = 0.25$ (standard deviations were 14% to 25% of the means), which indicated moderate dispersions of item ratings (Abdi, 2010). Most students agreed on the initial perception that the light fixture project was interesting (43.33%), enjoyable (50%), exciting (50%), important (46.67%),

useful (63.33% agree), and practical for interior design (46.67%). Fewer students agreed that they perceived the project as personally meaningful (30%) and applicable to real life (36.67%) just by reading the prompt.

At the end of the light fixture project, project interest remained high with more variations in responses. The means of the items ranged from $M = 5.10$ to $M = 6.07$ with the smallest and largest standard deviations of $SD = 1.18$ and $SD = 1.52$. Again, the means were higher than the middle split 3.5 of a seven-point scale. The coefficient of variations ranged from $CV = 0.19$ to $CV = 0.28$ (standard deviations were 19% to 28% of the means), which indicated larger dispersions of item ratings than the pre-survey (Abdi, 2010). Students strongly agreed that the light fixture project was interesting (40%), enjoyable (43.33%), exciting (43.33%), important (33.33%), useful (36.67%), applicable to real life (33.33%), and practical for interior design (33.33%). About 26.67% of the students strongly agreed that the light fixture project was personally meaningful. Table 15 summarizes the pre- and post-survey results for project interest. In the table, the somewhat agree, agree, and strongly agree responses have been combined.

Paired t-tests for eight Likert items regarding the project between the pre- and post-surveys were also conducted. No statistical significance was found in mean differences at the 95% confidence level. All p-values were larger than $p = 0.05$ and ranged from $p = 0.18$ to $p = 0.67$. Therefore, the overall high project interest of students in the Fall 2020 studio remained unchanged during the five-week light fixture design project. In general, statistical evidence did not indicate that the changes in project interest were accountable for the changes in the two Likert items on feedback perception.

Table 15. Project interest in pre-and post-surveys

		Pre-survey			Post-survey		
		$n = 30$			$n = 30$		
		M	SD	%	M	SD	%
Project interest (7-point scale)	Interesting	5.93	0.96	93.33%	6.07	1.18	96.67%
	Enjoyable	5.43	0.99	73.33%	5.80	1.40	90%
	(*Affect*)	5.68			5.94		
	Exciting	5.83	1.04	93.33%	5.90	1.35	86.67%
	Important	5.90	0.91	90.01%	5.60	1.40	83.33%
	(*Perceived value*)	5.87			5.75		
	Useful	5.63	0.80	86.67%	5.47	1.52	76.67%
	Personally meaningful	5.20	1.28	70%	5.10	1.47	60%
	(*Personal value*)	5.42			5.29		
	Applicable to real life	5.63	1.05	80%	5.33	1.49	70%
	Practical to interior design	5.77	1.12	80.01%	5.53	1.36	83.33%
	(*Reengagement*)	5.70			5.43		
Cronbach's alpha		$\alpha = 0.86$			$\alpha = 0.97$		

Note. Reported percentages combined somewhat agree, agree and strongly agree responses.

1.14.2. Feedback frequency from the post-survey and counts of Facebook comments

Feedback frequency in the post-survey reflected how often students sought the instructor's feedback (see Table 16). This component included two Likert items (five-point scale), which resonated with two stages of the design process: concept schematic (narrowing down 10 sketches) and design development (finalizing three revisions). During the concept schematic stage, with regard to feedback frequencies, 20% of students responded with almost always, 33.33% often, 30% sometimes, and 16.6% seldom. During design development, the frequencies slightly changed, with 23.33% responding with almost always, 36.67% often, 30% sometimes, and 10 % seldom. No student responded that they never sought feedback.

Table 16. Instructor's feedback frequency from the post-survey

	Never	Seldom	Sometimes	Often	Almost always
	%	%	%	%	%
Concept schematic	0	16.6	30	33.33	20
Design development	0	10	30	36.67	23.33

Note. Results from students who completed the post-survey ($n = 30$).

Similarly, the counts of Facebook comments indicated how often students sought the CEO's feedback and whether they received it (see Table 17). Only Facebook comments from 20 students with a complete design process (10 sketches, three revisions, and one final solution) were collected. However, unrelated comments (i.e., the instructor's reminders to the CEO to give students feedback) were excluded. In total, the CEO gave 31 comments to 18 students. Overall, 17 comments were given for the concept schematic and 14 comments for design development. Per student, the CEO gave three

comments at most and one comment at least. Two students were present who solicited the CEO's feedback yet received none. Conversely, another student received feedback from the CEO but did not respond. In total, 19 students who sought/responded to the CEO's feedback made 56 comments (15 for concept schematic and 41 for design development). Per student, the comments ranged from eight to one. Overall, students made 1.8 times more comments than the CEO. They also focused on the design development with 2.9 times more comments. Changes in student works (following the CEO's feedback) showed that 38.89% of the students reflected on and incorporated feedback; 5.55% acknowledged applying specific comments to the design solution. However 55.56% disregarded the comments.

Table 17. CEO's feedback from the private Facebook group

		CEO	Students	
		Count	Count	%
Overall feedback experience	Reflect and combine			38.89
	Understand but not apply			0
	Skeptical and disregard			55.56
	Misunderstand			0
	Remember and apply			5.55
	Assume the same idea			0
Facebook comment	Concept schematic	17	15	
	Design development	14	41	

Note. Results from students who posted a complete design process ($n = 20$).

1.14.3. Creativity ratings

Two judges each rated students' creativity ($n = 20$) using 15 CPSS items (seven-point scale) embedded in three Qualtrics surveys resonating the10 sketches, three revisions, and one final solution. Cronbach's alpha values were calculated for each CPSS subscale item (see Table 9) and ranged from $\alpha = 0.84$ to $\alpha = 1$. These high alpha values,

across three rating stages, showed desirable internal reliability for the 15 CPSS items. Moreover, for the 10 sketches, judge number 1 scored some students lower, while judge number 2 always scored above the middle split 2.5 of a five-point scale. However, with the three revisions and one final solution, both judges rated the students highly, as their scores were all higher than the middle split.

For the 10 sketches, mean scores in novelty (M_N) of judge number 1 were from $M_{N\_10\_1} = 1.8$ to $M_{N\_10\_1} = 6.0$ and of judge number 2 were from $M_{N\_10\_2} = 6.4$ to $M_{N\_10\_2} = 7.0$. Mean scores in resolution (M_R) of judge number 1 were from $M_{R\_10\_1} = 1.0$ to $M_{R\_10\_1} = 7.0$ and of judge number 2 were from $M_{R\_10\_1} = 5.0$ to $M_{R\_10\_1} = 7.0$. Mean scores in style (M_S) of judge number 1 were from $M_{S\_10\_1} = 2.0$ to $M_{S\_10\_1} = 7.0$ and of judge number 2 were from $M_{S\_10\_2} = 3.0$ to $M_{S\_10\_2} = 7.0$. Figure 10 presents the CPSS means in percentages for 40 inputs, as each judge rated 20 students independently.

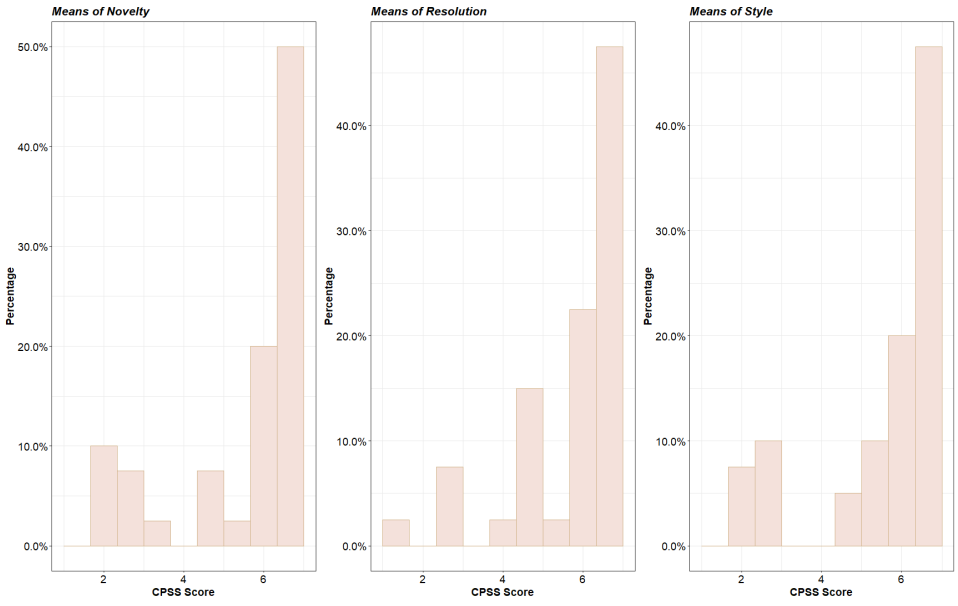

Figure 10. Means of creativity ratings for 10 sketches from the two judges

For three revisions, mean scores in novelty (M_N) of judge number 1 were from $M_{N\_3\_1} = 4.0$ to $M_{N\_3\_1} = 7.0$ and of judge number 2 were from $M_{N\_3\_2} = 6.0$ to $M_{N\_3\_2} = 7.0$. Mean scores in resolution (M_R) of judge number 1 were from $M_{R\_3\_1} = 5.0$ to $M_{R\_3\_1} = 7.0$ and of judge number 2 were from $M_{R\_3\_1} = 6.8$ to $M_{R\_3\_1} = 7.0$. Mean scores in style (M_S) of judge number 1 were from $M_{S\_3\_1} = 4.0$ to $M_{S\_3\_1} = 7.0$ and of judge number 2 were from $M_{S\_3\_2} = 6.0$ to $M_{S\_3\_2} = 7.0$. Figure 11 presents the CPSS means in percentages for 40 inputs, as each judge rated 20 students independently.

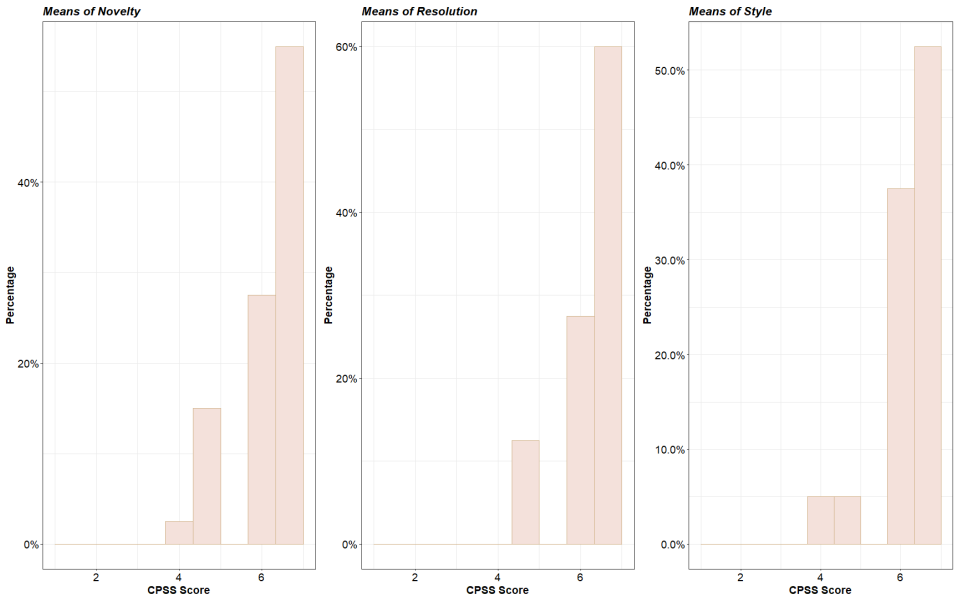

Figure 11. Means of creativity ratings for three revisions from the two judges

Regarding the final solution, mean scores in novelty (M_N) of judge number 1 were from $M_{N\_1\_1} = 5.0$ to $M_{N\_1\_1} = 7.0$ and of judge number 2 were $M_{N\_1\_2} = 7.0$. Mean scores in resolution (M_R) of judge number 1 were from $M_{R\_1\_1} = 5.0$ to $M_{R\_1\_1} = 7.0$ and of judge number 2 were $M_{R\_1\_1} = 7.0$. Mean scores in style (M_S) of judge number 1 were from $M_{S\_1\_1} = 4.0$ to $M_{S\_1\_1} = 7.0$ and of judge number 2 were from $M_{S\_1\_2} = 6.0$

to $M_{S\_1\_2} = 7.0$. Figure 12 presents the CPSS means in percentages over 40 inputs as each judge rated 20 students independently.

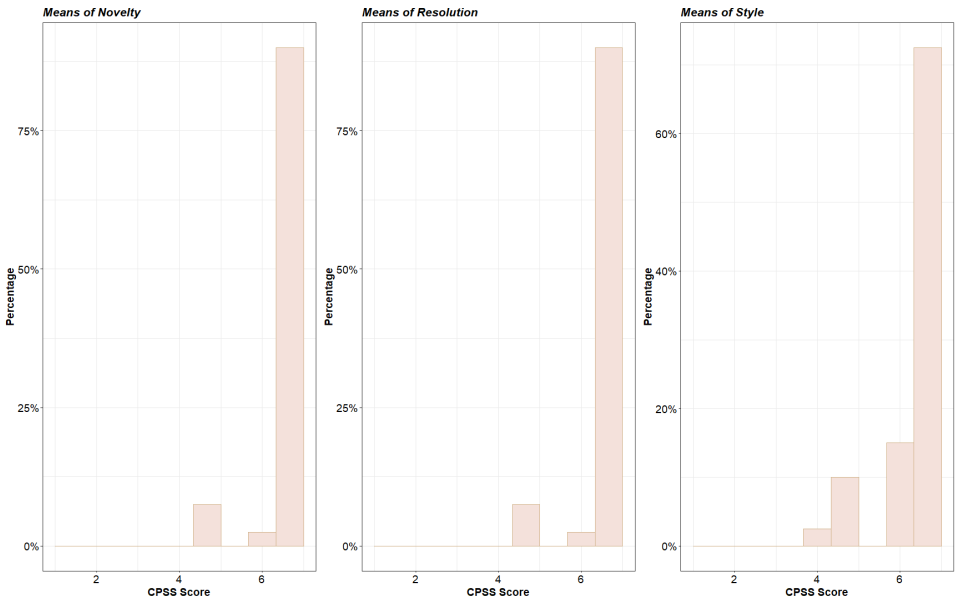

Figure 12. Means of creativity ratings for one final solution from the two judges

Paired t-tests were conducted for creativity ratings/CPSS scores between (a) the 10 sketches and the three revisions and (b) the three revisions and one final solution. As the judges only rated 20 students who posted a complete design process and interacted with the CEO on the private Facebook group, the t-test assumption of sample size was invalid. Hence, the Shapiro-Wilk normality tests were conducted to see if the scores met the t-test assumption of normal distribution (Park, 2008). When p-values (from the Shapiro-Wilk normality tests) were above 0.05, paired t-tests were performed. When p-values (from Shapiro-Wilk normality tests) were below 0.05, Wilcoxon signed-rank tests were performed instead (Woolson, 2007). Table 18 describes the paired t-tests and Wilcoxon signed-rank tests as discussed above.

Table 18. Paired t-tests and Wilcoxon signed-rank tests for creativity ratings

	10 sketches to 3 revisions			3 revisions to 1 final solution		
	$n = 20$			$n = 20$		
	ΔM	t	V	ΔM	t	V
Novelty (M_N)	0.69	2.61*		0.49	4.97**	
Resolution (M_R)			40			12
Style (M_S)			51.5	0.195	1.48	

Note. $^{*}p < 0.05, ^{**}p < 0.01$.

Results of the paired t-tests/Wilcoxon signed-rank tests showed that the mean scores of novelty (M_N) significantly increased from 10 sketches to three revisions ($\Delta M = 0.69, t(19) = 2.61, p = 0.02$) and from three revisions to one final solution ($\Delta M = 0.49, t(19) = 4.97, p < 0.001$). The mean scores of resolution (M_R) moderately increased from 10 sketches to three revisions ($V = 40, p = 0.05$) and from three revisions to one final solution ($V = 12, p = 0.05$). Furthermore, the mean scores of style (M_S) moderately increased from 10 sketches to three revisions ($V = 51.5, p = 0.05$) yet showed non-significant improvement from three revisions to one final solution ($\Delta M = 0.195, t(19) = 1.48, p = 0.15$). Figure 13 represents the directions of changes in mean scores of novelty (M_N) from 10 sketches to three revisions and from three revisions to one final solution. Similarly, figures 14 and 15 display the directions of changes in mean scores of resolution (M_R) and style (M_S) from 10 sketches to three revisions and from three revisions to one final solution. At a 95% confidence level, students' creativity significantly increased across the design process stages in terms of novelty or the newness of their light fixtures.

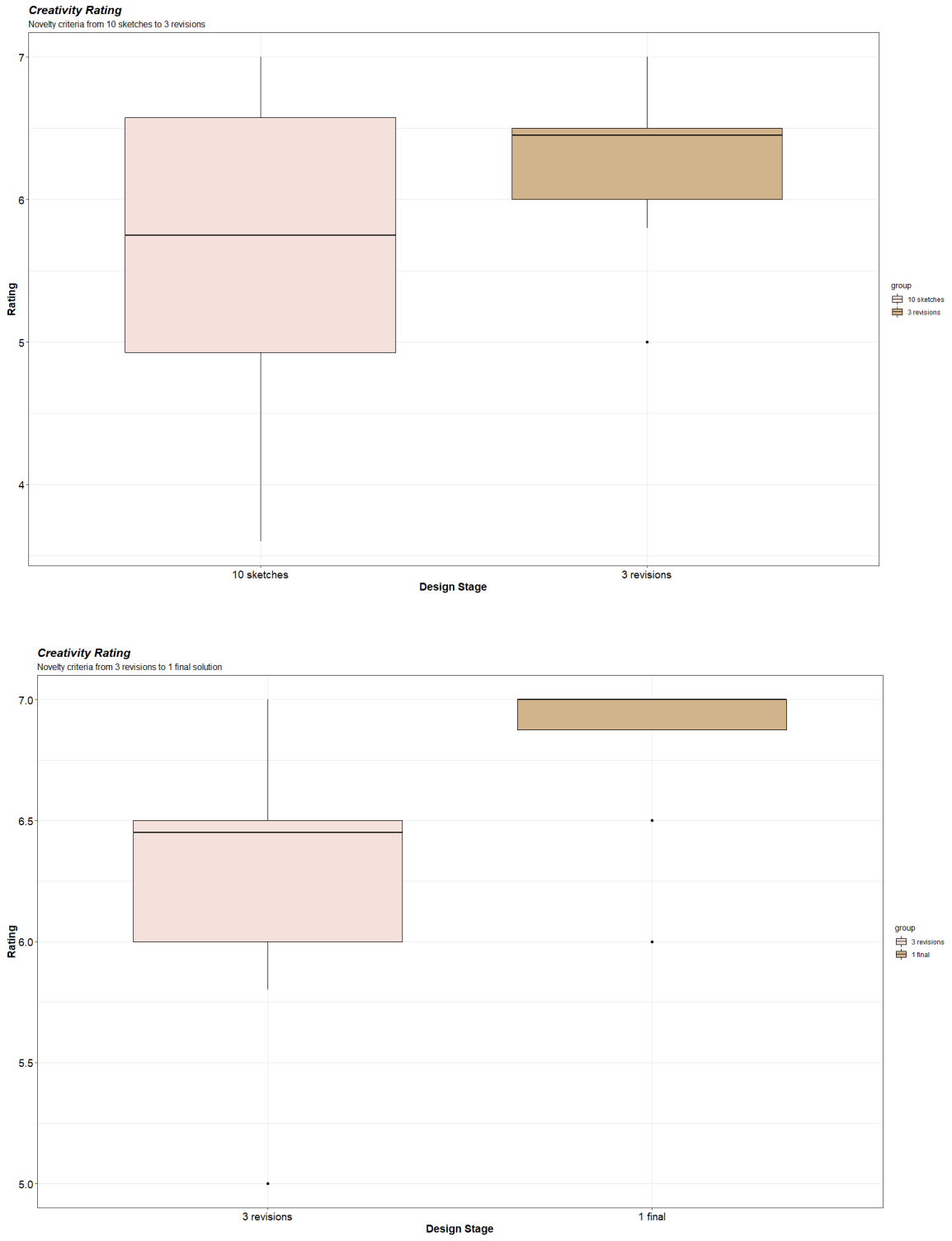

Figure 13. Changes in mean scores for Novelty (M_N) between design process stages

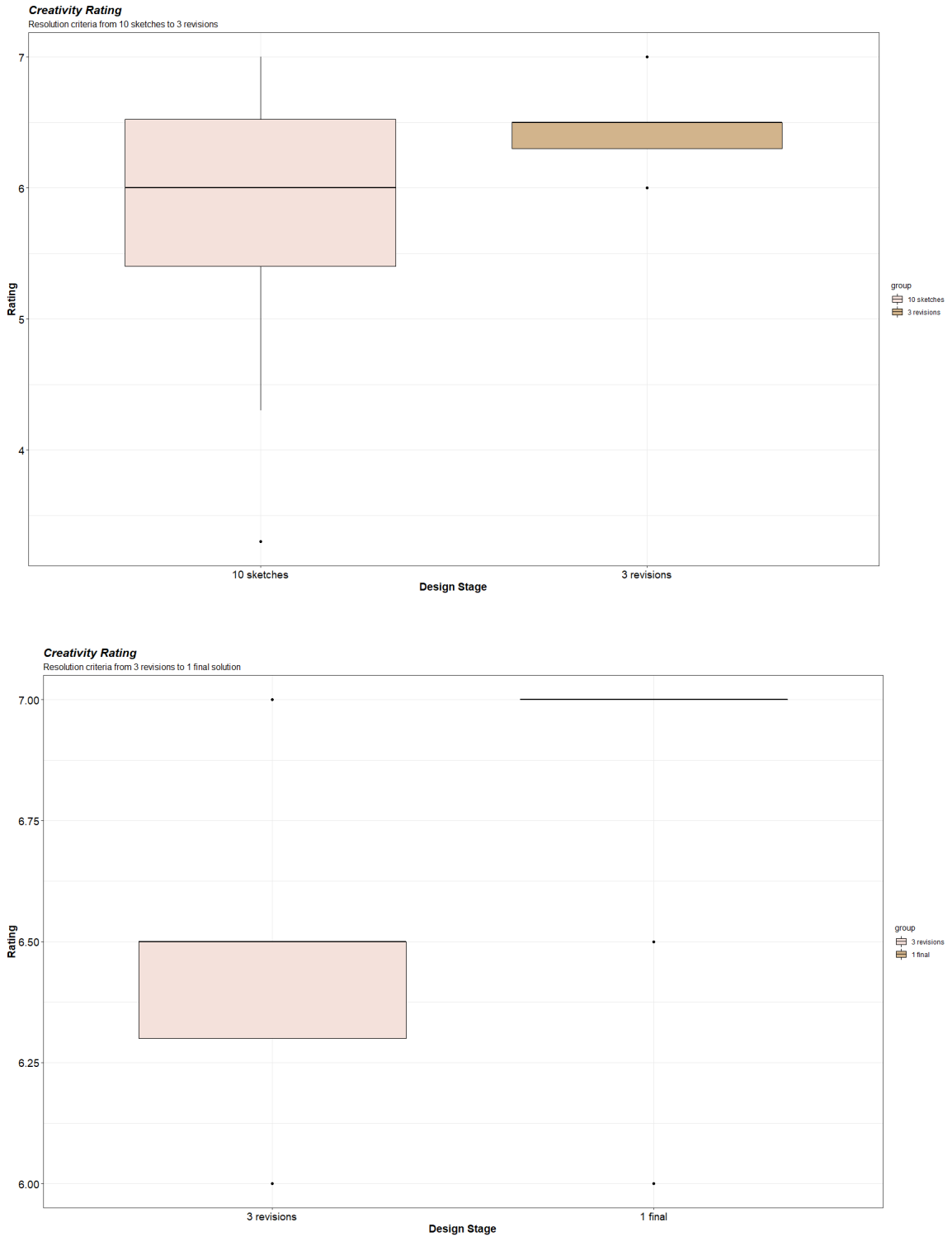

Figure 14. Changes in mean scores for Resolution (M_R) between design process stages

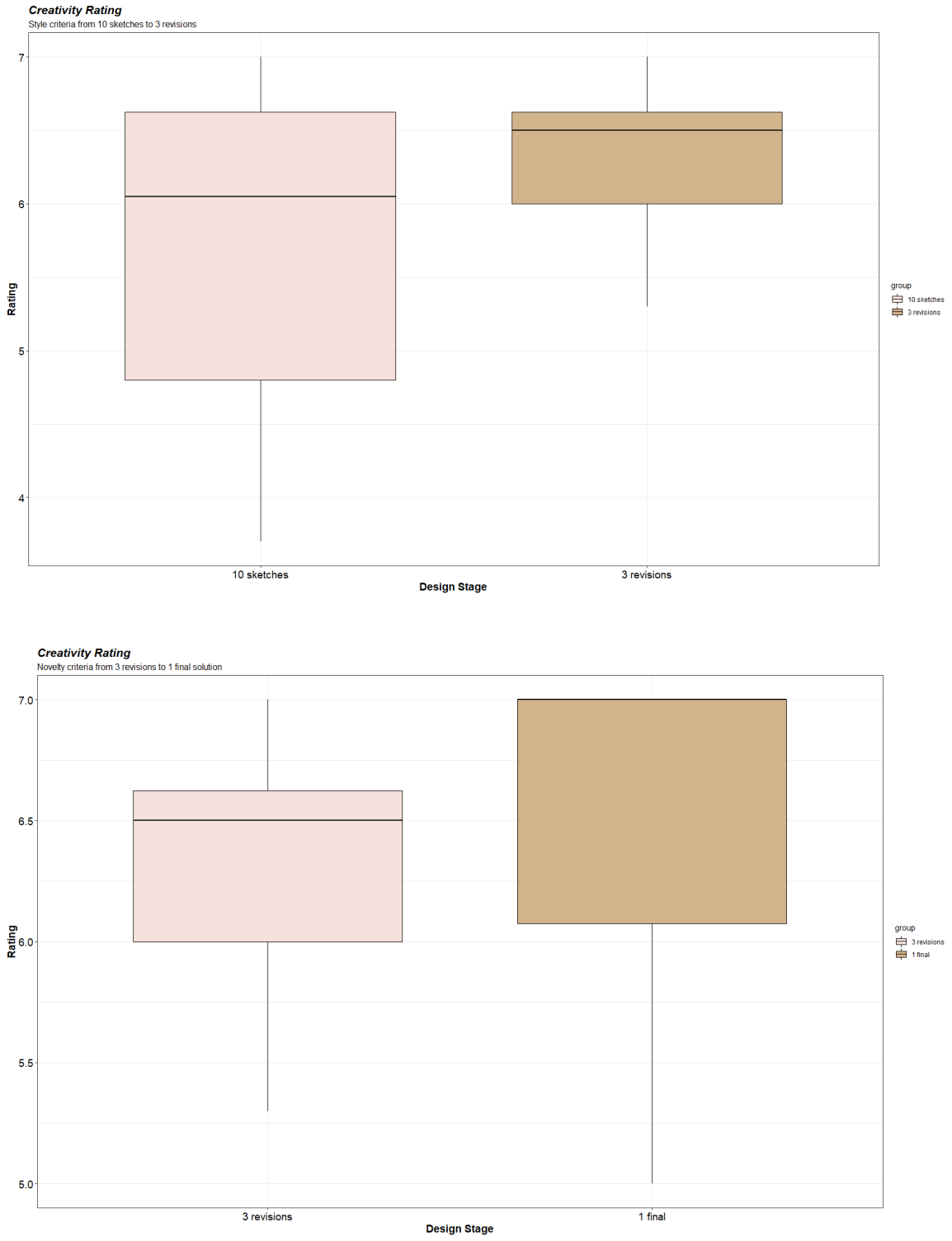

Figure 15. Changes in mean scores for Style (M_S) between design process stages

1.15. Qualitative Results

This section presents qualitative results from the open-ended responses from the post-survey ($n = 30$), the CEO's feedback via the content of Facebook comments, the instructor's feedback via the transcripts of Zoom meetings, and the transcripts of follow-up interviews ($n = 10$). The codebook from Weisen et al. (2021) was introduced into Nvivo 12 with FT, FP, FR, and FS as coding nodes and their defining attributes as code descriptions. Moreover, FT, FP, FR, and FS were color-coded and visualized to demonstrate their frequencies in the feedback of the CEO and the instructor. Word clouds were generated to explore the open-ended responses from the post-survey and the transcripts of the follow-up interviews. Words with high frequencies were then examined in their contexts to identify emerging themes (and relevant subthemes). The themes and subthemes were compared with the codebook and the literature review on feedback in Chapter 2 to finalize and describe the themes with corresponding quotes.

1.15.1. Open-ended responses from the post-survey

The feedback input component in the post-survey had two open-ended questions. The first question (Q1) was "What will be your suggestions for the instructor's feedback in the light fixture project of this studio (IDES 3612/5612)?" The second question (Q2) was "How can the instructor's feedback in the light fixture project of this studio (IDES 3612/5612) be more effective?" A total of 30 responses were collected for each question. Figure 16 displays words with high frequencies in students' responses for Q1. Although the question was directed toward the instructor's feedback, students used this opportunity to express their perception of the CEO's feedback as well. As a result, "Facebook"

became the second most notable word after the keyword “feedback.” Other notable words included “time,” “helpful,” and “instructor.” Overall, students perceived the instructor’s feedback as helpful yet expected more from the CEO’s feedback.

Figure 16. Word cloud for frequencies in Q1 (top) and Q2 (bottom)

Similar notable words came up in students' responses for Q2, which is also presented in Figure 16. "Facebook" was still prevalent, yet "light" was another word that dominated the cloud as well. These high-frequency words, together with their contexts, revealed five themes and five subthemes (see Table 19) across the two open-ended questions. The orders of the themes and subthemes were determined by the number of coded units within them. Themes as parent nodes aggregated coding from their subthemes or children nodes. Each theme and subtheme is described in the following sections with corresponding quotes from students as examples. These quotes demonstrate how students' words were used to define themes and subthemes.

Table 19. Themes and subthemes from Q1 and Q2

Themes	Subthemes
Feedback content	Task specific No opinion Consistency Process specific
Feedback timing	Time intervals
Feedback quantity	
Feedback perception	
Feedback communication	

Note. Parent and children coding nodes in Nvivo 12.

1.15.1.1. Theme #1: Feedback content

This theme indicated the suggestions students had for the instructor and (mostly) the CEO in giving effective feedback content in Q1 and Q2. While "a general comment" was "not helpful," students welcomed "more details" so that they could "know what they are doing" or if "the light fixture works or not." Via the coded units, this theme was divided into four subthemes: (1) task specificity, (2) no opinion, (3) consistency, and (4)

process specificity. Most students needed task-specific feedback or concrete directions regarding the functions, structures, and materials of their light fixtures. For instance, regarding the current feedback (Q1), a student noted as follows:

> *"I wish we talked more about the lighting type for this project. Example: How many Kelvins would be advised for our light fixture? What materials would work best?"*

Regarding how feedback could be more effective (Q2), another student suggested the following:

> *"I was confused on how to implement an actual light into my design. It wasn't a regular lampshade, so it was hard for me to figure out how to insert a light."*

Students who responded to Q1 and Q2 with "not sure," "don't know," and "no suggestions" were classified into the no opinion subtheme. Some students stressed the consistency of feedback, especially for the CEO on the private Facebook group. Students wished that the instructor and the CEO had "[made] sure that everyone receive[d] the same information" for "what materials [they] could use" (and what not) for the light fixture. Several students mentioned the need for process-specific feedback. Discussions on "the actual form of my light and the pros and cons of that" plus "more suggestions on how to improve" were also desirable.

1.15.1.2. Theme#2: Feedback timing

The second theme was quite prominent among the open-ended responses as well. Having timely feedback was critical, as delays hindered students' design process and

shortened their time for revise/finish the designs, thus the subtheme: time intervals. In general, students perceived that the instructor "was helpful in replying on time at the desk critique in every class." Whereas, the CEO was quick at giving feedback on the private Facebook group in the "very beginning stage" yet became less responsive later on. As a result, in Q1, one student noted as follows:

> *"Feedback on Facebook was slow, so maybe the people who critique via Facebook could be given a time frame to critique, and all students could make sure to have their assignments up."*

Timely feedback was especially "helpful when determining a final prototype" to students. Moreover, the time intervals between feedback cycles/the stages of the design process were crucial as students needed "a little bit more time to reflect" on the received feedback. In case the instructor/the CEO deemed that the "3d model might not work well," students would "have extra time to prepare a handmade model" and complete the project on time.

1.15.1.3. Theme#3: Feedback quantity and Theme#4: Feedback perception

These two themes showed that students were receptive to feedback that would keep them on track with the project. Regarding theme #3, feedback quantity, students explicitly expressed the need for more feedback (especially from the CEO on the private Facebook group), as they sought "a different point of view" or "more perspectives." One student even requested an extended "critique mid project submission" although feedback was already given in each stage of the design process (10 sketches, three revisions, and the final solution). As the project lasted for five weeks, the instructor only required a final

submission. Thus, the request would have increased the student's workload. Nevertheless, the student prioritized receiving feedback over reducing their workload.

Regarding theme #4, feedback perception, students favored the instructor's feedback with confirmations such as "good," "helpful," "more guided," and said that it had helped them move forward with the design process. Furthermore, to counter the insufficient amount of CEO's feedback, they expected "more feedback from the instructor to make up for that." For instance, when asked to provide suggestions for effective feedback (Q2), a student stated the following:

> *"I did not receive much feedback on the Facebook group….I did not receive feedback on there and had to make many decisions to proceed with my design on my own, but I received helpful feedback from my instructor, which was more guided."*

Similarly, another student emphasized as follows:

> *"I had hoped for feedback from the jurors on the Facebook group, but* [the instructor] *made sure to give me feedback so I could proceed with my design."*

1.15.1.4. Theme#5: Feedback communication

While students showed no explicit perception regarding the CEO's feedback (except for the timing as shown in theme #2), they provided some opinions on what could result in a more favorable outcome. Comments on the limited communication with the CEO came up across Q1 and Q2, which held the COVID-19 pandemic and technology relevancy accountable. Requesting "more" communication, one student explained that "it was a little difficult trying to explain my ideas over the computer" and preferred instant

communication on Zoom "breakout rooms…instead of [a] Facebook page." For example, a student commented the following for Q1:

> *"I think Facebook is an impractical way to get groups talking together. Maybe Canvas would work better? I know COVID makes everything much harder."*

In Q2, another student elaborated on why Facebook deprived them of the possibility of instantly explaining/elaborating on their designs to the CEO:

> *"Having in person—or on Zoom—feedback seemed to be much more helpful than feedback over Facebook, as it gave the opportunity to talk out exactly what they are referencing and suggesting with it being much harder to communicate over Facebook."*

1.15.2. Content of Facebook comments

While the CEO gave a total of 31 Facebook comments, the coded units differed as multiple feedback levels (FT, FP, FR, and FS) could occur in one comment. For feedback at task level (FT), process level (FP), self-regulation level (FR), the number of coded units were 10, 19, and 20, respectively. None of the coded units reflected feedback at the self level (FS). Overall, the CEO gave FR the most (i.e., comments encouraging exploration and self-assessments) and FT the least (i.e., concrete directions and accuracy confirmations). For the design process, feedback levels also varied between concept schematic (10 sketches to three revisions) and design development (three revisions to one final solution). The concept schematic stage received FR the most (14 coded units), followed by FP (nine coded units) and FT (six coded units). On the contrary, FR dominated design development with 10 coded units, followed by FR (six coded units) and

FT (four coded units). Table 20 summarizes the number of coded units in each feedback level in each stage of the design process.

Table 20. Coded units (Facebook comments) by feedback levels and design stages

	Coded units		
Feedback levels	Concept schematic	Design development	Total
FT	6	4	10
FP	9	10	19
FR	14	6	20
FS	0	0	0
Other	0	0	0

Note. Coded using the codebook from Weisen et al. (2021). FT (task feedback), FP (process feedback), FR (self-regulation feedback), FS (self-level feedback).

Consistent with the codebook from Weisen et al. (2021), the CEO started FR by reassuring students of their successful design concepts/ideas/sketches. The CEO then encouraged further exploration by suggesting that students self-assess the pros and cons of their concepts/developments. A disproportional amount of FR was dedicated to the concept schematic as shown in the following sample:

> *"…*[sketches #1 and #5] *the ideas of layering and shadow/light are interesting and offer a lot of possibilities. Keep the material properties and scale of the plywood in mind as you go forward, what does it allow you to do, what are the ways that you can control the light?"*

In design development, the same structure of FR remained. The following sample showed that the CEO complimented one of the three revisions and then challenged the student to reevaluate the choice in terms of material and lighting effect:

> *"…*[paper model #3] *this is interesting and might work in various scales, but the one thing that I would ask you to consider is the*

materiality of the plywood and how the opacity would change the overall design."

FP, as the second prominent level of feedback, was more balanced between the stages of the design process. Again, the CEO's feedback echoed the codebook with strategies for students to achieve successful concepts/developments. Early in the design process, the CEO guided students in creating their light fixture concepts by asking them to think about scale and typology. The following excerpt is a sample of FP at this stage:

"...[from sketches #1 to #10] *what are the scale(s) that these* [sketches/concepts] *might work at and how do those change the qualities. Are they floor/table/wall/etc.?"*

Later in the design process, the CEO focused more on the material and structural aspects of the light fixtures. A sample FP on the thickness of structural components is as follows:

"Are the discs 3/4 thick, are they layered to be 1.5" or more thick, what is the distance between the pieces that allows the light to spill out? How are the discs attached?"

FT, as the least prevalent feedback level, included concrete instructions and accuracy confirmations. Across the design process, the CEO gave FT sparingly via short and direct comments, which were mostly about changing certain components of the light fixture concepts/developments. However, in the concept schematic stage, the CEO gave more comments on whether the light fixture concepts correctly responded to the project prompt, as shown in the following sample:

> *"Think of how the plywood works to conceal or reveal the light. These* [sketches #1 to #4] *are all very delicate and open, which runs contrary to the 3/4" material."*

In design development, the CEO even pointed out the desirable developments, such as "the most intriguing image is the bottom left." Another approach was to command direct changes in the developments, such as "Think of these as arched fins rather than ribs" or "Think of the material as flat discs with the center cut out rather than a ring of paper."

While students voiced their confusion about the light fixture materials in the open-ended responses, the CEO's feedback constantly included a reminder to use the 3/4" plywood across the three levels (FR, FP, and FT). For example, "How might you translate this using the plywood?," "Keep in mind the material properties and scale of the plywood sheet as you go forward," or "How can this be achieved with the 3/4" plywood? Perhaps more of a faceted approach?" This observation is elaborated further in Chapter 5: Discussion, considering the CEO's feedback on Facebook was significantly delayed.

1.15.3. Zoom transcripts

Transcripts were collected from five Zoom meetings where the instructor gave students feedback on their light fixture designs. A total of 8 hours and 13 minutes resulted in 70,162 words or 147 pages of a Word document. Housekeeping reminders and studio regulations (e.g., requesting students to zoom in and switch between concepts/draft models/3D models and directing student groups to different breakout rooms) were excluded. The instructor's communications with students were coded using the same codebook from Weisen et al. (2021). Unlike the CEO, the instructor gave FP the most

and FS the least with varying amounts of FT and FR. Regarding the design process, except for FT, other feedback levels (i.e., FP, FR, and FS) occurred more in the concept schematic stage rather than the design development stage. For instance, FP reduced by 8.7%, FR went down by 55.6%, while FS decreased by 41.7%. Table 21 summarizes the number of coded units in each feedback level in each stage of the design process.

Table 21. Coded units (Zoom transcripts) by feedback levels and design stages

	Coded units		
Feedback levels	Concept schematic	Design development	Total
FT	78	89	167
FP	116	101	217
FR	63	35	98
FS	12	5	17
Other	0	0	0

Note. Coded using the codebook from Weisen et al. (2021).

FP, in general, dominated the instructor's feedback. This feedback level included strategies for digital and physical modeling, feasibility assessments of concepts and developments, and considerations for safety, codes, and regulations. For instance, the instructor discussed the appropriateness of different three-dimensional (3D) modeling software (e.g., Fusion 360 and Revit), materials (e.g., plywood), positions, and the types of light sources (e.g., tape lighting) to specific concepts/developments of students. With FR, the instructor motivated students to further explore their concepts/developments by pointing out potential light fixture designs (e.g., certain sketches were nice) and indicating not-so-successful ones (e.g., whether something similar already existed). Via FT, the instructor confirmed what concepts/developments students should pursue, explained what worked in their light fixture designs, discussed light fixture typologies,

and conveyed her concerns about feasibility (e.g., the stability of the structures). Further discussions with relevant quotes for all feedback levels in each design process stage are in the following paragraphs.

In the concept schematic stage, students dominated the conversations with explanations of and elaborations on their concepts (i.e., the 10 sketches). Using a significant amount of FP (116 coded units), the instructor provided students with ideation strategies and resources for inspirations and motifs for the light fixture designs, besides answering concerns on drafting models from concepts. For instance, the instructor proposed that "many designers use napkins for sketches," so "imagine you are sketching on a napkin" to help students who were stuck with getting ideas. Similarly, the instructor responded to a student who aspired to build a mid-century modern light fixture with the following:

> *"If you want to do something like that, I would look at…maybe look at the furniture and the buildings from that era, like glassware and furniture, and get your inspiration from that."*

Regarding model drafting, the instructor offered students some techniques such as for bending cardboard: score "it with a knife, do not cut through completely" and create "round shapes by stacking layers." This approach aided students in transitioning into design development, as they estimated how their light fixture designs would be executed in the fabrication labs using laser cutting, 3D printing, or when making them by hand. Students were able to choose between Fusion 360 and Revit, two prominent modeling

software for design disciplines. In the following FP examples, the instructor encouraged students to decompose their concepts into multiple 3D geometric pieces:

> *"... if you cut the rings, just do a laser cut. Then if you cut several rings and stack them together and then create like a hole or a nudge in there, then you can slot this* [the light source] *in there."*

Or

> *"... depending on if you have pieces that need to be connected, you might have to use other pieces to bring the connection together, so depending on what your final design is."*

The instructor also directed students to available resources such as video tutorials on digital modeling (either provided by the fabrication labs or on YouTube) and contacts of the technicians in the fabrication labs. To further support students in learning how to develop their light fixture designs, the instructor also gave them information on the types of light sources (e.g., tape lighting) and where to find tape light (e.g., Target). The instructor also stressed safety concerns and suggested using a battery to power the light fixture models. For instance, "… to stop a fire hazard, you would want to use safe materials. Yes, you have to be very careful."

While giving FR, the instructor invited students to describe and elaborate on their concepts, as users' perceptions of their light fixture designs varied greatly. For instance, "this [sketch] could be a sconce and then the other one [sketch] you have can vary from person to person and so it is probably a pendant." Fixation on a single sketch was also discouraged, and students were encouraged to venture in different directions. In the FR

sample below, the instructor reassured students that they were learning and should be comfortable with the messy process of finding ideas:

> *"Whichever direction you want to go…but why don't you explore more during class now? At the end of class, even if time is over, I want to visit with you again and see what your whole fixture looks like."*

From there, the instructor encouraged students to further explore their two-dimensional (2D) concepts via digital models. This approach granted students a better understanding of how their light fixture designs turned out in terms of 3D structures, materials, and functions (e.g., glare). Thus, the instructor asked students to think actively about concept feasibility and stressed that if a 3D digital model was feasible, so was a physical one. The following FR sample indicates how the instructor reminded students to pay attention to the ways through which their designs affected users:

> *"Remember that you are building a light to minimize glare. Think about it because you have to think of the way by which you're going to ensure that the lamp itself is not causing too much glare to the person."*

FT in the concept schematic stage focused on identifying potential concepts, correcting design accuracies, and confirming project information. When each student presented 10 numbered sketches, the instructor indicated which of the sketches to develop further. There were brief explanations on why specific concepts were selected as well. For example,

> *"I'm leaning towards six of an eight, uhm, where it kind of tapers and then it gets wider at the middle and then it goes back down. I like that shape."*

Or

> *"Number four looks interesting, you know. Yeah, I feel like this one's will be doable with the plywood."*

Moreover, as students demonstrated their light fixture designs from a 2D perspective, several inaccuracies, such as having paper-thin structures, were pointed out. Hence, the instructor corrected this issue by stressing that "everything needs a thickness." Students also asked for confirmations regarding the materials allowed "… like, the final model I know that we use the cardboard, but could we use other materials as well to make it or only the cardboard?" While the instructor's responses reassured students that plywood was a prerequisite, there were other materials mentioned: "it could be a wood dowel," "but you could use your acrylic for sure." Lastly, the instructor also gave FS to signify her approvals in general comments such as "nice concept" and "good."

In design development, the instructor's feedback contained FP the most (101 coded units), FS the least (five coded units), and a good mix of FT (89 coded units) and FR (35 coded units). Overall, with FP, the instructor directed students to resources for developing their concepts into digital (e.g., Fusion 360 techniques and troubleshooting) and physical models (e.g., contacts of the technicians and related workflows in the fabrication labs). Via FT, the instructor continued to specify and suggest changes in students' design development in terms of shapes, forms, structures, and materials. In case of FR, the instructor reminded students to pay attention to functions (e.g., scale and thickness), codes, and regulations (e.g., how far should a scone be from the wall). Similar to the concept schematic stage, FS was represented through general comments such as

"nice concept," "that is good," and "nice "job." This feedback level took place at the end of each breakout room session as summative feedback for the whole group.

The major distribution of FP makes sense as students spent most of their Zoom time asking for modeling techniques in Fusion 360. On certain occasions, the instructor brought students back to the developments of the light fixtures to avoid misconceptions about a successful design (i.e., being novel and appropriate over digitally well-executed). Other times, the instructor encouraged students to switch back to the software that they felt more comfortable with: "I do not want you to spend so much time learning different software" and "if you're struggling with it, you can model it elsewhere [Revit] or Sketch Up". The following FP examples demonstrate the instructor's responses to students' questions about modeling techniques in Fusion 360:

> *"If you wanted to make it hollow, yeah, you should have done the offset before you extruded."*

Or

> *"You have to rotate the object in 3D by a particular percentage or a particular angle to get it back to sit on the ground plane."*

The following is another example of how the instructor explained what made a successful design:

> *"Before you jump into the computer start drawing, do not let the software be the one that drives your design. It's going to be more successful if you have your sketch, and you have your idea, and you are using the tool (software) to accomplish it…it's important to have a sketch of what it looks like before jumping on the tool (software)."*

As students came closer to the final presentation day, the instructor constantly reminded them of the feasibility of building the physical model. A technician from the fabrication labs was invited to present on a software that transformed 3D digital models into geometric pieces for laser cutting (i.e., Slicer). The presentation was recorded and available for students to review. Therefore, via FP, the instructor offered students strategies that would help them complete their physical models more effectively: "… they're going to slice it and it might come up in many pieces that you have to put together to get the curve" and "if you watch that video, you will know where you can connect planes and connect parts". Like in the concept schematic stage, students were invited to reach out to the technicians in the fabrication labs to plan for their final solution (the scale/physical model of the selected development): "reach out to them," "look at what their hours are or how you can access the shop," and "you might want to check today so you know."

Via FT, the second most frequent feedback level, the instructor helped students identify a successful light fixture development to finalize. Unlike in the concept schematic stage, the instructor gave students the freedom to choose one of the three revisions to build, telling them to "go with that one that you like." FT, however, contained changes that the instructor deemed necessary for a successful light fixture design and was customized for each student. While being specific, the instructor also left some room for student autonomy, such as "my suggestion is a wall sconce, but you could also build it as a table [lamp]" and "for your model, you might have to build it as a table [lamp] because I don't know how you will hang it." The following FT sample describes

how the instructor asked a student to retain a certain shape while changing the light fixture from a wall sconce to a table lamp:

> *"If you decide to build this as a table [lamp], I want you to maintain that curvilinear shape because that's the unique aspect of your design with the gears on all the faces."*

For some students, the instructor also included codes and regulations in FT. A repeated code was having the wall sconce four inches away from the wall at most because "that's the rule." While FT was tailored for each student, the instructor also included reminders for the whole class regarding the code: "if you're building…if anyone is building the scones, they're limited to this thickness, basically." An FT sample with the code is as follows:

> *"…so that is your wall sconce. Imagine this is the wall, it can stick out four inches at the maximum. So, what you're going to build is a box behind it, basically."*

FR, as the third most frequent feedback level, helped students assess their progress and acknowledge how users perceived their light fixture design. The final solution included a (physical) scale model and a presentation board (i.e., storyboard) with inspirations, technical drawings, and images of the light fixture (including light sources and lighting effects). Therefore, the instructor constantly repeated the following requirements in the Zoom meetings (in the design development stage): "it's important that you begin to tell your story too on the storyboard" and "maybe have a storyboard…so you don't have a crazy rush to finish it off." A sample FR reminder of the deadline was as follows:

> *"It's due the next Monday. So, on Monday, the 19th, I think you should already start building your fixture if anything or maybe have a storyboard of your poster."*

When FR was used to deliver the instructor's assessment of how users might perceive the students' light fixture developments, design principles were also included. As students moved from the 10 sketches to the three revisions, some struggled with organically bringing their past works into new developments or became detached from their original inspirations/intentions. The next two FR samples showed how the instructor helped students navigate these learning processes:

> *"It seems like you took one sketch, and you just stuck it over here and there* [trying] *to combine it. I would not take that approach. If you try to combine, make it seem fluid that no one will even know,* [make] *it not so literal* [about] *the combination."*

Or

> *"I wonder—is this shape right? They're kind of elliptical and curvilinear, these shapes are here, but then your cutouts are hexagons. Well, I am just curious why exactly because the inspiration behind this whole thing was a beehive if you look at it. Then mimic that."*

Due to time constraints (i.e., one-on-one discussions with 32 students in three breakout rooms), those who overelaborated on their three revisions did not get much feedback. However, the instructor provided comprehensive feedback for those who met the allotted time.

1.15.4. Follow-up Interviews

In the follow-up interviews, 10 selected volunteers/students were asked to (1) explain their light fixture design (to build rapport), describe the impact of (2) the CEO's feedback and (3) the instructor's feedback on their light fixture designs, (4) suggest what they wished were different about the feedback experience, and (5) provide additional comments (if any). The complete interview protocol is available in Appendix C. Interview transcripts contained 51,715 words or 115 pages, resulting in the word cloud in Figure 17, which displays Nvivo-generated word frequencies. The most notable words were "concept," "helpful," and "ideas." In general, students wished to get feedback early on in the design process, hence the word "concept" for the concept schematic phase. Across the interviews, students mentioned what were and proposed what would be "helpful" for feedback practices in the studio. Lastly, with "ideas," they emphasized the importance of receiving feedback during the ideation process.

Figure 17. Word cloud for frequencies for the follow-up interviews

The themes and subthemes discussed in the section of open-ended responses from the post-survey assisted the content analysis process for the interview transcripts. While certain themes were repeated, new themes also emerged. Although (1) feedback content, (2) feedback timing, (3) feedback quantity, (4) feedback perception, (5) feedback communication remained, they varied in their corresponding subthemes. New themes included (6) feedback experience and (7) project interest. The following paragraphs discuss the themes and their subthemes (see Table 22) with selected quotes from the 10 interviewees.

Table 22. Themes and subthemes from the follow-up interviews

Themes	Subthemes
Feedback content	Task specific Process specific
Feedback timing	Concept schematic Design development Time intervals
Feedback quantity	
Feedback perception	
Feedback communication	
Feedback experience	
Project interest	Creative freedom Tangible product

Note. Parent and children coding nodes in Nvivo 12.

1.15.4.1. Theme #1: Feedback content

This theme summarized the feedback given by the CEO and the instructor as described by the interviewees/students. Students' recalls of feedback, overall, reflected the analyses of the CEO comments on Facebook and the Zoom transcripts. However, according to the students, the CEO's feedback was "more generic" and focused on the

required material (i.e., plywood) and the scale of their light fixture designs. For instance, student #3 indicated the following:

> *"... but it* [the student's favorite concept] *just wasn't really plausible with the materials that we had* [plywood]. *So, that was the only thing I think that gets pointed out."*

Similarly, student #4 also made the following remark:

> *"... so I actually got one* [Facebook] *comment on my initial* [10] *sketches, which was like play with the scale. I think about it because we had to keep the light fixture on the sheet of plywood and stuff..."*

In other words, the CEO offered students with strategies (i.e., pay attention to scale and material) to complete the task more effectively (i.e., design a successful light fixture). Therefore, students recalled FP from the CEO but not FT and FR.

The instructor's feedback to the students was "specific" and focused on light fixture typologies, shapes, and concept selections. Students also mentioned that the instructor helped with the digital light fixture models in Fusion 360 by inviting the technician in the fabrication labs to come and demonstrate the software for them. As student #6 stated,

> *"*[The technician] *was very helpful because when he was demonstrating how to use Fusion 360,* [the instructor] *recorded and posted the link on Canvas...we actually don't know how to use Fusion 360, we can just go back to Canvas and watch the recording."*

As a result, the reported feedback was disproportionally FT and FP and rarely FR and FS. Student #5 described task-specific feedback (FT) with indications of potential concepts and suggested changes from the instructor as follows:

> *"Okay, so* [the instructor] *told me to consider…the overall style of the light…suggested some types of lights that we should put in the design…so, like, a light bulb or led tape light or, like, the sparkle decorative lights."*

Or

> *"… we like kind of looked at all of them* [10 sketches]. *I showed* [the instructor] *which ones I like the most, and then [the instructor] gave me feedback based on that and what* [the instructor] *thought would be the most successful."*

Students #1 and # 2, respectively, recalled how the instructor explained the learning process necessary for a successful light fixture design (FP) with repeated comparisons between light fixture scales and typologies:

> *"… and a lot of, like, the scale of it* [the light fixture design] *as well. So, if we were going to have, like, a pendant or a table lamp or, like, a floor lamp. Uhm, and, like, how our designs were appropriate for whatever size or type of lamp we had chosen."*

Or

> *"Yes, this is a lighting fixture and this is what I want to achieve* [the lighting effect]*...but* [the instructor] *would always ask what kind of style of lighting would I want to put in this fixture in order for it* [the

lighting effect] *to get achieved. And* [the instructor] *would try and help me figure those things out."*

These prominent patterns, hence, made the two subthemes—that the feedback was (1) task-specific and (2) process-specific. Interestingly, while mostly recalling FT from the instructor, students still emphasized that they wished for more task-specific feedback. Student #7, for example, stated the following:

> *"...but they* [the CEO and the instructor] *could go further: 'I like this idea, but maybe it's missing this* [a specific point]' *or 'This idea is not great, but if you add this* [a specific change], *then it'll be better.' Getting feedback* [of] *that kind…like, the pros and cons were always in my head, but* [the feedback can focus] *at different aspects and things that I hadn't thought of. Since, like, that was what I liked most about getting feedback."*

The fact that students recalled most FT (while ruling out FR and FS) showed that they favored this feedback level. More evidence for this observation is available in Theme #4—Feedback Perception and Theme #6—Feedback Experience with discussions on whether and how students perceived feedback as effective and how they used it in their light fixture designs.

1.15.4.2. Theme #2: Feedback timing

This theme described how references for feedback timing varied among students. While the subthemes (1) concept schematic and (2) design development indicated two discrete references, the last subtheme (3) time intervals reflected the students' need for equal feedback cycles with sufficient time in between to revise their

light fixture designs. In total, four students (#3, #4, #8, and #9) referred to receiving more feedback in the concept schematic stage. Three students (#2, #7, and #10) wished that the feedback was focused on the design development stage. The other three students (#1, #5, and #6) wanted an equal amount of feedback across all stages of the design process, especially with enough time to reflect and revise between cycles.

The following quotes demonstrate the students' explanations for their references. Students who favored the concept schematic stage prioritized identifying the most potential design among the 10 sketches. They did not diminish feedback in the design development stage but wished to have a limited amount. In this context, student #3 stated as follows:

> *"I would say the beginning…is the most important for me to be getting a lot of feedback and have the opportunity to speak a lot about what you're thinking about. I think going back and forth a lot in the beginning can help you, like, flush out the not-so-great ideas* [which] *are not so plausible. And then I think once you start to move into the final, it's important to still get into small details…"*

Students #4 and #8, similarly, endorsed receiving feedback early on in the design process: "I am more for the concept" and "getting a lot of feedback in the beginning is really good." Student #9, moreover, implied the need for more autonomy in design development:

> *"So, actually, my instructor did not interrupt my design in a later step. She did correct me at the very beginning when I just finished my design sketches."*

Students who preferred getting feedback later on in the design process emphasized the completion of the final solution of the light fixture project. For instance, students #2 and #7 emphasized getting more feedback "definitely…with the final design" "towards the end," as "[i]t'd be helpful to get continuous feedback as we're making it [the light fixture] more and more into the design we want" and "when I had my final design…moving forward, [to know] what was the best way to design it [the light fixture]." The two still felt comfortable with having received feedback in "the first stage with the 10 [sketches]," "in the concept phase." On the other hand, student #10 preferred more autonomy in the concept schematic stage yet more guidance in the design development stage:

> *"I think for the beginning with concept creation, I just playing with all these different ideas that I could do…So, I didn't want as much feedback there. I think having more feedback with my final design or one or two weeks before the project was due would have been nice."*

Those who wished to have an "equal amount" of feedback in the design process felt that it was "tricky to navigate other parts [stages] of the project" if feedback only focused on "one thing [stage]." They, in other words, prioritized continuous feedback to keep track of their progress and plan for future steps. Student #1, for example, stated as follows:

> *"Good feedback in all of the different stages of the design and all of the different areas. Like, the project requirements and what you're working on is really helpful to actually know what to move forward with what's good, what should be reconsidered."*

Students #5 and #6 also provided the reasons for their preferences, respectively:

> *"I think it would be helpful to have equal feedback for all of them. Yeah, just to discuss the concept [and] make sure that it's going clearly throughout the entire projects. Like…making sure I know this is right and to continue."*

Or

> *"Equal amount will be my option. Because giving many information or feedback in the beginning, I would just feel kind of like…probably losing my way to the final."*

1.15.4.3. Theme #3: Feedback quantity

All students agreed that the instructor's feedback was sufficient or "enough" yet wished that "there had been more feedback" from the CEO. The reason for desiring more feedback in general and from the CEO in particular was to seek "different perspectives" and "new eyes" to avoid "bias" from one's "own assumptions." Students also emphasized having more than two feedback sources: "multiple people set up to give feedback" and "probably like three to five would be good." Some notable comments have been presented below to help illustrate the aforementioned points. Student #4 expressed the need for a variety of opinions:

> *"I think it would have been helpful to have more* [feedback] *just because I didn't like* [having] *only one person's opinion like this….have like a variety of different perspectives on it because getting the same feedback from someone who was a senior in design process would make some biases. So, like, having fresh eyes look at it and, like, to know your progress."*

Student #8 gave a concrete suggestion on how many sources of feedback would be sufficient and backed it up with a specific reason as well:

> *"Yeah, so I would say probably, like, three to five would be good. Because if there are two sometimes, they can, like, have conflicting ideas. And then if you bring a third person, and then maybe it's like two of the three have this same idea. And one has a different idea. So, I think having, like, an odd number is kind of good. Because then you probably won't have a tie on conflicting ideas. So, I think, three or five would be a good number."*

Student #10 especially deemed having different feedback sources (i.e., perspectives) as critical, as this experience would prepare the student for professional development:

> *"Having other people's perspectives is important because after I graduate, I'll be working in the real world with clients who actually are going to give, like, criticism and their judgment. So, that's really helpful because it gives me a challenge to propose a better design solution."*

1.15.4.4. Theme #4: Feedback perception

In general, students viewed the instructor's feedback as "helpful" and considered it to have "impacted" them during the design process, as it was consistent in terms of the amount and immediate in terms of timing. With the instructor's feedback, students kept track of their progress and made design decisions to achieve a successful light fixture. For example, student #1 stated that "it was super helpful just to hear [the instructor's] thoughts on the concept. Like, if [the instructor] thought it [the concept] would be successful and be able to move forward with." Several students also acknowledged that

the CEO's feedback "was actually helpful" for providing another perspective, different from those of their instructor and themselves. For instance, student #8 shared that the CEO's feedback on "how everything would work together and fit into a table map" was "a really really nice piece of feedback," as the student "didn't really think about that beforehand." Student #8 demonstrated this theme as follows:

> *"I think just getting feedback on any project. Like, no matter the amount is always going to be helpful because you get other people's opinions on it. They might look at it and see something completely different from me, and it's really nice to just hear what they have. And even if it's like a really bad critique and they're like 'This is really a dumb idea,' it still gives me the standpoint of, like, 'Maybe I should rethink this and reconsider.' Some of the things that make improvements on it. So, that's always really helpful."*

The majority of students, however, deemed the CEO's feedback as "not have a huge impact" and "was not as helpful" due to the insufficient amount and delayed timing. For instance, student #6 felt "stressful" when they received feedback late and had to "go back in the beginning to check the works." Similarly, student #7 claimed that the CEO's feedback "was not critical" to the design process, as it came when the student had "already picked the final one [light fixture design]." Student #2 gave exemplar comments on students' perception of the CEO's feedback (versus the instructor's) and how it could be more impactful:

> *"I definitely think* [the instructor's] *feedback impacted it more than the online feedback* [the CEO's] *because we got it consistently every class period….The feedback was helpful through* [the instructor] *presenting*

ideas, but also listening to what I had to say and asking me questions that led me to think in a new way in order to keep the design moving forward and not getting stuck…"

Or

"Uhm, I think it [the CEO's feedback] *impacted it a little bit in that when I did get feedback. I definitely tried to change my design in order to fit the* [CEO's] *feedback. I think there was some questions about scale as well. Originally, I was going to have a wall sconce, and it got changed to a table light just due to the dimensions I would need to have in order to make my fixture work. But I don't think it influenced it too much…So, everything would have influenced it more if there had been more feedback."*

1.15.4.5. Theme #5: Feedback communication

Resonating with the open-ended responses from the post-survey, theme #5, feedback communication, signified the need for instant communication with the CEO. Overall, students preferred Zoom to Facebook, as "it is so much easier to just talk over Zoom than through comments on Facebook." The reasons behind this preference, however, varied between students. Some wished to "have a dialogue" to "know who [they/the students] were talking to." In other words, these students needed rapport to feel comfortable seeking feedback from an unfamiliar source besides their instructor. Student #3, as an example, was expected to "speak" and form a "connection" with the CEO:

"I think it's always helpful to have the ability to speak with someone more than one time. If you're having a critical conversation like that…I think in studio, it's really helpful because we're all comfortable with each other and with our professor, and I think that has allowed us to

> *ask more questions. Because when you're more comfortable or if you're a little bit more shy usually would be more comfortable asking questions if you have spoken to the person before…That's connection."*

The expectation then led student #3 to re-evaluate feedback communication:

> *"Just if there was a better way to get feedback from them…because we never even had, like, a meeting with them, which I know there was some issues of scheduling there. But it was hard* [to ask for feedback] *don't even know who we were talking to. Like…at least in one* [Zoom] *meeting, this is what I was thinking. But yeah, I think overall, the feedback was helpful for me and helped me move forward. But I just think maybe if there was a better way of getting feedback or asking feedback."*

Likewise, other students emphasized the means of communication, such as "… if (the CEO) can show up in a Zoom meeting, we can kind of like chatting, sharing screen, and then (the CEO) can provide feedback directly to us." Student #7 also suggested "Canvas," a common platform across design studios, as an alternative for Facebook. As students were unable to have real-time conversations on Facebook, their questions were left unanswered despite their efforts to notify and initiate a dialogue with the CEO. Student #6 explained the strategies used to seek more concrete feedback on Facebook:

> *"Because they don't know what you are thinking about your picture and your design. So, then we're just kind of, like, giving you the basic information or basic answer…Like giving some comments* [under the posts on Facebook] *so they can understand. Oh, this is how you think about your fixture, and I will just try to answer you."*

However, the student also acknowledged that direct conversations with the CEO would have been more efficient:

> *"I wish they can just come to our Zoom meetings and talk to us so we can get feedback from them."*

Student #7, on the same note, commented as follows:

> *"When I got the comments* [the CEO's feedback]*, I would see them, and I make sure to reply back to the comments as soon as I saw them....I didn't get a reply….It wasn't like a dialogue."*

1.15.4.6. Theme #6: Feedback experience

This theme echoed the overall feedback experience component of the post-survey regarding whether students utilized the feedback given by their instructor and the CEO. Eight students (#1, #2, #3, #4, #5, #7, #8, and #9) reported that they had applied the feedback provided into the light fixture designs. Although the CEO's feedback was delayed, most students still "tried [their] best to incorporate what [the CEO] was telling [them] after [they] had already made some decisions" and "definitely tried to change [their] design in order to fit the feedback." Student #1 attributed grades and peer competition to this collective effort as shown in the following quote:

> *"I really like listen to what feedback I'm given and use that to move forward. And I like to have that guidance, especially, like, when things are graded and for competitions. I like to know what people are looking for. Um, and so it's helpful for me to have [feedback]."*

Student #3, nevertheless, credited the CEO's feedback for a more successful light fixture design:

> *"… then* [the CEO] *saying, you know, how is the light going to interact with? That made me think more about how…like the shadows would fall and how the light would interact with each piece more than I had originally been thinking. So, then I kind of went back and sketched out how should I put the light on the outside or the inside because…There was one piece up the middle to hold everything together. So I ended up going with wrapping a piece around the middle that had lights on it. And that kind of created a really cool."*

Another quote of student #5 showed mixed experiences when the student actively attended to the CEO's feedback but found minimal impact on their light fixture design:

> *"I think* [the CEO] *might have gave me two comments and the first one was just about considering the amount of cardboard used since it was one of the requirements for the project. So I basically just like take into consideration the amount of cardboard that would be used to create each of these ideas. I can't even remember if* [the CEO] *gave me another comment back but it's basically* [the CEO] *he said. So it doesn't really impact my design that much."*

On the contrary, student #6 selected what was applicable based on the feedback content, while student #10 prioritized their own design decisions. Despite deviating from the rest, these students also provided explicit explanations on their feedback experiences. For student #6, significant changes suggested by the instructor and/or the CEO would be applied. On the contrary, general project information and progress check-in would be passed over. The following quote from student #6 illustrated these points:

> *"… it actually depends on the feedback they provided important and I have never thought of that. Uhm, I personally will just go back and fix*

> *the concepts or incorporate those to a future design. But if that feedback is kind of just make sure you're on the track, I would probably say…Okay, I would just kind of ignore the most* [of the feedback]*."*

Student #10, on the other hand, considered the feedback on the feasibility and materiality of their favorite concept but determined to pursue it nonetheless:

> *"So they* [the instructor and the CEO] *also mentioned, like, make sure you know how you're going to make the model, especially if it's with cardboard or plywood…So I did take that in mind. But, at the end of the day, this* [concept] *was my favorite. So, I still went for it and it was challenged. But I like a challenge."*

1.15.4.7. Theme #7: Project interest

This theme represented students' interest in the light fixture project. All students expressed positive affects on the creative nature of the project and the ability to produce a tangible fixture. Across the interviews, students repeated that "the project was really open, and it allowed a lot of, like, creativity." Specifically, they liked "getting to be very creative," "pushing the boundaries of creativity," and "taking inspiration from wherever [they] wanted." Unlike a typical interior design project with specific client profiles that direct certain design directions, students perceived more "freedom" in the light fixture project, "to explore what [they] wanted [their] design to look like." They were free to choose the light fixture typologies (e.g., table lamp or wall sconce), pick the light sources, and determine the lighting effects. Student #2 summed up the point with this quote:

> *"Oftentimes* [in a typical interior design project]*, we have such close circumstances that usually you have a direction that you're going in and keep following. Versus, this lighting design was very open—it was designed a light* [fixture] *for a problem that you choose. So, it was just really cool to make it more applicable to ourselves."*

Similarly, student #6, expressed how the light fixture project was the first for them:

> *"You have to think about your concept before you start with your model. Before that, I never thought about using the concept for my lighting fixture because I felt, I think, fixture is just a component of interior design. Now, it is also kind of an individual thing you have to thought about."*

While the project "was something new," it "was challenging because of the pandemic." The main challenge brought forth by COVID-19 was limited access to the resources for physical modeling (e.g., students were reluctant to come to the fabrication labs for 3D printing and laser cutting). Nevertheless, students were excited about "actually getting to see your design come to life" with the minimal materials and tools they had at home. They also explained that having a physical model was "much more interesting than just getting to see it on a computer screen." Being "able to touch it [the physical model]" reminded students that they had "made this" and achieved project fulfillment. For instance, student #2 stated the following:

> *"The accomplishment felt so much greater just because it was, like, I have something physical. I made this over the last few weeks and just made the project feel like…fully finished."*

Student #3 echoed the above expression:

> *"So, it was nice to be able to do it all at home. Um, so I really liked how it turned out. I think when I eventually put the little fairy lights inside. So I kind of wrapped it around the inside. It ended up looking really nice, and I actually have it (the physical model) in the living room."*

Another quote from student #5 indicated how making the physical model by hands at home was a satisfying experience:

> *"Yeah, I used to like craft a lot when I was little. So that kind of like brought me back to when I was like…10 and make your little things, but it's also fun to see, like, the—the—end result, like, the physical thing. Um, it's just kind of satisfying."*

In short, the student interviewees were interested in the project, as reflected by the non-significant changes in project interest between the pre- and post-surveys.

CHAPTER 5: DISCUSSION

This chapter discusses how Chapter 4: Results informs feedback practices that enhance students' creativity in interior design studios and the moderators of this relationship. In other words, the two research questions (and the corresponding sub-questions) help interpret the above findings with respect to Chapter 2: Literature Review. Specifically, the model of feedback (Hattie & Timperley, 2007) and interest-based feedback preferences (Lipstein & Renninger, 2006, 2007) facilitate the researcher in answering RQ1 and RQ2, respectively. The comparisons and combinations between quantitative and qualitative results offer a holistic understanding of feedback and creativity in the Fall 2020 interior design studio with the light fixture project.

1.16. Feedback Practices and Students' Creativity

CPSS scores for the final solution were substantially high with a median of 7 across novelty (M_N), resolution (M_R), and style (M_S). Likewise, the corresponding means of the student sample ($n = 20$) were as follows: $M_N = 6.8$, $M_R = 6.8$, and $M_S = 6.6$. Instead of splitting students using medians or means, ranking them using CPSS scores was found to be more relevant. This approach results in 11 students with $M_N = M_R = M_S = 7$, five students with either $6.5 \leq M_N, M_R, M_S \leq 7$ or $6 \leq M_S \leq 7$, and four students with either $6 \leq M_N, M_R, M_S \leq 6.5$ or $5 \leq M_S \leq 6$. Rather than having two groups of high and low creativity, the ranking resulted in three tiers with descending CPSS scores: Tier I (11), Tier II (5), and Tier III (4). Among the top 10 students chosen by the CEO, six students were in Tier I, of which five were interviewed. The other four were excluded from the CPSS ratings due to insufficient posts on their design process on

the private Facebook group. Among the 10 students who were selected for the follow-up interviews, eight of them were in Tier I and two of them were in Tier II. The findings were discussed in Chapter 4: Results; therefore, this chapter focuses on Tier I and Tier III to determine which feedback practices were effective for creativity and which were not.

1.16.1. RQ 1. What are the feedback practices of practitioners and instructors that enhance students' creativity in interior design studios?

To answer this question, a series of paired t-tests were conducted for the feedback perception component in the pre- and post-surveys. A set of t-tests/Wilcoxon signed-rank tests were also performed for CPSS scores in the concept schematic (10 sketches to three revisions) and design development (three revisions to one final solution) stages. The results indicated that feedback perception remained positive ($3.20 \leq M \leq 4.60$, higher than the middle split 2.5 of the five-point scale) with non-significant changes ($p > 0.05$) in most items from the pre- to the post-survey. Furthermore, over 80% of students implemented the suggestions they received into their light fixture designs (73.33% reflect and combine, 10% remember and apply). A statistically significant increase in novelty across the design ($t(19) = 2.61, p = 0.02$ and $t(19) = 4.97, p < 0.001$) supported students' positive perception of feedback practices in the Fall 2020 junior studio.

Said feedback, however, came from the instructor, not the CEO. Assigned Likert values of feedback experiences from the post-survey and Facebook documents (see Table 8) further demonstrated this statement. Among the 20 students who were rated for CPSS scores, 15% made all changes suggested in the instructor's feedback, 75% made several

to many changes, and 10% made changes unrelated to the given feedback. For the CEO's feedback, 25% of the same 20 students made several to many changes, 35% made none to a few changes, while the rest 40% got no feedback on Facebook. In other words, most students only made use of the instructor's feedback, as the CEO's feedback was either late or insufficient (as recorded on the private Facebook group and described in the follow-up interviews). The CEO's feedback, as a result, was excluded from the correlation calculations for feedback experience and CPSS scores due to missing values (i.e., no feedback returned as N/A).

Spearman's correlations were calculated for the assigned Likert values of the instructor's feedback experiences and novelty ($rho = 0.25, p = 0.14$), resolution ($rho = 0.26, p = 0.13$), and style ($rho = 0.14, p = 0.28$), respectively. Overall, coefficients (rho) were mildly positive but not statically significant (all p-values > 0.05). While Spearman's correlations detected no significant connection between feedback experiences and creativity (via CPSS scores), accessing data patterns of ordinal Likert values via scatterplots was found to be incompatible (Xiao et al., 2016). Furthermore, students consistently acknowledged the instructor's feedback as helpful for their design process in the pre- and post-surveys plus the follow-up interviews. That is to say, the complexity between feedback experiences and creativity was not captured entirely via Spearman's correlations. Thus, evidence of the lack of correlation between students' feedback experiences and their creativity is indecisive. As a result, RQ 1.a. and RQ 1.b. focused on the evidence provided via the qualitative analyses of the open-ended responses in the post-survey, Facebook comments, Zoom recordings, and the follow-up

interviews. The special focus was Tier I students with high creativity (i.e., high CPSS scores).

1.16.1.1. RQ 1.a. What are the attributes of feedback practices that benefit creativity of all students (e.g., contextual- and individual-free)?

To answer this sub-question, the researcher looked into similar themes that emerged from the open-ended responses in the post-survey and the follow-up interviews. Content analyses of the Facebook comments (CEO's feedback) and Zoom meetings (instructor's feedback) helped explain and elaborate on these observed similarities. Figures 18 and 19 display the distribution of themes and subthemes in the two open-ended questions regarding the instructor's feedback in the post-survey, Q1 (current observations) and Q2 (future improvements). Similar distributions of themes (and corresponding subthemes) between Q1 and Q2 indicated general suggestions from students for effective feedback practices. Among the five themes, feedback content and quantity were the most consistent, while timing and communication varied. For feedback perception, 73.33% of the students ($n = 30$) agreed that the instructor's feedback was "good," "helpful," and had guided them to finish the light fixture project. These observations were also supported by the follow-up interviews (100% of the students agreed that the instructor's feedback was helpful, $n = 10$) with similar themes and relatable explanations. Hence, students shared similar views on feedback content and quantity (RQ 1.a.), while their preferences differed on timing and communication (RQ 1.b). For feedback content, students preferred and sought for FT and FP, which were task-related suggestions and progress indications.

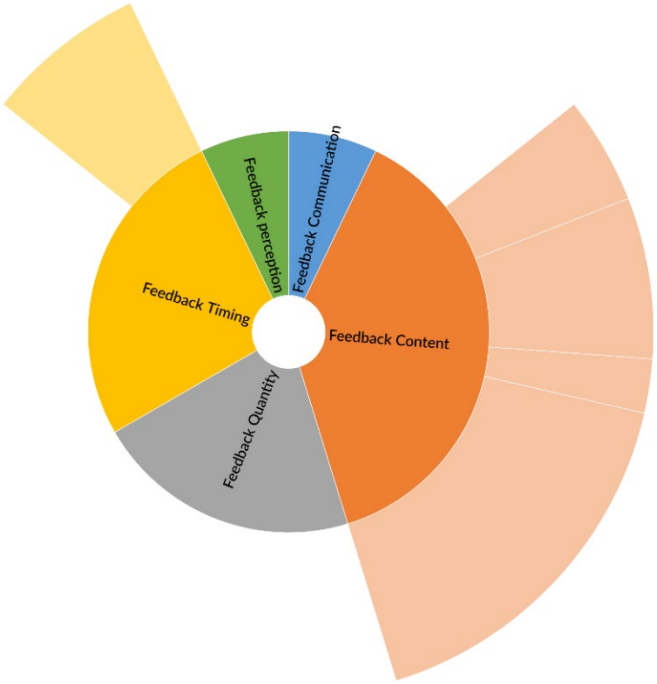

Figure 18. Distribution of themes and subthemes in Q1

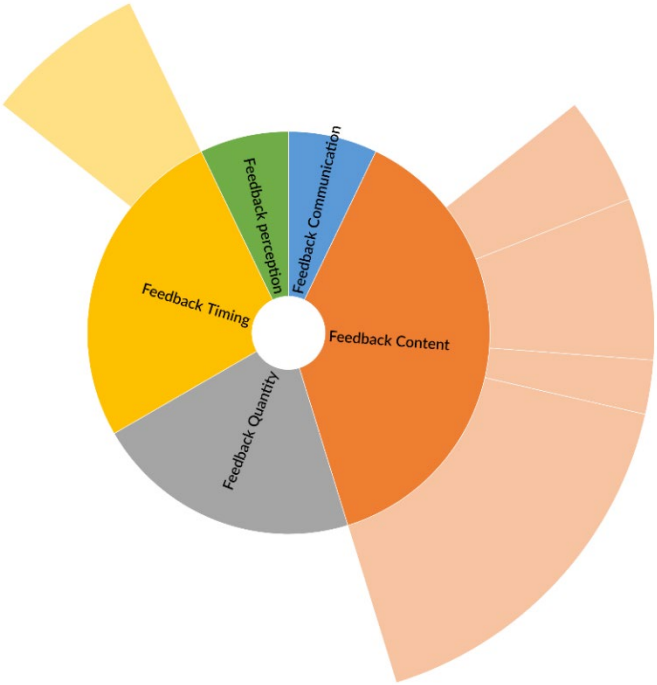

Figure 19. Distribution of themes and subthemes in Q2

While being comfortable with both direct (e.g., what works and what not) and generalizable (e.g., digital modeling techniques) suggestions, students were less responsive to FR and FS. This observation was first reflected in the feedback perception component in the post-survey and the follow-up interviews. The majority sought feedback that helped them with problem-solving (93.33%), capability enhancement (93.34%), project improvement (96.67%), progress checking (90%), knowledge improvement (96.67%), and project completion (86.66%). Among those, they prioritized feedback that led to a better light fixture design (i.e., project improvement) and provided related strategies and information (i.e., knowledge improvement). Only 43.33% of students reported seeking FS in terms of praises. Likewise, the 10 students mostly recalled FT and FP from the instructor as being helpful for their design process.

The above observation was also reflected via the feedback content as analyzed from the Facebook comments (for the CEO) and Zoom transcripts (for the instructor). Overall, 41% of the CEO's coded feedback units was FR compared to 20% of those of the instructor. For the CEO, the percentages of FT and FP were 20% and 39% of the coded units, respectively. For the instructor, FT and FP were 33.5% and 43.5% of the coded units. However, the total coded units of the CEO was 49 and of the instructor was 499. That is to say, the instructor gave a dominant amount of FT and FP compared to the CEO. Either in the open-ended responses or the follow-up interviews, students deemed the CEO's feedback as "more generic" and less impactful. Apparently, the CEO provided more typical FR by encouraging students to explore their 10 concept sketches further while maintaining their awareness of scale and materiality (i.e., plywood). These

comments were neither concrete suggestions nor actionable strategies and, thus, went far from students' expectations. Even with the CEO's FT and FP, focusing on the feasibility of the light fixture designs (e.g., typologies and structures), students were not able to utilize them. These comments came late in the design process, and students found it challenging to go back and change their designs. Hence, students relied on the FT and FP from their instructor to make design decisions and complete the light fixture projects (as described in the open-ended responses and follow-up interviews). Eight interviewed students (in Tier I or high creativity) also favored the instructor's pointers on successful concepts, light sources, and digital modeling techniques, which were typical FT and FP.

Regarding feedback quantity: The more, the better. The feedback frequency component in the post-survey supported this observation. Despite frequency preferences varying in different design stages (i.e., concept schematic and design development), no student deferred the need for feedback. Via the open-ended responses in the post-survey and the follow-up interviews, students all asked for more feedback. First, students expected to receive more guidance from the instructor to compensate for the insufficient amount of feedback from the CEO. Second, students wished to have "multiple perspectives," "new eyes," or feedback from different sources (i.e., the instructor, the CEO, and possibly new experts) to ensure their light fixture designs were optimal. Eight interviewed students (in Tier I or high creativity) especially wanted to avoid becoming biased from having only one perspective on their light fixture designs and were open to opinions that differed from their own. Thus, students were receptive and actively sought feedback. General preferences were FT and FP that were in abundance and from multiple

sources. FR and FS were perceived as less impactful despite being given by the CEO and the instructor during the design process.

1.16.1.2. RQ 1.b. What are the attributes of feedback practices that only benefit creativity when customize to specific students (e.g., contextual- and individual-customized)?

To answer this sub-question, the researcher looked into the variances in feedback timing and communication across the open-ended responses in the post-survey and the follow-up interviews. Furthermore, the feedback frequency component of the post-survey demonstrated an overview of how students varied in their preferences for feedback timing. About one-third of students sought feedback sometimes regardless of the design stages. However, there were more students who seldom sought feedback in the concept schematic stage than the design development one ($16.6\% > 10\%$). On the other hand, there were more students who often and almost always sought feedback in the design development stage than the concept schematic one ($36.67\% > 33.33\%$ and $23.33\% > 20\%$, respectively). For the eight students in Tier I of creativity, the timing preferences also differed. Students #3, #4, and #9 favored receiving feedback in the concept schematic stage. Students #2, #7, and #10, preferred feedback that focused on the design development stage. Students #1 and #5 wanted consistent feedback across the design process. Thus, preferences for feedback timing varied among those with high creativity and there was no ideal timing for all.

Regarding feedback communication, students presented mixed preferences regarding verbal and written conversations for corresponding communication platforms.

That Zoom was more effective than Facebook was the consensus, as students appreciated the ability to directly present their designs and get instant feedback. Some, however, still acknowledged the benefit of being able to "go back and see what (the CEO) said" on Facebook. They even suggested using a third communication platform, Canvas, where students can have dialogues with the instructor/CEO and retrieve those if needed. Similarly, many students found talking and sharing screens on Zoom worked well for feedback communication. Others found it difficult to explain their light fixture designs over the computer screen.

These differences in feedback communication also existed among the eight students in Tier I of creativity. For example, student #5 was comfortable with verbal communication on Zoom but wrote down all the instructor's feedback for better comprehension and retrieval. Moreover, student #7 suggested using Canvas instead of Facebook due to their familiarity with the platform. In addition, Canvas allows a mixture of verbal and written conversations and the ability to retrieve them. Students #1, #2, #3, #4, #5, #9, and #10 favored verbal communication on Zoom. However, students #2 and #10 preferred not to form deep connections with the CEO/new experts. Their reasoning was to avoid the CEO/new experts getting used to their design thinking so much so that they became unable to offer fresh perspectives. On the contrary, the other students wished for more rapport with the CEO/new experts so that they could be comfortable sharing their design process and asking for feedback. It was hard for these students to start a (feedback) dialogue with someone they "never really got to know." In essence, there was no one-size-fits-all practice in terms of feedback timing and communication.

1.17. Mediators in the Relationship of Feedback Practices and Students' Creativity

Feedback perception remained positive between the pre- and post-surveys for most items. The conducted paired t-tests, nevertheless, showed significant decreases in (a) whether feedback helped with learning and (b) whether students sought feedback to improve the quality of their projects ($t(29) = 1.82, p < 0.05$ and $t(29) = 2.28, p < 0.05$). The open-ended responses in the post-survey explained these statistical results. Despite being asked about the instructor's feedback, students included their perceptions of the CEO as well. These changes occurred because the students wanted more feedback from the CEO. After actively reaching out on Facebook for a while, they started to seek more feedback from the instructor instead.

Changes in the two items above for the four students in Tier III of creativity were as follows. One of the students went from *strongly agree* to *strongly disagree* with (a) whether feedback helped with learning and from *strongly agree* to *agree* with (b) whether students sought feedback to improve the quality of their projects. Another student, likewise, went from *strongly agree* to *agree* with both (a) and (b). The other two remained *agree*/*strongly agree* with (a) and (b) across the pre- and post-surveys. Hence, no pattern for feedback perception emerged from the students in Tier III of creativity. This observation also applied to students in Tier I of creativity. Overall, 11 students ranged between *neither agree nor disagree* and *strongly agree* with (a) and (b). Their ratings remained unchanged in both the pre- and post-surveys. While being statistically significant, the decreases in these two items of feedback perception were less likely to interfere with students' creativity (as reflected via CPSS scores).

The insignificant changes in the CPSS scores for resolution (M_R) and style (M_S) across the design process are also worth discussing. Due to differences in statistical assumptions between data sets, three Wilcoxon signed-rank tests and one paired t-test were performed. The Wilcoxon signed-rank tests showed moderate increases in the concept schematic ($V = 40, p = 0.05$) and design development ($V = 51.5, p = 0.05$) stages for resolution and only the concept schematic stage ($V = 51.5, p = 0.05$) for style. The paired t-test indicated a slight increase in design development ($t(19) = 1.48, p = 0.15$) for style. At a 95% confidence level, none of the results were statistically significant. Zoom meetings and follow-up interviews, however, shed some light on these results.

The instructor gave FT and FP (e.g., light typologies, light sources, and codes) early in the design process to ensure the appropriateness (e.g., practicality and feasibility) of light fixture designs, the embodiment of resolution. When students counted on the instructor's feedback throughout the design process and kept refining the resolution of their light fixtures, incremental instead of radical increases were expected. In follow-up interviews, students also brought up the COVID-19 challenges they faced, including limited access to fabrication labs and minimal resources for physical modeling. These challenges could interfere with the scores of style (i.e., appearance), as refined physical models were hard to achieve without using the fabrication labs, advanced tools, and materials. In short, changes in feedback perception were unrelated to students' creativity. Non-significant changes in resolution and style were likely due to COVID-19 challenges, which were not the scope of this study. As a result, RQ 2 focused on feedback experience and project

interest as shown in the follow-up interviews and explored in Chapter 2: Literature Review.

1.17.1. RQ 2. What are the mediators of the relationship between feedback practices and students' creativity in interior design studios?

To answer this question, the researcher conducted a series of paired t-tests for the project interest component in the pre- and post-surveys and looked into themes #6 and #7 from the follow-up interviews. Results of the paired t-tests showed no significant changes in project interest in students between the pre- and post-surveys ($0.36 \leq t(19) \leq 1.36$, all p-values > 0.05). The overall interest was high with all item means exceeding the middle split 3.5 of the seven-point project interest component. Moreover, students scored high in the *well-developed individual* interest level with the means of the *reengagement* items ranging from 5.33 to 5.43. The feedback experience component in the post-survey, together with themes #6 and #7 of the follow-up interviews, was in tune with this observation.

According to Hidi and Renninger (2006), students with the *well-developed individual* interest level were receptive and actively sought feedback. As shown in the feedback experience component in the post-survey, a total of 83.33% of the total sample ($n = 30$) made *many to all* changes in their light fixture designs based on the instructor's feedback. Even with the delayed feedback of the CEO, 25% of students with complete progress posted on the private Facebook group ($n = 20$) revisited their decisions and made related changes. Theme #6, feedback experience, of the follow-up interviews echoed those percentages with 80% of the 10 interviewees incorporating feedback from

both the instructor and the CEO into their light fixture designs. Again, theme #7, project interest, displayed a high level of engagement of students in overcoming COVID-19 challenges to complete the physical light fixture models that they enjoyed and were proud about.

It is also important to note that feedback perception across the pre- and post-surveys was positive in most items. In items where feedback perception decreased, no pattern was identified between students in Tier I and Tier III (i.e., high versus low creativity). Especially, for theme #4, feedback perception, from the follow-up interviews, several students acknowledged the helpfulness of the CEO's feedback. While the Facebook comments were delayed and insufficient, these students still perceived them as fresh perspectives. They even wished to have more feedback from the CEO even if it was "a really bad critique" on a failed design concept. Nevertheless, with project interest remaining substantially high across the tiers (high to low creativity), there was no evidence of this variable being a moderator of the relationship between feedback practices and students' creativity.

Another possible variable was feedback expectation. Based on the discussions in Chapter 2: Literature Review, except for the indecisive results of FS, the other feedback levels were beneficial to creativity (Amabile, 1997; Hennessey, 2019; Runco & Chand, 1995). FT and FP, for instance, develop competence with accuracy confirmations and improvement cues. FR, on the other hand, promotes autonomy in regulating the task completion process. Content analyses of Facebook comments and Zoom meetings showed an array of feedback levels given by the CEO and the instructor. In the CEO's

case, FR was 41%, FP was 39 %, FT was 20%, and there was no FS. For the instructor, FR was 20%, FP was 43.5 %, FT was 33.5%, and FS was 3%. Students, however, recalled and appreciated mainly FT and FP from the instructor, while deemed FR from the CEO as "generic" and less impactful.

There was a mismatch in expectations between feedback providers (i.e., the CEO and the instructor) and recipients (i.e., students). In fact, the CEO's feedback practices were relevant to the project prompt, which required a *novel* and *appropriate* light fixture for residential uses made from a single sheet of 4'x8' birch plywood in ¾" thick (Asojo, 2020). The CEO's FR emphasizing scale and materiality would ensure that students fitted their light fixtures into the designated plywood sheet. At the same time, the CEO encouraged further explorations while limiting specific directions to give students autonomy in conceiving design solutions. These comments, however, were either delayed or unevenly distributed among students. Both feedback timing and quantity, thus, were unfulfilled. Especially, theme #7, project interest, from the follow-up interviews, revealed that the students expected "freedom," "getting to be very creative," and "pushing the boundaries of creativity" in the light fixture project. Being reminded of the strict material (plywood) and scale (4'x8' sheet) through the CEO's feedback went against their design aspirations.

Above all, students expected concreted suggestions (FT) and relevant strategies or techniques (FP) to successfully complete the project. Their goals in getting feedback, again, were improving the project quality and accumulating knowledge. The instructor met these expectations due to the ample FT and FP provided. As the instructor met with

the students twice a week during the five-week project, feedback timing and quantity were satisfied. Across the post-survey and the follow-up interviews, students deemed "general comments" such as reminders, "keep the material properties and scale of the plywood in mind" (FR), and praise, "oh, it good" (FS), as not helpful. Instead, they preferred receiving detailed feedback that signified their current progress and directed them on how to move forward. In summary, together with the right timing and sufficient quantity, students' expectations moderated the relationship between feedback practices and creativity. These expectations, in turn, were influenced by students' project interest and goals.

CHAPTER 6: CONCLUSION

1.18. Overview

This study provides a holistic understanding of feedback practices and students' creativity in the Fall 2020 interior design studio with the light fixture project. In terms of students' creativity, paired t-tests detected significant increases in novelty (i.e., newness) across the stages of the design process. Although there were no identified significant changes in Resolution (i.e., appropriateness) and Style (i.e., appearance) were observed, the early feedback on feasibility/practicality from the instructor and the unintended consequences of COVID-19 help explain these statistical results. Assessments of students' creativity were consistent between experts as well. Six of the top ten light fixture designs chosen by the CEO were in Tier I of creativity based on the CPSS scores from the two invited judges.

Correlation coefficients between feedback experience and creativity from a sub-set of students ($n = 20$) were insignificant. However, the collective feedback experience of the studio ($n = 30$) said otherwise. The feedback experience component in the post-survey, documents/artifacts, and the follow-up interviews showed that a majority of students applied/combined the instructor's feedback while making use of the CEO's feedback whenever possible. Furthermore, the five students in the CEO's top 10 and five others in Tier I of creativity selected for the follow-up interviews were reliable sources to identify feedback practices that were effective for their creativity.

Consequently, RQ 1 and RQ 2 were answered through the content analyses of documents/artifacts, open-ended responses, follow-up interviews, and corresponding

statistics from the pre- and post-surveys. RQ 1 focused on effective feedback practices for the creativity of all (1.a.) and specific (1.b.) students. The general practices for effective feedback focused on (1.a.1.) *content* and (1.a.2.) *quantity*. In short, feedback that emphasized FT and FP was effective in most cases. Additionally, multiple feedback sources (i.e., possibly new practitioners) were better. Feedback practices, however, varied among students in (1.b.1.) *timing* and (1.b.2.) *communication*. While having high creativity, students preferred feedback that emphasized either the concept schematic or design development or substantially across the design process. Likewise, students with high creativity leaned toward either verbal or a mixture of it with written communication. Those who favored verbal communication even differed in rapport preferences (i.e., fresh conversations versus well-built connections) for feedback providers (i.e., the CEO and possibly new practitioners).

RQ 2 focused on the variables that moderated the relationship between feedback practices and creativity. Viable variables were (2.1.) *project interest* and (2.2.) *feedback expectation*. Students sustained a high interest level from the pre- to post-survey and across the tiers of high to low creativity. Statistical results of paired t-tests for project interest between the pre- to post-surveys returned as non-significant. No pattern emerged among students in Tier I and Tier III as well. Theme #7, project interest, of the follow-up interviews demonstrated how engaging students were with the light fixture project amid COVID-19 challenges. A majority of students (83.33%) were also receptive and actively sought feedback regardless of their creativity scores. The researcher, thus, found no

evidence that this variable moderated the relationship between feedback practices and creativity.

The second variable, feedback expectation, was more evident. Echoing the findings of Weisen et al. (2021), the actual feedback provided differed from what students recalled. Feedback from both the CEO and the instructor varied in terms of levels, including FT, FP, FR, and FS. Specifically, the CEO gave more FR (41%) than FT and FP, with no FS. Whereas, the instructor gave about the same amount of FT (33.5%) and FP (43.5%) with some FR and FS. Students, on the other hand, recalled mostly FT and FP (especially from the instructor). Their reasons/goals for seeking feedback explained this observation. Students prioritized detailed suggestions that helped improve their light fixture quality and relevant strategies that expanded their knowledge about the project. With these expectations in mind, it was clear that students only attended to FT and FP, as those were actionable and applicable to their light fixture designs. Besides the lateness and the insufficient amount of feedback from the CEO, the focus on FR was a mismatch with the students' expectations. Right timing, a substantial amount of feedback, and the instructor's focus on FT and FP were what students expected and applied to/combined with their design process. The researcher, therefore, found sufficient evidence that this variable moderated the relationship between feedback practices and creativity. Table 23 summarizes the two research questions and their respective answers.

Table 23. Summary of RQ 1. and RQ 2. answers

RQ 1. Feedback practices that were effective to creativity	
RQ 1.a. True to all	Feedback content (FT and FP) Feedback quantity (more is better)

RQ 1.b. Vary by individuals	Feedback timing (during stages or entire process) Feedback communication (verbal, mixture)
RQ 2. Moderators of the relationship between feedback practices and creativity	
	Project interest (no evidence) Feedback expectation (sufficient evidence)

1.19. Limitation

One limitation this study is the small sample size, it is appropriate to describe the study as exploratory rather than generalizable. A large sample size allows more accurate inferences from the sample to the target population by reducing standard errors (i.e., how far sample statistics are to the parameter) (Frankfort-Nachmias et al., 2015). However, Smith and Little (2018) argued that increasing sample size could not substitute for adequate measurements and theories. This study, while having a small sample size, build on well-established measures (CAT, CPSS, and optimal Likert scales), theoretical frameworks (the model of feedback and interest-based feedback preferences), and a diverse literature review (educational and design settings). Revisiting the experimental studies in Table 4, Dow et al. (2010) had only 33 participants but collected data from multiple sources per participant. They assessed participants' creativity (33 web banners) via web visitors' preferences plus independent judges' scores and interviewed participants for feedback experience.

With random assignments (to contrasted groups) and controls for intervening variables (task time, design experience, and proficiency), their claims are evident and strong. These claims, however, made limited implications for design education less likely, not because of the small sample size, but the manipulation of feedback content. Using pre-determined statements of task goals and basic graphic principles, Dow et al. kept feedback consistent between groups but also oversimplified this variable. For

instance, feedback with cognitive strategies (FP) such as design heuristics and brainstorming can help students with few ideas enhance their creative performance without inducing negative emotions. Another example is Wu and Bailey's study (2017) with 270 participants. They also randomized pre-determined feedback between groups based on feedback source (expert, crowd, and anonymous) and valence (negative and positive). The feedback was drawn from the same pool of statements and did not necessarily reflect the participants' creative performance. This approach strengthened their experiment design but reduced the authenticity of feedback practices (i.e., ecological validity). A holistic understanding of feedback and creativity, therefore, needs to be a combination of experimental findings and rich-in-context data interpretations. This study design can even serve as an example for related research, including open-end questions and rigorous analyses of responses to elaborate and contextualize statistical results.

1.20. Implication

This study offers insights regarding feedback practices and creativity in the Fall 2020 studio with the light fixture project. These insights can have implications for the same studio in upcoming years and help formulate guidelines for future studies in different studio levels. In total, there are three suggestions derived from the answers to RQ 1 and RQ 2, including (a) quantity, (b) timing, and (c) feedback expectations. Feedback quantity in accordance with timing preferences works with most students. Nevertheless, there is no one-size-fits-all standard for feedback expectation. While students favored FT and FP, the researcher decided not to use these specific feedback levels as a suggestion. Said preferences resulted from students' dominant goals for

feedback-seeking (e.g., improving project quality and accumulating relevant knowledge) and can, thus, change with different cohorts.

In this study, students prioritized mastery goals such as improving performance and gaining knowledge. These junior students, while being proficient in the design process, were novices in creating light fixtures (e.g., light sources, structures) and using new digital tools (e.g., Fusion 360). Resonating with the findings of Brooks et al. (2019), FT and FP were better for students with novice to proficient expertise and mastery goals. Providing mostly FR, as in the CEO's approach, is more suitable for students with experience in light fixture designing (i.e., advanced expertise). Interior design educators (e.g., instructors and invited experts), however, should not limit their feedback to specific levels. Instead, they might want to explore students' expectations with respect to their feedback-seeking goals, levels of expertise, and even project interest. In this study, students were particularly interested in the light fixture project. Such high levels of interest might differ across cohorts and projects. The three implications derived from the above insights have been elaborated as follows:

(a) The More the Better

It is safe to give more feedback than less. Regardless of the projects, students need feedback to succeed. In other words, they need signals to be aware of their progress and guidance to fulfill project requirements with the necessary knowledge and strategies. Therefore, educators can assume that feedback is desirable to avoid giving their students an insufficient amount.

(b) Explore Timing and Frequency

During the design process, educators can check in with each student to adjust the amount of feedback. Some students might wish to have more feedback early on (i.e., the concept schematic stage) while others might save it for later (i.e., the design development stage). Educators then leave some autonomy for students depending on their preferences. For students who need feedback over the entire process, educators can keep the feedback amount consistent.

(c) Tune in with Students' Expectations of Feedback

Educators should not assume that specific feedback levels are more desirable than others. It is important to consider students' feedback expectations and adjust them accordingly. Educators can assess students' goals in feedback-seeking, their level of expertise/interest regarding the project at hand. These assessments will help educators direct students with concrete suggestions, provide necessary knowledge and strategies, and give self-regulated reminders where needed.

1.21. Future directions

The future trajectory of this study can focus on the insignificant Spearman's coefficients (rho) between the assigned Likert values of feedback experiences and students' creativity. Only 20 students who posted a complete design process on Facebook and interacted with the CEO were assigned the Likert values and rated for CPSS scores. This sub-set, hence, did not represent the whole Fall 2020 studio as the pre- and post-surveys did. Due to the COVID-19 pandemic, this situation was inevitable. Moreover, Spearman's coefficients were computed specifically with the final solution. In the future,

one possible approach would be to assess feedback experiences for each document/artifact (i.e., 10 sketches, three revisions, and one final solution). Spearman's coefficients will then be performed between the corresponding feedback experiences and CPSS scores. Moreover, data collection can span multiple studio years to see whether the insignificant results persist. All things considered, using the same mixed-methods approach in this study for multiple cases (i.e., one studio, different years) will enrich not only the current insights and implications but also the literature review of the subject matter in interior design. Educators, furthermore, need to prepare experts in offering feedback in the specific situation of a studio. This preparation will help students and experts set reasonable expectations.

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APPENDICES

Appendix A: IRB Approval

Hoa Vo <voxxx248@umn.edu>

MOD00021323 has been approved
1 message

ethosirb@umn.edu <ethosirb@umn.edu> Wed, Dec 9, 2020 at 3:21 PM
Reply-To: ethosirb@umn.edu
To: voxxx248@umn.edu

Template:IRB_T_Post-Review_Approved

Notification of Approval

To:	Hoa Vo
Link:	MOD00021323
P.I.:	Abimbola Asojo
Title:	Feedback and Creativity in Interior Design Studio
Description:	This submission has been approved. You can access the correspondence letter using the following link: Correspondence_for_MOD00021323.pdf(0.01) To review additional details, click the link above to access the project workspace.

Appendix B: Information Sheet

INFORMATION SHEET FOR RESEARCH

Feedback and Creativity in Interior Design Studio: A Case study-mixed methods of a Junior Level Light Fixture Project

You are invited to be in a research study of to explore **effective feedback practices** from experts (i.e., the instructor and the invited practitioner) to **enhance students' creativity** in IDES 3612/5612 with the light fixture project. You were selected as a possible participant because you have enrolled in the IDES 3612/5612 studio in fall 2020 and will be completing the light fixture design project. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by:

Investigator: Hoa Vo
Investigator Departmental Affiliation: Interior Design, Design, Housing and Apparel, College of Design, University of Minnesota
Advisor: Dr. Abimbola Asojo

Procedures:

If you agree to be in this study, we would ask you to do the following things:

- Be in a pool of participants for informal interviews regarding your feedback experiences (from both the instructor and the invited practitioner/the CEO) at the end of the light fixture project. The interviews only take places after you receive the grades.
- If selected, you will meet the investigator for a one-on-one interview in a private Zoom meeting. You will spend around **30 – 45 minutes to answer 5 questions** on your feedback experiences. The interview will be recorded for transcription purpose. You will make written agreement for the investigator to release your email address to the third party for the delivery of the **$25 Amazon eGift Card** as a gratitude for your effort and time.
- Review and make suggestions on whether the study findings reflect your feedback experiences.

Confidentiality:

The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely and only researchers will have access to the records.

- **NO** identifiable information from your participations will be **SHARED** with your instructor or the invited practitioner/the CEO in IDES 3612/5612.
- Your instructor/the advisor of the investigator will have access to the interpretations of the study records but NOT identifiable information.
- We will use and may share records of this study for future research. They may be shared with researchers/institutions outside of University of Minnesota. This could include for profit companies. We will not ask for your consent before using or sharing them. We will remove any identifiers which means that nobody who works with them for future research will know who you are. Therefore, you will not receive any results or financial benefit from future research done on the records of this study.

HRP-587 Template Version: 2/28/2019

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:

The researchers conducting this study are: Hoa Vo and Dr. Abimbola Asojo. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact them at:

Investigator: Hoa Vo, 612-323-2809, voxxx248@umn.edu
Advisor: Dr. Abimbola Asojo, 612-624-3271, aasojo@umn.edu

This research has been reviewed and approved by an IRB within the Human Research Protections Program (HRPP). To share feedback privately with the HRPP about your research experience, call the Research Participants' Advocate Line at 612-625-1650 (Toll Free: 1-888-224-8636) or go to z.umn.edu/participants. You are encouraged to contact the HRPP if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

You will be given a copy of this information to keep for your records.

Appendix C: Follow-up Interview Protocol

Interview Protocol

Dear Student,

You are being asked to volunteer for the interview part of the Feedback and Creativity in Interior Design Studio research study. This study is being conducted at the University of Minnesota, College of Design, Interior Design program. You were selected as a possible participant because you were enrolled in IDES 3612/5612 and your light fixture was of high creativity as determined by external judges. This part of study will just entail me to interview you about your experience.

If you agree to participate you will be asked the following questions 1 to 5, the process will take about 30-45 minutes. You will also receive a $25 Amazon eGift Card via email. Your responses will be recorded only for the transcription purpose.

If you agree to disclose your email address to the third party (i.e., Amazon) for the delivery of the eGift Card:

Please indicate your email: _____and sign here: _____

Date: _____

1. Tell me about the light fixture project that you worked on. Describe what you like the most about your design.
2. In what way do you feel the feedback given by the practitioner on Facebook impacted your light fixture design?
3. In what way do you feel the feedback given by your instructor impacted your light fixture design?
4. What do you wish was different about your feedback experiences in general?
5. Is there any additional information you want to share?

Thank you for participating.

Appendix D: Sample of CEO's Feedback and Student Works from fall 2020

October 5, 2020 ·

Model of design #1. The light will shine out of the slits on the sides. This would be standing lamp, but not sure about the stand yet. This is not to scale

— with

1 3 Comments Seen by 19

Like Comment

University Hall of Innovation

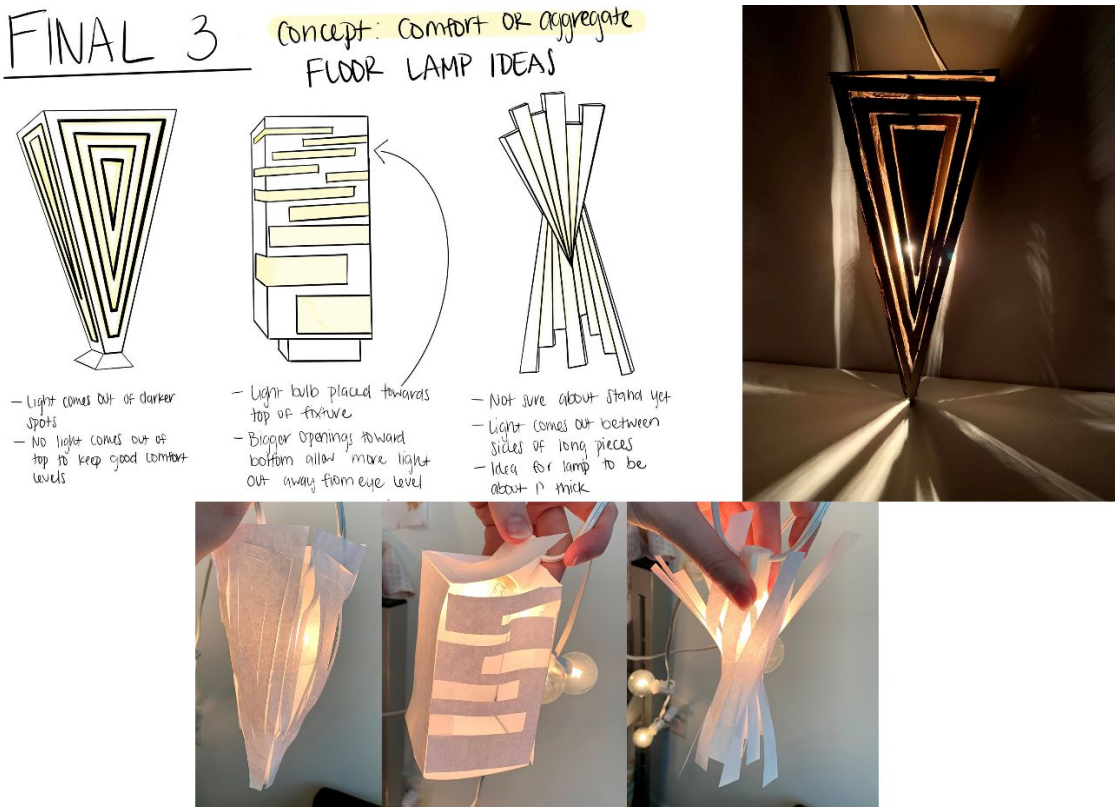
Like · Reply · 20w 1

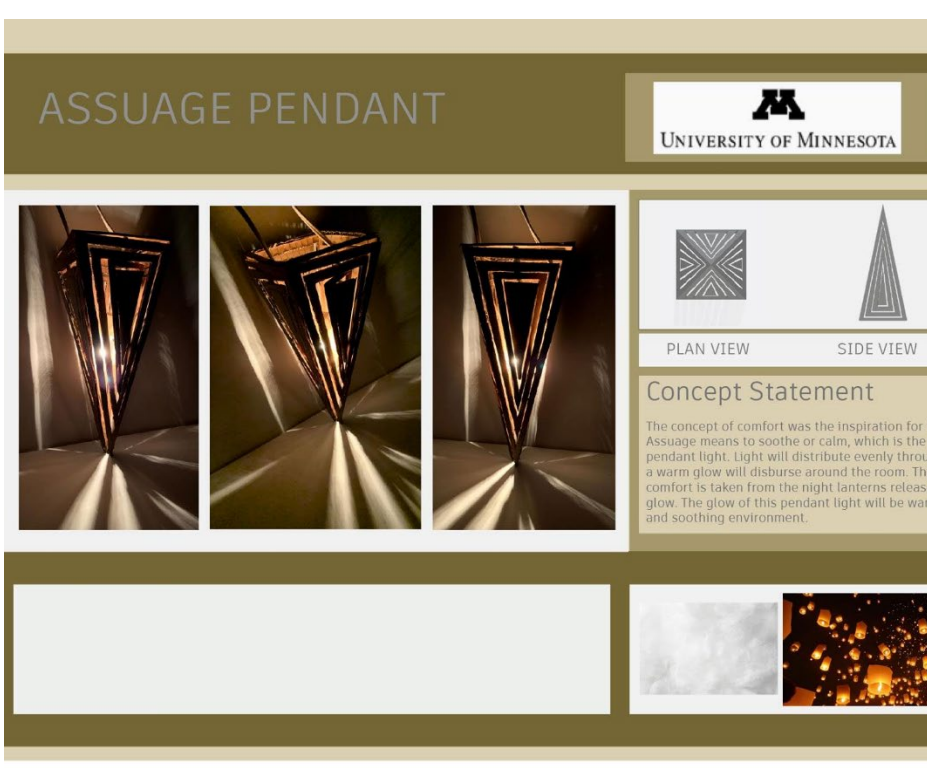
I am liking this fixture, I could see it being suspended by wire from a canopy with the light peeking through the shade. I see this as a modern suspension fixture, Morocco meet modern lighting...What material are you considering?

Like · Reply · 20w

For this light fixture, I'm considering more of a canvas-like material. Something that is sturdy, but off-white or cream in color to let out more of the light comfortably.

Like · Reply · 20w


FINAL 3
Concept: Comfort or aggregate
FLOOR LAMP IDEAS
– Light comes out of darker spots
– No light comes out of top to keep good comfort levels
– Light bulb placed towards top of fixture
– Bigger openings toward bottom allow more light out away from eye level
– Not sure about stand yet
– Light comes out between sides of long pieces
– Idea for lamp to be about 1" thick


ASSUAGE PENDANT
UNIVERSITY OF MINNESOTA
University HALL
PLAN VIEW
SIDE VIEW
AXONOMETRIC
Concept Statement
The concept of comfort was the inspiration for the Assuage Pendant Lamp design. Assuage means to soothe or calm, which is the main function of this hanging pendant light. Light will distribute evenly through the open slits in the fixture,and a warm glow will disburse around the room. The inspiration for the concept of comfort is taken from the night lanterns released into the air that create a warm glow. The glow of this pendant light will be warm and soft, creating a comforting and soothing environment.
INSPIRATION

Appendix E: Pre-Survey questions

Part I. Demographic Information

What is the day of your birth? For example, January 5 is 5.

What is the name of your favorite pet? Say none if you never had a pet.

Part II: Feedback Perception

Think about the feedback you have received in the studios you have taken so far. Please indicate whether you agree or disagree with the following statements.

From 1 (strongly disagree) to 5 (strongly agree).

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I have positive attitude toward feedback in the studio.	○	○	○	○	○
Feedback in the studio is helpful.	○	○	○	○	○
I learn more with feedback in the studio.	○	○	○	○	○
I feel comfortable asking questions while receiving feedback in the studio.	○	○	○	○	○
Receiving feedback in the studio is better for the design process.	○	○	○	○	○
I prefer having feedback in the studio.	○	○	○	○	○
I request feedback in the studio so that I can determine the target of my future project.	○	○	○	○	○
I request feedback in the studio because I want to hear praises that make me happy.	○	○	○	○	○

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I request feedback in the studio because I want to know how to solve problems in the project.	○	○	○	○	○
I request feedback in the studio because I want to be more capable in finishing a project.	○	○	○	○	○
I request feedback in the studio because I want to learn to improve the quality of my project.	○	○	○	○	○
I request feedback in the studio to ensure my design project is fine.	○	○	○	○	○
I request feedback in the studio to improve my knowledge and ability for my design project.	○	○	○	○	○
I request feedback in the studio to ensure I am able to finish my design project.	○	○	○	○	○

Part III: Project Interest

Read the light fixture project prompt you receive in this studio (IDES 3612/5612) and think about how it makes you feel. Please indicate whether you agree or disagree with the following statements.

From 1 (strongly disagree) to 7 (strongly agree).

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree
I think the light fixture project in this studio is interesting.	○	○	○	○	○
I enjoy working on the light fixture project in this studio.	○	○	○	○	○
I'm excited about the light fixture project in this studio.	○	○	○	○	○
I think the light fixture project in this studio is	○	○	○	○	○

important.					
I think what I learned from the light fixture project in this studio is useful for me to know.	○	○	○	○	○
I find the light fixture project in this studio personally meaningful.	○	○	○	○	○
I see how I can apply what I learned from the light fixture project in this studio to real life.	○	○	○	○	○
What I learned from the light fixture project in this studio is practical for my study in interior design.	○	○	○	○	○

Appendix F: Post-survey questions

UNIVERSITY OF MINNESOTA
Driven to Discover®

Part I. Demographic Information

What is the day of your birth? For example, January 5 is 5.

What is the name of your favorite pet? Say none if you never had a pet.

What is the name of your light fixture?

Part II: Feedback Perception

II.A. Overall Experience

Please indicate the ONE statement that represents your feedback experience in the light fixture project of this studio (IDES 3612/5612).

- ○ I reflect what I hear from the instructor and try to combine my ideas and instructor's feedback on my design.
- ○ I understand the instructors' feedback; however, I cannot come with an applied design.
- ○ I am skeptical regarding the instructor' comments about the design and I have tendency to discount the feedback I receive.
- ○ I misunderstand the instructor' feedback and apply what I want to hear.
- ○ I remember and apply the instructor' concrete feedback.
- ○ I assume that the instructor has the same idea with my ideas.

II.B. Feedback Perception

Think about your instructor's feedback in the light fixture project of this studio (IDES 3612/5612). Please indicate whether you agree or disagree with the following statements.

From 1 (strongly disagree) to 5 (strongly agree).

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I have positive attitude toward feedback in this studio.	○	○	○	○	○
Feedback in this studio is helpful.	○	○	○	○	○
I learn more with feedback in this studio.	○	○	○	○	○
I feel comfortable asking questions while receiving feedback in this studio.	○	○	○	○	○
Receiving feedback in this studio is better for the design process.	○	○	○	○	○
I prefer having feedback in this studio.	○	○	○	○	○
I request feedback in this studio so that I can determine the target of my future project.	○	○	○	○	○
I request feedback in this studio because I want to hear praises that make me happy.	○	○	○	○	○
I request feedback in this studio because I want to know how to solve problems in my light fixture project.	○	○	○	○	○
I request feedback in this studio because I want to be more capable in finishing my light fixture project.	○	○	○	○	○
I request feedback in this studio because I want to learn to improve the quality of my light fixture project.	○	○	○	○	○
I request feedback in this studio to ensure my light fixture project is fine.	○	○	○	○	○
I request feedback in this studio to improve my knowledge and ability for my light fixture project.	○	○	○	○	○
I request feedback in this studio to ensure I am able to finish my light fixture project.	○	○	○	○	○

II.C. Feedback Frequency

How often do you seek feedback from your instructor in the light fixture project of this studio (IDES 3612/5612)?

From 1 (never) to 5 (almost always).

	Never	Seldom	Sometimes	Often	Almost Always
During concept schematic (10 sketches)	○	○	○	○	○
During design development (3 revisions)	○	○	○	○	○

II.D. Feedback Input

What will be your suggestions for the instructor's feedback in the light fixture project of this studio (IDES 3612/5612)?

How can the instructor's feedback in the light fixture project of this studio (IDES 3612/5612) be more effective?

Part III: Project Interest

After you have completed the light fixture project in this studio (IDES 3612/5612), how does it make you feel? Please indicate whether you agree or disagree with the following statements.

From 1 (strongly disagree) to 7 (strongly agree).

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree
I think the light fixture project in this studio is	○	○	○	○	○

interesting.					
I enjoy working on the light fixture project in this studio.	○	○	○	○	○
I'm excited about the light fixture project in this studio.	○	○	○	○	○
I think the light fixture project in this studio is important.	○	○	○	○	○
I think what I learned from the light fixture project in this studio is useful for me to know.	○	○	○	○	○
I find the light fixture project in this studio personally meaningful.	○	○	○	○	○
I see how I can apply what I learned from the light fixture project in this studio to real life.	○	○	○	○	○
What I learned from the light fixture project in this studio is practical for my study in interior design.	○	○	○	○	○

Appendix G. The CEO's consent

September 17, 2020

Institutional Review Board,

I would like to take this opportunity to express my consent to have my comments and assessments collected and analyzed on the private Facebook page of IDES 3612/5612 during the 5 weeks of the light fixture project to understand the written feedback given to students on their designs during the University Hall of Innovation by Design Challenge.

Thank you for your time.

Stephen Garrison

President, University Hall of Innovation

Appendix H. The instructor's consent

Information Form

Dear Dr. Asojo

My name is Hoa Vo, the student researcher/ investigator of the research study **Feedback and Creativity in Interior Design Studio: A Case study-mixed methods of a Junior Level Light Fixture Project**.

The purpose of this study is to **explore effective feedback practices to enhance students' creativity in your junior-level IDES 3612/5612 studio with the light fixture project**. This study is for my dissertation of the Ph.D. degree in the Interior Design track, Department of Design, Housing, and Apparel, University of Minnesota.

I'd love to obtain your consent on:

- Having anonymous pre- and post-surveys on students' feedback perception and project interest as an integrated part of your light fixture project in IDES 3612 to understand how students experience feedback in the studio.
- Collecting and analyzing the transcripts of your studio meetings on Zoom during the 5 weeks of the light fixture project to understand the verbal feedback you give to students on their designs.

Any identifiable information of you or the students will be excluded. The analyses result from the collected information will be reported in my dissertation and contribute to a better understanding of feedback practices that enhance students' creativity in interior design discipline.

If you are able to help this study by giving consent for the above activities, I'd be greatly grateful.

If it is not the case, I understand and will respect your decision.

I CONSENT

My signature is below

Abimbola Asojo

Abimbola O. Asojo, PhD, AIA, IDEC, LEED AP
NOMA, NCIDQ

Associate Dean for Research, Creative Scholarship, and Engagement | https://design.umn.edu/
Professor | Interior Design | https://design.umn.edu/academics/programs/about-interior-design
Fellow, Institute on the Environment (IonE) | environment.umn.edu
College of Design, University of Minnesota | umn.edu
240 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108
aasojo@umn.edu | 612-624-3271 | 612-625-1771 | https://design.umn.edu/directory/abimbola-asojo
ORCID ID | https://orcid.org/0000-0002-5119-279X
Pronouns: she/her/hers