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The Creativity Lab: Interdisciplinary Creativity in Higher Education

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ABSTRACT

This qualitative study explores how educators can foster creativity across disciplines through a conceptual framework for creative interdisciplinary collaboration. The article introduces the Creativity Lab process model, which generates collaboratively developed, multifaceted but cohesive project ideas. The author argues that while creativity and collaboration are recognized as important 21st-century skills, opportunities for learning the granular mechanics of creative interdisciplinary collaboration are not yet fully integrated into higher education. The process model addresses this and offers a practical way to foster creative confidence in participants, encourage pluralities and possibilities through gamification, and emphasize integration and cohesion of multiple perspectives in ideas. The article concludes that educational institutions have an opportunity to build the capacity of students and faculty to become skilled at creative collaborations across disciplines, and the Creativity Lab process model offers a specific approach to doing this.

Keywords: Creative interdisciplinary collaboration, creativity education, experiential learning, innovation

INTRODUCTION

Educators play a crucial role in fostering creativity across disciplines and promoting interdisciplinary collaboration, especially in a world that faces complex challenges. Faculty model discipline-specific creativity in their contributions to their fields and their teaching, and many also facilitate

collaboration. However, this sits in tension with the claims that education falls short in teaching 21st-century skills such as creativity (Mishra & Mehta, 2017). The 4Cs of creativity, critical thinking, collaboration, and communication (Keane, 2012), along with a focus on innovation through interdisciplinarity, are often cited as the skills students lack when entering the workforce of today. Many argue that these are also the skills or capacities needed for future jobs that have yet to be invented (Jezard, 2015; Rose, 2012; Jerald, 2009; Pink, 2005; Mishra & Mehta, 2017). Countering this, however, Kereluik et al. (2013) argued that the 4Cs are not new skills, and they have questioned whether the demands of the 21st century truly do require new ways of thinking or learning. Perhaps what is needed is space within academia to hone, practice, and apply the creative and collaborative skills we already have within interdisciplinary settings.

Interdisciplinary collaboration has been well established for faculty in places such as communities of practice (CoP). These communities allow faculty from diverse disciplines to gather around a central theme or topic for interdisciplinary discussions and offer "a methodology for overcoming fragmentation, isolation, and competition" within higher education (Pharo et al., 2014, p. 342). However, Communities of practice do not often include students. Pharo et al. have cautioned that although learners may take courses in multiple disciplines, "the students themselves are left to make sense of 'disparate, and sometimes conflicting, learning experiences'" (p. 342). This element of their argument supports the wider call for educational institutions to better prepare students to navigate a complex and changing world where interdisciplinary collaboration is a norm.

Darbellay, Moody, and Lubart (2017) also advocated for the need for both students and faculty to engage in interdisciplinary collaboration since it fosters the ability to "think and act creatively, at the interface and beyond the disciplines, in an agile and insightful way" (p. xi). For the authors, interdisciplinary collaboration can take place at various levels from borrowing or transferring concepts or methods to "hybridization, transgression, or transformation" that can come from crossing disciplinary boundaries (p. xv). Their important argument was that "interdisciplinarity presents several points of contact with the creative process" (p. xv).

Outside of the work of Darbellay et al. (2017), the nuances and granular mechanics of how creative interdisciplinary collaboration happens successfully or how to actually teach the skills and capacities that are lacking have received less attention. Building on established scholarship (Duncker 2001; Huutoniemi et al., 2010), Siedlok and Hibbert (2014) argued that "the dynamics of interdisciplinary collaborations remain rather poorly understood, making it difficult to manage in practice" (p. 195). Investigating this same point of tension, Timmis and Williams (2017) suggested that while "the idea of successful interdisciplinarity has become widely accepted across

academia…it rarely fulfills its promise in practice and there has been relatively little research into how to foster and promote interdisciplinary research groups" (as cited in Moirano, Sánchez & Štěpánek, p. 258). However, there is a demand for graduates who are skilled in and able to apply interdisciplinarity, creativity, and collaborative approaches to working (Spoelstra et al., 2014; Sun, 2018). Educators and the institutes that house them must find ways to foster these skills in practice, not just in mission statements.

This study emerged from the tension described above and departed from the question "How can faculty foster creativity across disciplines?" to explore how creative interdisciplinary collaboration can be practiced within higher education. The article begins with a review of the literature on interdisciplinary collaboration and creativity as future skills as well as commonly used creativity techniques. It is followed by a description of the research design and the methods used to conduct the study. The resulting conceptual framework of creative interdisciplinary collaboration and the Creativity Lab process model are reported in detail. The paper ends with a discussion of the impact the findings can have and how the process model can offer structure to short-duration, action-oriented collaborations across disciplines.

LITERATURE REVIEW

The focus on creativity as a current skills gap for graduating university students and as one of the primary future skills identified by industries has been highlighted in many nonacademic publications, such as *Forbes*, the *World Economic Forum*, the *Business-Higher Education Forum*, *The Guardian*, and *Business Insider* (Ziv, 2019). These publications are insightful because they offer information coming directly from industry experts hiring and working with the students' universities train. Although it has been well established that creativity is a skill that can be taught and fostered (Best, 2010; Haynes, 2020), it remains an underdeveloped aspect of higher education training (Egan, Maguire, Christophers, and Rooney, 2017). Egan et al. discussed various reasons for this, including "rigid management practices within higher education which stifle creativity" (para. 2), challenges with the assessment of creativity, and conflicting discipline-specific perspectives on whether creativity is product-oriented or process-oriented (para. 2). A related skill that also seems to be missing from higher education graduates is interdisciplinary collaboration (St Louis, Thompson, Sulak, Harvil &Moore, 2021).

A report commissioned by The Business-Higher Education Forum (BHED) and cowritten by analytics software company Burning Glass Technologies (2018) calls for increased attention on foundational skills they

call “Human Skills” that “apply creative, social, and critical intelligence” which can transfer between and across disciplines (p. 9). To frame their report, they consider the rapidly changing world of work: many occupations at risk for “transition or elimination through automation and artificial intelligence” as well as redefined or brand-new modes of work (pp. 16-17). For the authors of the report, a core benefit of these foundational skills was an increased capacity to adapt and “navigate a dynamic landscape of accelerating change” (p. 17). Highlighted by this report and the review of interdisciplinary collaboration processes conducted by Reiter-Palmon and Leone (2018), what becomes clear is that a graduate’s ability to leverage critically creative skills is becoming paramount for success along with their ability to collaborate across disciplines.

Discussing collaborative creativity in transdisciplinary spaces, Guyotte and Sochacka (2015) emphasized that collaboration within educational contexts is not new, but focusing on the creative process as collaborative and across disciplines is a growing trend within STEAM (Science, Technology, Engineering, Arts, Math) (p. 3). Their study led Guyotte and Sochacka to conclude that through art education, “students developed an awareness of their own creative processes and how these processes might be (re)considered and reconciled in group projects and contexts” (p. 30). The authors noted how “facets of collaborative creativity, including empathizing” emerged across disciplines (p. 30).

Guyotte and Sochacka’s study supported the perspective that creative, collaborative, interdisciplinary projects can result in deep personal learning. They drew on the scholarship of art educators Marshall (2014) and Bequette and Bequette (2012), who positioned cross-disciplinary collaboration as a site to “cultivate creative thinking skills and mimic a ‘real world’ not bound by isolated disciplines” (Guyotte & Sochacka, p. 30). Together, these theorists built a case for interdisciplinary collaboration as a space that promotes self-reflexive, holistic, and dialogic perspectives on learning. To do so, they argued, requires “(re)examining traditional pedagogical practices in order to thoughtfully orchestrate collaborative and creative learning” (p. 30). However, just bringing together an interdisciplinary team does not guarantee the kind of learning Guyotte and Sochacka argued for. This could be due in part to the established creativity techniques often used by groups, which are not designed with integrative collaboration as a primary goal.

Design thinking is perhaps the most influential creative process applied across disciplines. It can bring together “highly specialized fields of knowledge so that they can be jointly applied to the new problems we are faced with from a holistic perspective” (Friis Dam & Siang, para. 21). Lwerick, Link, and Leifer (2018) described it as a mindset as much as a set of practices. It is driven by curiosity with a focus on people and a methodology

that accepts complexity, experiments and iteration (p. 8). It is entrepreneurial in the sense that it expands "capabilities to create scalable market opportunities in a digital world and in ecosystems" (p. 9). Leifer, founding director of the Stanford Centre for Design Research and founding director of the Hasso Plattner Design Thinking Research Program at Stanford (formerly d.school), also emphasized systems thinking, process awareness, networked collaboration, and self-reflection (p. 9).

There are five steps in the design thinking process: empathy with the people facing the challenge and the context in which they exist; defining the challenge to create a problem statement and point of view; ideating to develop solutions; prototyping the iterative artifacts; and testing them with users to refine solutions and prototypes (Friis Dam, 2022). Similar to other creative processes, it is designed to be adapted and adjusted and contains overlaps with other creativity-enhancing techniques. Design thinking is the predominant creative process used by universities, business schools, and companies. While many stages generate dialog between teams and can result in dialogic collaboration, the process does not focus on integrating interdisciplinary perspectives into a cohesive whole or teaching the skills of interdisciplinary collaboration.

Another idea-generating method of brainstorming widely used within design, business, and innovation is the SCAMPER method. Michalko (2006) wrote that SCAMPER is a collection of nine different brainstorming techniques used to transform existing objects, services, or processes into something new. Each of the techniques encourages divergent and innovative thought, driving imagination and sparking creativity (p. 72). He suggested that finding alternative ideas, as the SCAMPER method does, can help rearrange the components of the problem, allowing an indirect solution to emerge. Alternatively, it may lead to a better starting point or breakthrough idea that solves a different problem entirely (p. 73).

SCAMPER comprises a series of "directed, idea-spurring questions" (Serrat, 2017), originally developed in the 1950s by Alex Osborn, the person who coined the term "brainstorming." It was later arranged into the mnemonic by Bob Eberle in 1991. As Serrat (2017) notes, it has received attention "as a learning tool that fosters awareness, drive, fluency, flexibility, and originality" (p. 74) that comes from being asked questions not normally considered. The acronym stands for substitute, combine, adapt, modify/magnify, put to a different use, eliminate, and reverse/rearrange.

In addition to design thinking and brainstorming, a third ideation tool commonly used is mind mapping. Within this technique, participants work from a problem statement to add related concepts or solutions nearby, drawing lines between ideas to note connections. It is a layering technique that enables participants to visualize the relationships between ideas and between problems and solutions (Yan, Lee, Hui & Lao, 2021). While there are many

other techniques and ideation processes available, these three are commonly used when collaborating across teams and disciplines. However, they do not focus on the skills of collaboration, as they are outcome and idea-driven. Often, they produce a mosaic of ideas rather than cohesive ideas that have integrated multiple perspectives. The study exploring how faculty can teach and promote creative collaboration across disciplines follows directly from this point of friction between established practices and the need to teach the deep processes of creative interdisciplinary collaboration.

RESEARCH METHOD

The research was designed as a qualitative case study, which "facilitates exploration of a phenomenon within its context using a variety of data sources" (Baxter & Jack, p. 545). A strength of the qualitative case study method is that it allows for the complexity of the topic of creativity to be explored through a variety of lenses, "which allows for multiple facets of the phenomenon to be revealed and understood" (Baxter & Jack, p. 545). Following Stake (1995) and Yin (2003), the approach to the case study was based on a constructivist paradigm, which recognizes that truth is relative and based on one's experience and perspective. This methodological approach acknowledges the role of the researcher(s) in the coconstruction of meaning and requires "a reflective and transparent process" through the use of analytic memo writing (Alzaanin, p. 1634).

The case study involved data collection from a variety of sources that were analyzed using a constructivist grounded theory technique. The line-by-line analysis uncovered categories, themes, and patterns emerging from the case study data. Along with the integration of literature, these data were used to develop a conceptual framework of creative interdisciplinary collaboration (Alzaanin, 2020; Mfinanga, Mrosso & Bishibura, 2019). The conceptual framework was then used to create a process model for facilitating creative idea generation in interdisciplinary teams. The process model was applied in three workshops called "Creativity Labs" (Lab for short). The Creativity Lab process model was iterative, meaning that as data were collected from each workshop, the process model was updated to improve it (Srivastava & Hopwood, 2009).

After receiving Ethics Board approval, faculty focus group participants were recruited by email. All faculty at the university were invited to participate, including tenured, pretenured, permanent, and sessional faculty. A response to the recruitment email along with a signed letter of consent confirmed their voluntary participation. A series of questions were sent to participants via email before the focus group (Appendix A). The 90-minute focus group was held on Zoom on September 10, 2020. Ten faculty members participated from the following disciplines: graphic and digital

design, visual arts, business, communications, professional studies, English language studies, agricultural technology, computer science, and biology. The focus group discussion was semistructured with broad, open-ended questions (Appendix B) and was recorded.

Analytic memos were written by the research team directly after the focus group, reflecting on the experience and process. The recording was transcribed and analyzed using grounded theory analysis. Line-by-line coding produced the initial codes, which were then further analyzed using focused coding to categorize the most significant and frequent codes, emergent patterns, and themes. A third round of theoretical coding was completed to consider how conceptual categories related to one another. These were synthesized into more theoretical core categories (Alzaanin, 2020). After each round of coding, the researchers wrote analytic memos reflecting on their observations, assumptions, working definitions of codes and relationships between them to help with transparency. The coded data and analytic memos were used to craft the conceptual framework, which was emailed to participants as a means of member checking.

The conceptual framework, along with integrated literature on interdisciplinary creativity, was used to generate the Creativity Lab process model, both of which are described in detail below. The process model was applied and tested in three workshops called Creativity Labs. Each Lab had a real-world problem that interdisciplinary teams of university faculty, staff, and students worked on. Recruitment for the Labs was conducted through email and advertisements in various internal newsletters. Participation was voluntary and open to all members of the university community. At the end of each workshop, feedback was solicited from the participants (Appendix C). Researchers also reflected on their experience and observation directly after each Lab through analytic memos.

Data from the feedback and analytic memos were used to create each subsequent iteration of the process model. Data from Creativity Lab One, along with a university-wide anonymous survey administered on SurveyMonkey (Appendix D) and recruited through email, were used to create the next iteration of the process model, which was applied to Lab Two. Participant feedback and analytic memos were applied to the final iteration of the Creativity Lab process used in Lab Three. The final iteration of the Creativity Lab process was also checked against literature related to enhancing interdisciplinary creativity in digital spaces. The iterative approach was taken to both respond to the data emerging from the application of the process and to promote the credibility, dependability, and transferability of the Creativity Lab process.

RESULTS

The conceptual framework for creative interdisciplinary collaboration was generated through a faculty focus group comprised of representatives from graphic and digital design, visual arts, business, communications, professional studies, English language studies, agricultural technology, computer science, and biology. It comprises five interconnected principles: inherent creativity, collaboration, environment, structure, and facilitation.

Principle 1: Inherent creativity

Livingston (2010) has argued that humans are inherently creative and has long called for us to "anchor creativity in the mission of our educational institutions" (p. 59). Centering creativity in higher education pedagogies would allow us to foster, develop, and refine creativity as a skill. Literature focused on creativity, interdisciplinarity, and collaboration as essential 21st-century competencies seems to operate with an assumption that human beings are, by nature, creative (Mishra & Mehta, 2017). While there was agreement in the faculty focus group on this basic level of creativity, there was also discussion that only some people or disciplines are considered creative. Expressing this, one participant claimed, "I don't consider myself to be the world's most creative person…I can't draw, I can't dance, I can't sing. I can't do anything like that. I can't creatively write, I can only academically write." Within this perspective is an assumption that creativity looks a certain way (drawing, dancing, singing, or creative writing) and that some people are creative while others are not.

Runco (2012) and Bruno and Canina (2019) offered a counter perspective where "creativity is an ability to discover something new, to adapt the available knowledge purposefully and solve the problems originally, flexibly and effectively" (Bruno & Canina, 2019). Other participants agreed, noting that within the focus group, they were witness to "a huge variety of what creativity means when it's discipline specific." Exemplifying this, one participant from agriculture said that for some well-researched technical processes such as mixing chemicals, creatively adjusting formulas would be dangerous. However, they also noted, "Creativity comes into it in the problem-solving end and so we want to train our students to be creative problem solvers. So there are those places where we really try to teach creativity and to think outside the box."

Within the focus group, faculty revealed friction around definitions of creativity. Addressing this, one participant stated, "It seems like we need to break down some preconceptions about what disciplines are creative and what disciplines are not creative. I think that would go a long way for say,

science students, who then realize that they too are creative." Faculty also uncovered an expanded understanding of where and how creativity can become visible within processes, problem-solving, and as an orientation to the world. This runs across disciplines. As one participant expressed, "Your content may be different but you're still wanting to get people to think in a different way or turn the problem around and see it from a different perspective or make a connection."

Extending from this, the conceptual framework of creative interdisciplinary collaboration is grounded in a fundamental acknowledgment of inherent creativity. As the focus group revealed, creativity needs to be defined by the people using it, but it exists within all people and disciplines. Faculty in the focus group also emphasized that while higher education may be siloed into disciplines, the world, increasingly, is not. The problems and challenges our world is facing reach across disciplinary boundaries. Tackling these problems requires skills of collaboration, which is the second principle in the conceptual framework.

Principle 2: Collaboration

The data indicate that interdisciplinary collaboration within higher education could offer practice for work outside of academia, where work and life are not siloed but are inherently interdisciplinary and collaborative. For the research participants, collaboration contributes to expanded thinking and the development of new perspectives. This often results in more innovative, original, and effective idea generation. In the words of one faculty member, "It's like cognitive dissonance that all of a sudden—what makes you uncomfortable or your brain is having a hard time trying to handle—that's where the creativity comes out. You start seeing in a different way."

However, there are very real challenges to successful collaboration. As one participant suggested, "Sometimes if you're doing a project and different disciplines are involved, sometimes we tend not to take ownership of the whole project but take ownership in the silos and that can create a huge problem." Responding to this, another person noted, "Most of the people who are successful within a field, and by that, I mean that they have been able to build professional careers based on the skills they are learning within a university education, are truly practicing a collaborative approach…and a lot of that I think comes or stems from being able to ask the question what does the work need? It allows a more expansive approach to problem-solving."

Discussing collaboration, the focus group observed that people feel comfortable and inspired in different kinds of groups. Some prefer calmer groups; others prefer more frenetic energy. As such, giving choice and being flexible about the kind of grouping or being attentive to the amount of time spent within a certain kind of group energy is important. The faculty also emphasized that in their experience, people often need time to ruminate

individually or to have time to mull over problems or ideas before collaborating with others. While attuning to group energy and the combination of solo and collective work is clearly related to the principle of collaboration, it is also connected to the environment or atmosphere in which the work takes place.

Principle 3: Environment

The conversations showed that for many people, safety and comfort are components that allow for creativity to happen. One participant described "For me, having safe space where failures are kind of like expected or acceptable is something that helps foster creativity." Others added that physical comfort along with having comfortable objects or spaces to work in is important. What this showed was a blurred line between physical space and atmosphere. One person pointed out how problematic it can be when individual opinions about the environment or atmosphere are voiced. They expressed that "the sort of red flag moment in the question is that the specificity of it relies on who's contributing." They pointed out that when people start getting prescriptive about what environments foster creativity, we enter exclusionary terrain since not everyone shares one sense of comfort or safety. For them, a better option is to consider a "nonprescriptive environment."

Where participants all seemed to agree, however, is on the importance of making room for experimentation and failure. Where or how that occurs may be specific for each discipline. For instance, safe space may be built into rubrics or scaffolded into assignments, and it may be encouraged through thinking processes that enable students to decide on the right or wrong answer or by promoting divergent answers to a single problem.

Considering the interdisciplinary significance of this principle, the environment in which work happens contributes to both the level of collaboration and the level of creativity generated. Participants pointed to an environment where people can try, experiment, fail and not be penalized as important. Environments that emphasize process over product and encourage risk-taking as well as out-of-the-box thinking were highlighted. While participants noted that each person can identify the environment or atmosphere that best serves their creative process, they also reflected that facilitators need to create a flexible space for this to happen. One participant astutely commented that perhaps what should be focused on is "teaching creatively…in other words, if the instructor is creative, then all else follows." They also pointed out that emphasizing the critical thinking aspects of creativity is important, especially in disciplines that do not identify as creative and instead value rationality and logic. Having conversations about where disciplinary creativity exists and the ways it is paired with critical thought

were important dimensions of the conversation. This pointed to the importance of the next principle—structure.

Principle 4: Structure

For the faculty in the focus group, creativity can be enhanced by specific structures, methods, and perspectives. Prominent was the idea that across disciplines, creativity is about seeing and thinking about questions or problems from new perspectives. Creativity is also about promoting divergent responses and processes, as well as "effectiveness, innovation, and originality." Consideration of the skills and abilities a person has and then selecting or combining them to create or make something new or useful also generated agreement across faculty. One participant described the structure of "bookending" where students first learn technical skills, which "gives students the power of choice," coupled with "thinking about the conceptual, which is *how* to choose." For this instructor, "It's not about a kind of convergence toward an answer but almost flipping that …we're actually looking for divergence in thought." Additional structures such as the ideation process, along with the risks and failures that come with it, were also noted. Across disciplines, importance was also placed on asking questions to generate ideas and options that a person can then apply critical thinking to.

For some faculty and disciplines, clear structures such as rubrics within a class can help ensure that process, ideation, failure, collaboration, and originality are a focus, but other faculty felt that they hinder creativity. This tension was noticeable, and it may fall along disciplinary lines or pedagogy, but it was also generative, as it prompted discussion about the need for choice to increase engagement. One participant championing this argued, "I think across disciplines allowing students to have some agency over any project they're doing is probably a fundamental way to achieve any form of creativity."

For most faculty, importance was placed on process. Structures to achieve this include teaching disciplinary methods to think about situations, ideas, material, ideation, and failure. It also includes teaching how to question and dig deeper. Other elements of structure include creative problem solving, established creative processes, ideation, and critical thinking. Structures that can enhance creativity across disciplines are a critical component of creative interdisciplinary collaboration, and often they require or are enhanced by facilitation.

Principle 5: Facilitation

Guiding people through the processes and mindsets that promote creative ideation and problem solving allows students to generate multiple ideas that can then be pared down, tested, or selected with critical thinking. Facilitators also directly impact the working environment within which

collaboration takes place. They act as curators of the kinds of activities undertaken by the group. As one participant noted, "We need to create spaces within our curriculum and within our programs and with our teaching where students can be expressing creatively." Facilitators drive conversations and structures that define and put boundaries around definitions of creativity. Woven throughout the focus group was an emphasis on the role that faculty or facilitators play in creative interdisciplinary collaboration. In one way, facilitation can be seen as a component of each principle but was highlighted as a specific principle to emphasize its importance. Springboarding from the significant role that facilitation plays in fostering creativity across disciplines, the Creativity Lab process model was developed.

Creativity Lab Process Model

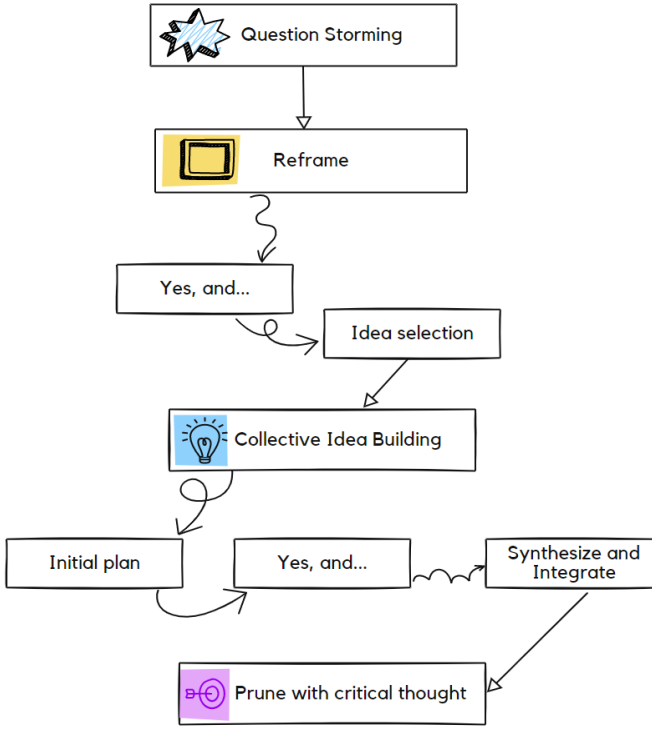
Moirano, Sánchez, and Štěpánek (2020) identified four process models for creative interdisciplinary collaboration, which provided context for the Creativity Lab process. The first model is the Room of Opportunity, described by Ness and Søreide (2014). It emphasized that groups must actively integrate different perspectives, especially at the start of the collaboration. Also noted was that this process takes time and requires participants to learn from one another. Second, a process emerged from the maker movement, which celebrates creativity and "explosions of inventiveness," called the Learning in Tinkering Framework. It was articulated by Bevan, Petrich, and Wilkenson in 2015. Their process focused on dedicated environments for creativity, embraced iteration, scaffolding, and development of understanding, along with an ethic of personal initiative and intentionality (p. 32). A third framework proposed by Li and Liu (2015) investigated the relationship between knowledge diversity and creativity, while the fourth model, proposed by Edmondson and Harvey (2018), explored the elements necessary for dynamic innovation across teams. Called Cross-boundary Teaming, this process emphasized the need for knowledge integration when collaborating across knowledge boundaries. Each of these process models offered a way of framing creative interdisciplinary collaboration in various environments. Except for Learning in Tinkering, all of the processes focus on longer-duration collaboration.

The conceptual framework generated by this project, along with key insights from the literature on creative interdisciplinary collaboration, is combined to propose a fifth process model called the Creativity Lab process.

The Creativity Lab process, described in detail below, offered scaffolding to enhance creative idea generation and integrated the perspectives of an interdisciplinary team. The process aimed to create cohesive, interdisciplinary project ideas or solutions to a real-world complex problem. It focused on collaborative idea development that is not built into the other process models or established creative processes such as design

thinking or brainstorming techniques. It was also structured in a way that drew out participants' situated knowledge, skill, interest, and disciplinary perspective, in addition to their positionality as a basis for understanding the anchoring problem. The process went through three iterations, and each iteration was applied in a Creativity Lab workshop. The basic Creativity Lab process remained intact throughout the project but was tweaked, improved on, and tested in each subsequent iteration, informed by participant feedback and researcher reflections through the analytic memos.

Figure 1: The Creativity Lab Process Model



In the Creativity Labs, participants were placed in curated, interdisciplinary teams of five to seven people that included university faculty, staff, and domestic and international students. Each Lab was framed by a specific, complex, real-world problem communicated in the form of an anchoring question.

The first stage of the process was a question-storming activity where participants generated as many questions as they could about the framing questions. This was a timed activity, and facilitators encouraged participants to generate "what-if" or disruptive questions, as well as questions that helped them to see smaller components of the problem. This activity was completed on whiteboards where all participants could see the questions being generated.

They were also prompted to write down questions that sparked off of the ones they could see. At the end of this activity, after reading all of the questions generated, participants selected two questions – one what-if question either written by themselves or another person and one question written by someone else.

The second stage of the process was a reframing activity. Participants were instructed to translate the questions they had chosen into a new iteration of the question that drew from their disciplinary knowledge or specific perspective. Then, people were asked to generate as many answers to their reframed questions as possible. This work was done individually in notebooks and used time pressure to both stimulate and boundary the activity. For the second half of the activity, participants selected one of their reframed questions and their top three answers to it and wrote these on the whiteboard.

The reframed questions and answers were presented to the group. Each question and answer grouping went through a round of "yes, and…," a theatre improvisation-based game. Participants were instructed to build on the answers by contributing ideas that were introduced with the phrases "yes, and—," "that makes me think of—," or "I wonder if—." Additional questions, comments, ideas, and solutions were documented on the whiteboard by the facilitator, who also encouraged participants to make connections between them. At this point, the facilitator also started to shift the language used, instructing participants to start considering answers as possible project ideas.

The third phase of the process was called collective idea building. To begin, participants were instructed to select one answer or idea, and they were prompted to choose something interesting or exciting to them. They could choose any idea regardless of who had contributed it. Participants wrote their selection on the whiteboard and individually worked to quickly sketch out the project idea and a brief project plan from their perspective. After a short amount of time, the group came back together, and the project ideas were further developed using another round of "yes, and…," to which all team members contributed. The facilitator took notes of all contributions underneath the original idea and plan sketch. This resulted in an idea that had all team members' contributions integrated into it. In the last parts of the collective building phase, participants were asked to select one project idea, either the one they had just worked on or one from someone else, and to synthesize and integrate all of the ideas and perspectives that had been generated. This was done individually and resulted in large, unwieldy, complex plans.

In the final stage, participants were asked to prune the ideas with critical thinking and analysis, along with their disciplinary or personal expertise, to develop a feasible project plan. These project plans were presented to the rest of the team.

DISCUSSION

The Creativity Lab process was iterative, and after the initial Lab, it was adjusted each time to respond to participant feedback that was solicited at the end of each Lab. Participants were instructed that they could offer oral feedback that was recorded or written feedback through email about their experience with the Creativity Lab process as well as the strengths and weaknesses they perceived and how they would change the process (Appendix C).

In the feedback for Lab One, participants discussed how facilitators modeled deep listening and fostered greater collaboration between participants. Participants also emphasized that working with people from different disciplinary perspectives was important for generating new ideas. The framework provided a scaffolded process through which ideas could be transformed and built upon related to the participant's specific discipline. Participant feedback indicated that the combination of having an attentive moderator, a group of diverse individuals, and a structure that encouraged building and expanding ideas led the Lab to be more of an "organic" conversation that felt "easy and not forced." For one participant, the structure allowed them to "automatically and naturally build off of ideas…it sprung other ideas." Another participant mentioned, "I appreciated hearing the ideas from the other participants and felt our group worked well together… it was a testament to the power of working in groups." Participant critiques of the first Lab process were primarily focused on the technical difficulties of working on Zoom and using the Zoom whiteboard, as well as the Lab feeling rushed at the end.

To adjust the process for Lab Two, the feedback was incorporated along with the results of a university-wide survey that asked three questions about creativity (Appendix D). The survey had fifteen respondents whose contributions resulted in five key themes. First, developing new approaches to ideas and questioning can help drive original and innovative thinking but also imagination, action, and application or experimentation. Second, collaboration is critical to seeing things from different or alternative perspectives and can come from meaningful dialog with people or ideas. Third, to have positive collaboration, there needs to be a safe, respectful space or structure to what you are doing. Fourth, established methods can be used to fuel the creative process. Fifth, facilitation is a very important component – visible in how a workshop or class is designed, the processes used, and the activities included to develop creativity, imagination, connection and concept building, and to promote collaboration (of ideas, or with students and community partners). Facilitators can foster inspiration and encourage the use of intuition.

The feedback confirmed that the process was useful, as it had already been designed to address many of the themes emerging from the survey, but there were nuances in the survey results that we used to adjust the second iteration of the process. The facilitator's script was adjusted to remind participants to use their impulses and intuition, and they were cued to mention the importance of selecting a question posed by another participant for the reframe activity to enhance collaboration. A section was added where participants could use the SCAMPER brainstorm method, which is an established creative process, to increase their creative idea generation. After Lab Two, researchers again gathered participant feedback, which was used to adjust the framework for the next iteration.

Participants in Lab Two had much of the same feedback as those in Lab One. Although they had to work within a limited time frame, more than one participant noted that the speed at which they worked encouraged them to "keep moving and let [them] be more generative than [they] would normally be." One person stated that although the time constraint meant that only one part of the problem was addressed, their group's discussion was deeply meaningful. This resulted in more impactful and concise solutions compared to if they had approached the entire problem. As in the first Lab, the role of the facilitator was highlighted. Participants also commended the support and encouragement of the facilitators in creating a space in which people were open to relating to each other's points and building off of one another instead of presenting disjointed ideas one by one.

The feedback from Lab Two was combined with an additional focused literature review on enhancing creativity in digital spaces. This allowed the researchers to check the Creativity Lab process against specific techniques and best practices for enhancing creativity in interdisciplinary teams in online environments.

The literature described "diffractive switching" (Cook, Major, Warwick & Vrikki, 2020), which is similar to problem-based work as well as the challenges of reframing a problem and working with other people's ideas. Referred to as "ill-constructed challenges," it forces participants to think outside the box, fill in gaps in knowledge, and create suggestions without many constraints. This confirmed the approach within the Creativity Lab process as well as the size and scope of the problems being worked on. Pluralities, participation, playfulness, and possibilities (Craft, 2014; Walsh, Chappell & Craft, 2017) were emphasized, which reflected and confirmed many stages of the process model.

What some literature called "appropriation," or putting things to new uses, was also embedded in the reframing and selection activities in Lab Two. Relatedly, Walsh et al. (2017) explained how gamifying is a common theme in enhancing digital creativity, which can be seen as applying methodology across disciplines. The Creativity Lab process included this by giving

challenges to complete in short time frames and using the theatre improvisation game "yes, and…" as a participant response and building activity. Additionally, when participants were asked to describe what success and failure looked like in the project plans, they needed to adopt a game-based understanding of the project where there is a clear winner and loser who achieve those positions based on specific actions. As participants worked on other people's ideas, it allowed what the literature called "freedom of play," where people can engage in different ways than their disciplines may normally allow (Bruno & Canina, 2019). The literature also emphasized the importance of "transformative modes" (Swirski, 2012) where people could create a collective vision. The researchers determined that this occurred at multiple points in the Creativity Lab process.

Participant feedback and literature review findings were used to adjust the framework for Lab Three in four ways. First, the SCAMPER section was removed since none of the participants chose to use it or mentioned it as useful in their feedback. Second, a section for backward planning was added that reintroduced the original problem/challenge to remind participants of the objective and as a reference point for determining success and failure. The third change was to ask participants to take a different person's backward plan and add their expertise to create a second draft of the plan, from start to finish (a forward plan). The fourth small change tasked participants to determine metrics of success and failure in a more traditional sense for clarity.

After the third workshop, participants again reflected on their experience with the Creativity Lab process. Participant feedback provided rich confirmation of the efficacy of the model. In their final reflections, the participants noted the importance of taking a collaborative approach with people who have different perspectives to broaden and refine their ideas. One participant remarked on how "the small group setup and working with people from different academic disciplines helped generate a lot of ideas and different strategies." The term "scaffolding" was used again, along with "laddering," to describe how the process was "logically sequenced" while also having an "iterative component" to the ideas generated. One participant said that "nothing was discarded so we could go back to previous ideas and incorporate them." Multiple participants mentioned how this format allowed them to "build on" and "play off one another's thoughts and ideas without making the initial question feel overwhelming to tackle."

One common theme in the final feedback was how the structure helped participants to expand their thinking and allowed them to see the problem or ideas from new perspectives. While some exercises and activities were relatively simple and commonplace, the way they were combined and facilitated allowed for focused thought about problems and an expansion of ideas to generate more possibilities.

Limitations

The method of using a qualitative case study with grounded theory analysis to generate the conceptual framework of creative interdisciplinary collaboration and the Creativity Lab process model was robust. However, there are inherent limitations to this project. The first is the relatively small sample size within the faculty focus group, Creativity Lab workshops, and survey respondents. Second, specific faculty and disciplinary perspectives informed the conceptual framework and process model. Not every discipline at the university was represented. While the case study findings were supported by the literature, different faculty and disciplinary perspectives would inform the results. Even with this limitation, however, the results are generally applicable across disciplines, as was demonstrated in the Labs. Students and creative practitioners external to the university were not included in the initial focus group, which could also be seen as a limitation to the breadth of the study. Regardless of these limitations, however, the Creativity Lab process model was effective at fostering creative, integrated idea generation across disciplines.

IMPLICATIONS AND CONCLUSIONS

The implications of this process model to enhance creativity, team cohesion, and inclusivity are striking. Educational institutes and industry alike recognize the need for effective collaboration methods and innovative pedagogy. The Creativity Lab process model incorporates and adapts many established techniques, which have been combined in a new way. It is attentive to the ways power operates within groups and deliberately scaffolds to promote greater equity. It offers a variety of modalities and structures for working that blend quieter individual work with more boisterous group collaboration, and it recognizes that part of the creative process is critical thinking. The model embraces an ethic of deep play with time-pressured tasks and specific gamification strategies in both the process structure and facilitator dialogue.

As the literature discusses, although recognized as an important 21st-century skill, opportunities for creative interdisciplinary collaboration are not the mainstay in higher education. However, educational institutions have an incredible opportunity to build the capacity of students to become skilled at collaborations across disciplines. The Creativity Lab process is focused on generating cohesive project ideas or solutions that integrate multiple perspectives from a range of diverse voices. To be able to achieve this, the process also fosters creative confidence in participants, which is important. The world faces incredibly complex challenges, and we need everyone to contribute their skills and creativity to solve them.

A more nuanced aspect of the process is the personal connection it fosters to the problems or challenges being worked on. Beyond developing an assumed empathy for an outside user and the problems they encounter, as one would in design thinking, the reframe activity requires participants to consider the problem through the lens of their personal expertise and perspective, bringing it closer to home. Additionally, the Creativity Lab process encourages plurality, participation, playfulness, and possibilities thinking (Walsh, Chappell & Craft, 2017) through gamification. In that spirit, failure is not generating "bad ideas," but rather, failure is not trying or not generating anything. The process is not a copy-and-paste template for creating ideas. Rather, it offers guidance and tools to create spaces for interdisciplinary creativity to be fostered. The structure works to generate cohesive, integrative, and collaboratively developed ideas from interdisciplinary teams.

Future development of the process should include consideration of structures to promote anti-racism and equity within interdisciplinary teams. Additionally, integrating processes of critical feedback to develop ideas further, paired with principles or mechanisms of nonviolent communication for feedback, could be useful additions. These elements are important to cultivate if the Creativity Lab process is to be used across communities and to address the biggest, most complex problems we face.

CREDIT STATEMENT

Anna Griffith: Conceptualization, Methodology, Formal Analysis, Investigation, Resources, Data Curation, Writing – Original Draft, Review & Editing, Visualization, Supervision, Project Administration, Funding Acquisition. **Hannah Celinski**: Investigation. **Luke Pardy**: Investigation. **Kyla Mitchell-Marquis**: Formal Analysis.

Appendix A
Pre-Focus Group Questionnaire

1. What experience have you had working in interdisciplinary or transdisciplinary teams?
2. What contributes to a successful interdisciplinary collaboration?
3. What is challenging about interdisciplinary collaboration?
4. How do you define or measure creativity?
5. Where does creativity come from?
6. What environments allow you to be the most creative?
7. What does creativity allow us to do?

Appendix B
Focus Group Guiding Questions

1. How does your discipline define creativity?
2. How does your discipline measure creativity?
3. What methods do you or your discipline use to "teach" creativity?
4. How do you assess creativity?

5. What environments contribute to the creative process?
6. What connections do you see between disciplinary approaches to teaching creativity?
7. What obstacles are there in applying methods of teaching creativity from other disciplines to yours?
8. What are the most important best practices of teaching creativity to highlight across disciplines?

Appendix C
Feedback Questions

1. What was your experience with the structure of the Lab?
2. What was meaningful to you?
3. How did the structure of the Lab influence the collaboration in your group?
4. What would you change about the structure of the Lab?

Appendix D
Open Survey Questions

1. What is creativity?
2. How do you foster creativity in students or in research?
3. What interdisciplinary methods do you use that could be applicable across disciplines?

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