An Exploratory Mixed Method Study on Teachers' Creative Skill Development

with Metaphor in Language, Gesture, and Pedagogy

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Abstract

In this exploratory mixed method study we investigated teachers' skill in and use of language-based and enactive metaphor in their own learning and in their instructional design. This study represents a rare, and thus early, exploration of creative multimodal metaphor in the educational context, starting first with teachers. This study builds on the premise that skill development in metaphor should support multidisciplinary instructional design and culturally relevant and responsive teaching for educators. The sample of 53 teachers used gestural metaphor in their sensemaking about abstract and complex concepts and ideas in a variety of unique ways, which could translate to the student context. Findings revealed that (a) teacher training in creativity and arts integration may have contributed to creative skill in metaphor generation, (b) teachers were successful at generating a variety of gestural metaphor to represent abstract concepts about creativity, and (c) metaphoric thinking and acting served as a vehicle for instructional design innovations. In this way, familiarity and skill development with linguistic and enactive metaphor is worthy of continued exploration in the educational context and as a research tool for creative thinking and acting in different modalities. (Word count: 188)

Keywords: metaphorical thinking; enactive metaphor; creative teaching; creativity assessment; creativity training

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According to the emergentist philosopher, John Dewey (1925; 1938), meaning does not draw on what an interaction or object *immediately is* but rather what it *makes possible*. From this perspective, metaphor can be seen as a primary fuel in the meaning-making machinery that makes us human. As a universal communication tool across cultural contexts, metaphor represents the properties of one idea—the subject—through the properties of another idea—the vehicle—which may be completely unrelated (Lakoff & Johnson, 1980). Metaphorical thinking plays a unique role in the creative process across different contexts, modalities, and global cultures; in fact, some suggest generating creative metaphor may be one of the most relevant creative thinking skills to actual creative production in real life (Beaty & Silvia, 2013).

Importantly, the familiar use of metaphor in language is just one form of metaphor; gestural or "enactive" metaphor may be an even more powerful form of metaphor in creative teaching and learning (Gallagher & Lindgren, 2015). Work across mathematics (Alibali & Nathan, 2012; Cook, et al. 2008), science (Christidou et al., 1997; Scherr et al., 2013), and drama-based instruction (Lee et al., 2015) draws a connection between metaphor, embodied cognition, and creativity as a promising path to enhance teaching and learning. Yet, metaphor has been understudied in both the creativity and education fields of research and practice.

In this exploratory mixed method study, we investigated teachers' understanding and use of both language-based and enactive metaphor as they engaged in a professional development experience focused on fostering creative engagement in the classroom. We also analyzed their ideas about ways to integrate metaphor into their instructional design. This three-part mixed method study represents a rare, and thus early, exploration of creative multimodal metaphor in

the educational context. To begin this line of research, we start first with teachers to learn how teachers engage with metaphor in both language and gesture and how they envision using metaphor in creative teaching and learning.

This study's mixed method research design proceeds from the rationale and logic detailed in the following pages of our introduction: if metaphor might be useful in teacher development toward more creative and multidisciplinary instructional design and creative teaching and learning, then (a) teachers should first be able to understand and use metaphor in both language-based and enactive forms in meaningful ways, which should result in (b) improved creative metaphor generation through repeated practice and assessment and, ultimately, (c) useful ideas for how to integrate metaphor in instructional design for creative teaching and learning. To pursue those aims, this study is situated within an early pilot of a teacher training experience that introduces the concept of metaphor and prompts teachers to develop metaphor in different modalities, including language and gesture—the foci of this study.

This mixed method study includes three distinct but interrelated parts that follow that logic train empirically (see mixed method sequence in Figure 1). First, we applied an existing metaphor generation assessment to explore the degree to which teachers' language-based creative metaphor skill might change before and after their training experience. Second, we sought to learn if teachers can be successful in using enactive metaphor in gesture to express their understanding about concepts related to students' creative engagement. To do so, we analyzed teachers' video-based demonstrations of creative gesture completed halfway through the training experience to express the meaning of concepts they learned. Third, to explore teachers' ideas about how to integrate creative multimodal metaphor in teaching and learning, we

compiled and categorized teachers' own creative instructional ideas with metaphor to enhance students' creative learning experience.

Theoretical Framework

How Do We Use Metaphor to Understand Our World?

Metaphor is a meaning-making tool for humans used across cultures to explore and express our understanding, experiences, and perspectives on the world (Gallagher & Lindgren, 2015). As an unconscious process in our regular everyday communication and sense-making (Lakoff & Johnson, 1980), metaphor aids in how we make meaning of abstraction and complexity we encounter using a variety of modalities—language, gesture, full body movement and choreography, sound, and visual imagery, among others. As a figure of speech, metaphor attributes one thing (the vehicle) to an object or action (the subject) to which it is not literally applicable. Take for instance the common phrase *we are running out of time*. Time does not actually run, nor is there actually a finite amount of time we deplete. The phrase expresses meaning of the abstract concept of time by using the physiological action of running to illustrate the feeling of being rushed or being chased. The metaphor grounds a largely abstract notion in embodied experience. This metaphor conveys the emotional and physical experience of time familiar to all. In this way, metaphor moves the meaning of an idea beyond its literal definition.

What is the Difference Between Creative and Generic Metaphor?

Creative metaphor employs novel connections to create new meaning around an idea or object that may spur new thinking and possibilities or shifts in perspective. *I am running out of time* or *time keeps slipping through my fingers* are common or generic metaphors to express the feeling of being rushed. More novel and creative language-based metaphors to convey similar meaning could be *time getting sucked down the drain* or *wishing you could put minutes in an ice*

cube tray to freeze them. As potentially creative metaphor—both novel and effective—these two examples generate new ways of thinking about the idea of time for the creator and receiver. Metaphor allows us to make mental leaps across distinct conceptual domains, for instance, from science concepts to felt emotions and back again, often through conceptual anchors that have strong cultural roots. Take for instance, all the metaphors we use about war when we talk about argument (e.g., ideas get shot down, points are on target, etc.; see Lakoff & Johnson, 1980).

Conceptual Metaphor Theory

Conceptual Metaphor Theory (CMT) provides some rationale and framing for this phenomenon (Lakoff & Johnson, 1980). CMT proposes metaphor is a psychological phenomenon as much as a linguistic one, and that people use metaphor to think and reason about abstract ideas and complex issues, even though they may not be aware of the process as it occurs. CMT has become the dominant framework through which many scholars have investigated the function of metaphor in language and thought (Gibbs, 2011). Conceptual metaphors that reflect a whole system of ideas or way of thinking in a culture are so ubiquitous and ingrained, they often go unnoticed (Daane, et al. 2018). For instance, many clichéd idiomatic expressions about romantic love use the enduring conceptual metaphor of *love is a journey* (e.g., "we're headed in opposite directions" or "our marriage is on the rocks").

It is no surprise that in educational settings, teachers and students use conceptual metaphors regularly and often subconsciously. If teachers can become more aware of these larger conceptual metaphors and the how they shape meaning, explicit teaching about metaphor could lead to more novel and personally meaningful ideas and better understanding about students' different perspectives and lived experiences (Gallagher & Lindgren, 2015). Moreover, the act of

generating new metaphor about common ideas (love) or abstract concepts (time) may be self-expressive and liberatory.

Metaphor pervades speech, text, and sign language (Gibbs, 1994; Lakoff & Johnson, 1980), but also appears in music, dance, theater, architecture, visual media, and beyond. Humans use metaphors in everyday communication to express thoughts, interpretations, and embodied lived experience of emotions. From an embodied perspective, common metaphors help us explore the meaning of abstraction (e.g., *passage of time*) through our physical experience of the world. When we probe this process further, we see how our bodily experiences are filled with metaphoric possibility. Considering the idea of time, again, these experiences can be spatial perception (*stuck in time*), anatomical function (*watching the hand of a clock*), and movement (*racing against time*). In metaphor generation, the body can play two different roles: (a) as a vehicle for new metaphor to explore and explain non-human processes and (b) as the actual modality to find and express new metaphor to represent an idea, in a way off-loading cognitive demand from the brain onto the body as described in embodied cognition (Nathan, 2021).

Metaphor Generation as a Creative Skill

In this study, we suggest that teacher skill development in multiple modalities of metaphor generation can be advantageous in two ways. First, metaphor can be employed at the conceptual level in instructional design where teachers think metaphorically about their content to design an interdisciplinary unit that illustrates the connections between multiple domains (e.g., music and math). For instance, if a math teacher identifies that students struggle conceptually with dividing fractions, she might think about other modalities or disciplines outside written numbers that represent these mathematic principles, such as timing in rhythm or folding patterns in origami. Second, teachers can introduce metaphor generation to students, explicitly, as a self-

directed and creative learning tool for sensemaking of abstract and complex ideas to help

students make their own novel connections (Anderson et al., 2021). Though metaphor has a long

tradition in interventions to enhance learning in science and beyond (e.g., Christidou et al., 1997;

Duit, 1991; Gentner & Wolff, 2000; Winner et al., 1979), the integration of metaphor into typical

instruction remains an underdeveloped aspect of common educational practice (Gallagher &

Lindgren, 2015). We argue that filling this gap begins first with teacher development.

Teachers' own skill in metaphoric competence consists of several abilities, including (a)

the ability to produce metaphors that make sense and (b) the ability to distinguish conventional

metaphors used in everyday communication from novel metaphors, which are more unique and

intentional in the personal meaning they convey (Littlemore, 2001; Wang & Cheng 2016).

According to Silvia and Beaty (2012), unconventional and clever metaphors are among the most

creative uses of language and associative thinking and, in fact, may exemplify real-world

creativity better than other assessment approaches to creativity, such as divergent thinking tasks.

Yet, the study of creative metaphor has received very little attention in the creativity field

compared to other areas, such as divergent thinking (see Reiter-Palmon et al., 2019). This current

study explores the potential of metaphoric skill to serve as a key creative resource for teachers,

and that with explicit training this skill can fuel new approaches to integrate creativity, culture

the arts, and social-emotional learning across K-12 curriculum and instruction.

Though people may use many conventional or generic metaphors in everyday speech,

those metaphors are not likely original or creative. More creative metaphors require intention and

effort. For instance, describing a hard rain with the colloquialism that it is raining cats and dogs

undergoes a more conventional thinking process than describing it as *crashing cymbals* or *the*

clouds' sobbing, each metaphor drawing out different imagery, meaning, and sensory

experience.[1] Creative metaphors are distinctly original uses of language and ideas, where their association to a specific topic may be more remote and challenging to grasp (Chiappe & Chiappe, 2013). Creative metaphors are unique in that neither the creator nor the audience has encountered the metaphor before. To this end, Beaty and Silvia (2013) suggest creative metaphor generation likely draws on executive mechanisms similar to general creative thinking, such as controlling attention during idea generation (Vartanian, 2009; Zabelina & Robinson, 2010) and switching between semantic categories in memory (Nusbaum & Silvia, 2011). Those executive functions differ from the mechanism of working memory functions and vocabulary knowledge, primarily at work in generating quality conventional metaphors (Chiappe & Chiappe, 2007).

Metaphor processing relies on the ability to link disparate conceptual domains and to find the similarity between two apparently unrelated concepts (Menashe, et al. 2020). That specific aspect of metaphor supports the premise that metaphor skill may help teacher and student competency and creativity to make interdisciplinary connections across what they know and learn—from academic objectives to lived social-emotional experience. Moving beyond language-based metaphor, the cognitive and embodied process of generating metaphor to make meaning could provide a strong pathway for culturally responsive practice. Students' can use movement and metaphor from their lives in the process of content acquisition and expression of understanding (Hammond, 2015).

Enactive Metaphor as Embodied Creative Cognition in Learning

Creating, reading, or discussing language-based metaphor about a topic can reveal potential insights for a learner (e.g., discussing the atmosphere as a "blanket" covering the world;

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[1] It should be noted that the colloquialism of raining cats and dogs reveals the historic and cultural nature of metaphors invented and passed on to expressed universally shared experiences for people, such as rain. According to Wikipedia (https://en.wikipedia.org/wiki/Raining_cats_and_dogs) there are dozens of similarly bizarre metaphors about the rain from around the world.

Cameron, 2002). Though this form of "sitting" metaphor may help us along in our understanding, the ideas remain implicit and internal. A growing body of evidence indicates enactive metaphor that requires learners to physically act out their understanding makes the metaphor explicit and active and more powerful for learning (Gallagher & Lindgren, 2015). For instance, students learning English as a second language employ embodied metaphor, naturally, by imagining their bodies as part of actual science and acting it out (Rosebery & Warren, 2008). Substantial research evidence links naturally occurring gesture and movement to higher levels of understanding in math and beyond (see Gallagher & Lindgren, 2015 for review). For instance, elementary school students who pointed to two sides of an equation while explaining arithmetic had better learning outcomes than students who did not use their hands (Cook et al., 2009).

Alibali and Nathan (2012) proposed gesture can play several roles in embodied cognition: (a) grounding the learner in the environment, (b) physical simulation to represent ideas in action, and (c) metaphoric gesture that ground concepts in the body and human experience or play with different possibilities that objects and ideas can take. Some domains, such as scholarship in science education (Amin et al., 2015), have laid new groundwork for theorizing and conceptualizing the role of metaphor and embodied cognition in learning, but, generally, this work needs more development to become actionable to enhance learning and creative outcomes for students. This study begins that pursuit through teacher development.

Context of Study

This *quant-qual-quant-qual* mixed method study aims to extend our understanding of metaphor generation as a potentially important cognitive, embodied, and pedagogical resource for creativity in the education context for both research and practice. The research questions begin first with evaluating the validity and reliability of scores produced by the metaphor

generation tasks prior to training. Second, we analyzed the embodied and gestural exploration of creativity concepts by teachers using enactive metaphor in the course. Third, we evaluated evidence of change in creative metaphor generation skill across two time points. Fourth, we compiled and categorized the possibilities teachers ideated to integrate metaphor into their instruction. The following research questions guided this study:

1. In metaphor generation tasks, to what extent does rater-scored creativity of metaphors correlate with their fluency, flexibility, and originality in divergent thinking and discriminate from their creative anxiety and fixed creative mindset (quantitative)?

2. In their enactive metaphor generation during online training, how did teachers use different metaphoric sources and creative metaphor themes in gestures to explore and express meaning about different creativity concepts (qualitative)?

3. Comparing pre-training levels of creative metaphor to post-training levels, to what extent did teachers improve in their language-based metaphor generation (quantitative)?

4. How did teachers see metaphor as a useful tool for creative teaching and learning (qualitative)?

Methods

This exploratory study follows a mixed method design that aims to maximize the potential for integration of data sources and analytic technique. . Because of the exploratory nature of this study, the emergentist focus on teacher meaning-making with metaphor, and the non-experimental approach to evaluating quantitative change, qualitative and quantitative results carry equivalent status in interpreting and situating findings in relevant theory and practice (Creamer, 2018). The choice for a mixed methods approach to explore the phenomenon of metaphor in different modalities and for different purposes stems from a shared pragmatist

philosophical approach (Anderson, 2018; Dewey, 1999; James, 1907) among the authors to studying and understanding the phenomena of human meaning-making and creativity. We believe combining analysis of language-based and gestural metaphor encourages new ways of thinking about and investigating these culturally universal dimensions of creative thinking and action as synergistic. We aimed to use the final analyses on teachers' ideation for classroom integration to center the implications pragmatically in the context of education.

Sample

Eligibility to participate in the grant-funded project was based on federal requirements (i.e., at least 20% of families with school-aged children in the district lived in poverty). The sample of 53 teachers included two teachers identifying as Hispanic, 51 teachers identifying as white. In the sample, 36 teachers identified as female, 16 as male, and one as gender queer. Teachers came from more than 30 schools, every content area, and all levels of K-12. Teachers had an average of 14.25 years of teaching experience.

Procedures

Recruitment

The recruitment efforts took place during the April–June 2020 period when schools were shut down due to the COVID-19 pandemic. As such, the convenience sample of teachers who selected to participate were likely already interested and invested in creativity and the arts. We aimed to recruit 80 teachers but were limited by the circumstances of the pandemic. As such, the analytic sample is smaller than had been intended, originally.

Teacher Training

Teacher-participants completed the Foundation Course for Creative Engagement and the virtual Summer Institute to gain a research-based understanding of creativity in teaching and

learning through reflective, experiential, and arts integrated instruction and application. Teachers learned and applied a variety of teaching techniques to integrate creative and artistic processes into their instruction and curriculum, starting with brief creative routines. The guiding design principles included making the professional development experience: (a) highly engaging and interactive; (b) grounded in current theory and research; (c) scaffolded challenge and complexity; (d) immediately actionable, adaptable, and relevant to different classroom contexts; and (e) consistently integrated with creative and artistic opportunities and exchange of creative work with peers online (Anderson, Katz-Buonincontro, Bousselot, Land et al., 2022). Participating teachers consented to participate in all research activities and agreed to complete the online course material and attend the Summer Institute to receive payment for their time.

Online Learning Materials. The online Foundation Course (depicted in Figure 2 and outlined in Table 1) included 12 modules, taking approximately 16 hours to complete. Modules included interactive instructional packages with video, narrated slideshows, pop-up interactives, creative exercises, reflective processes, and brief creative assignments. All content was designed, written, and narrated by professional instructional designers with expertise in creativity in education and arts integration. Teachers logged into the online platform and completed the pre-training survey with open-ended and close-ended items prior to starting the course. Project partners sent each participant a sketch journal and a small pack of *metaphor cards* to use in the course, where each card has a clip art image of a common object or scene. Teachers were instructed to use those cards to explore ideas at different stages of the training. Teachers were required to complete each module to proceed to the next. The course was designed to support teachers with useful mental models, language, examples, and routines for exploring the creative process in teaching and learning. For instance, teachers explored their own personal creative

resources (creative attitudes, creative thinking, and creative behaviors; Anderson, 2020) by responding to the question—*How am I creative?*—and creating a metaphoric *creative avatar* collage. They photographed and uploaded their work to share with colleagues and facilitators.

The course content summarized the state of research in education, motivation, creativity, and the arts and applied that research and theory to both personal reflection and immediate integration into teaching and learning. Teachers engaged in an hour-long module focused specifically on metaphor. The professional development experience provided teachers with creative classroom routines to develop students' language-based, image-based, and gestural metaphor skill. Throughout the course, participants were asked to experiment with key concepts and practices, such as structured uncertainty, metaphorical thinking, divergent idea production, and active reflection. Teachers were prompted to consider their journey through the Foundation Course as if it were a river journey, illustrating one way for metaphors to be a gateway into creative learning. About halfway through, teachers were prompted to think of a gestural metaphor to express the meaning of different concepts introduced about creativity. They posted a video of the gestural metaphor along with a brief written explanation, in some cases.

Virtual Summer Institute. The 2-day virtual Summer Institute was hosted on Zoom videoconference software and through the Oba learning management system where the Foundation Course was accessed. The experience provided synchronous presentations from facilitators and pre-recorded presentations that participants watched and reflected on through discussion forums and live breakout rooms. All participants had access to those discussion forums and could read and respond to peers. Only half of the participant sample were able to attend the Summer Institute due to summer scheduling conflicts. Figure 3 provides a timeline of participant recruitment, course engagement and completion, and assessments.

Measures and Protocol

Metaphor Generation Skill

To assess language-based metaphor generation skill, teachers responded to eight topics for metaphor (see Table 2). Each topic included a descriptive property to help teachers think about a metaphor vehicle that might be unrelated to the topic but share that property. Teachers were encouraged to think beyond that property, to elaborate, and to have fun with it.

Rationale for items remaining the same. Metaphor topics were the same in both pre- and post-assessments, which had the benefit of removing the issue of stimulus dependency typical to some creativity assessments but introduced the potential for retesting effects (Barbot, 2019). We chose this approach for several reasons. First, retesting effects in creativity assessments have been found to be ambiguous. On one hand they can reduce the novelty of the cognitive challenge and result in improved results—a positive retesting effect—for participants by calling on rote memory. On the other hand, they can increase the cognitive load through a "double fixation effect"—a negative retesting effect—by requiring participants to inhibit both their prior response and the "prepotent solutions," in this case conventional metaphors (Barbot, 2019, p. 204).

In this metaphor generation task, still in its infancy in research, we believed the likelihood of a negative retesting effect would be higher for generating more creative metaphors than the potential for a positive bias due to the lack of novelty or recall of previous responses. Conceptual metaphor theory illustrates how conventional metaphors have a powerful effect on our language and thinking and require effort to avoid (Lakoff & Johnson, 1980). We did not feel rote memory would play a substantial role in biasing results, given the raters were scoring for aspects of creativity. We felt that any benefit from the lack of novelty would be unlikely to

produce a substantial effect in creative metaphor generation without the input of training. We were more concerned with stimulus dependency effects in using a different selection of eight topics, when there has been no research completed to date with these tasks to define any differential difficulty in topics. Additionally, the training has no other explicit practice opportunities, where teachers engage in metaphor generation in this same format. As an exploratory study, we were more interested in studying if improvement of creative skill in this assessment was possible, regardless of the training experience, so holding the stimuli stable was advantageous. It is still possible that either a positive or negative retesting effect contributed to any change detected, so interpretations must be made with caution.

       Scoring metaphors. We integrated the approach to scoring generated metaphors provided by Silvia and Beaty (2012) and Chiappe and Chiappe (2007). Raters scored on multiple criteria: remoteness, novelty, cleverness, aptness, and creativity. *Remoteness* reflected the conceptual distance of the metaphor vehicle from the given topic. *Novelty* reflected the originality of the response. *Cleverness* reflected the degree to which the response was funny, witty, or interesting. Following the longstanding tradition of the consensual assessment technique (Amabile, 1982; Baer & McKool, 2016), *creativity* was scored based on the subjective perspective of each rater. *Aptness* referred to the degree to which the metaphor was a successful fit or representation of the topic (Beaty & Silvia, 2013). All responses were scored on a 1–5 point scale (1 = low; 5 = high).

       Metaphors from the pre- and post-training assessment were then scored by two raters who were blind to each other's scoring results, and whether they were rating the pre- or post-assessment. The order for assessing the pre- and post-assessment was switched for the two raters. Three items (items 1, 4, 8) from different stages of the assessment were selected to assess the

inter-rater reliability of the two raters for each criterium. Table 3 reports the intraclass coefficient of those three items and the Cronbach's alpha inter-item consistency across all eight items. Results indicated sufficient inter-rater and inter-item reliability across criteria.

Construct Validity of Metaphor Creativity

To evaluate the construct validity (Shadish et al., 2002) of assessed creativity in teachers' metaphors, we assessed teachers' divergent thinking originality, fluency, and flexibility with the *Alternate Uses Task,* their creative anxiety, and their fixed creative mindset.

Divergent thinking. scored teachers' responses to three divergent thinking prompts in the well-established *alternate uses task*. Researchers decided to ask teachers to follow a "Be-fluent" instruction type (Reiter-Palmon et al., 2019) to avoid triggering any anxiety in teachers who might respond negatively to a "Be-creative" prompt. Two raters scored teachers for their fluency (number of ideas generated), flexibility (number of different conceptual categories among the ideas), and originality (the novelty and uncommonness of the ideas generated as an ideational pool) following the approach in past research (Reiter-Palmon et al., 2019) at the post-training assessment stage. Reliability was good for each factor across the two raters and three items: (a) Fluency $\propto$ = .83; (b) Flexibility $\propto$ = .80; and (c) Originality $\propto$ = .82. Teachers' creative anxiety and creative fixed mindsets were included to identify the degree creative metaphor skill contrasted with these constructs, both identified as barriers to creative action in past research with teachers (Anderson et al., 2021; Anderson, Katz-Buonincontro, Bousselot, Mattson et al., 2022).

Creative anxiety. Creative anxiety was measured with four items from the Creative Anxiety Scale using a 1-to-5 scale with 1 = Not at all and 5 = Very much (Daker et al., 2019), which achieved a Cronbach's alpha of $\propto$ = .83. Teachers were prompted to respond to four

different situations with how much it would make them feel anxious (sample item: *Having to come up with a unique way of doing something*).

Fixed creative mindset. Fixed creative mindset was measured using four items from a revised version of an extant instrument used with a similar population to ensure greater reliability and alignment to mindset theory (Hass et al., 2016; Anderson, R.C., Katz-buonincontro, J., Bousselot, T., Mattson, et al., 2022). We used the subconstruct targeting self-theory fixed creative mindset (sample item: *I have a certain amount of creative potential, and I can't really do much to change it*) with a Cronbach's alpha of $\propto$ = .88.

Metaphoric Gesture

After receiving some examples and instruction about using creative metaphoric gesture to learn new vocabulary, teachers were prompted to choose one of the concepts recently presented in the course (e.g., autonomy, belonging, competency, structured uncertainty, risk-taking, etc.) and upload a short video of themselves making a gesture to represent that new idea to a discussion forum. Teachers were also asked to share ideas in writing about how they might use this process with their students.

Mixed Method Data Analysis

We used a convergent mixed method research design (see Figure 1; Creswell & Plano-Clark, 2018) to explore different aspects and modalities of creative metaphor generation skill with teachers with distinct analytic approaches for each phase and type of data. First, we used bivariate correlations and within-subjects analysis of variance (ANOVA; Pedhazur & Schmeklin, 1991) to respond to Research Questions 1 and 3. We report effect sizes, statistics, and Cronbach's alpha internal consistency in Table 4. Raters were blind to whether the teacher responses were from the pre- or post-training data collection phase.

To address Research Questions 2, two authors conducted a thematic analysis of the teachers' video-based gestures, grouping them by the vocabulary term chosen as the subject of the metaphoric gesture. The researchers followed a similar approach used in past mixed method research, where the gesture is described with text and that text is treated as transcription data to code (Katz-Buonincontro & Anderson, 2020). The analyses used memoing about specific details of each respondent's gesture to incorporate the emergentist perspective (Dewey, 1925) and a phenomenological approach to meaning-making of human experience (Gallagher & Zahavi, 2021) with the aim to understand the meaning conveyed through the metaphoric gesture. Those methodological traditions informed an analytic framework, similar to that used by others (Scherr et al., 2013), where the phenomena of interest (i.e., creativity concepts) are the bases for meaning-making, and the intentional gestures participants make illustrate their individual embodied interaction with the abstract idea, the environment, their felt experiences, and the mechanical and aesthetic affordances of their bodies. In addition to describing the gesture and meaning conveyed, the researchers coded each metaphoric gesture as (a) common/uncreative or novel/creative and (b) representative of an *action* associated with the selected concept or "metaphoric" of *properties* of the selected concept. Because the sample was generally small for each concept, these analyses are exploratory and not meant to generalize beyond the sample. As part of that cross-data exploration, we analyzed the correlations between teacher creativity in generation of gestural metaphor and linguistic metaphor.

To address Research Question 4, one researcher compiled the range of classroom implementation ideas produced by teachers at three different time points in the professional development experience to compile and describe the possibilities teachers imagined for

meaningful integration of metaphor in teaching and learning. The researcher grouped the ideas

for the role of metaphor in teaching and the role for metaphor in learning.

Results

Results for each research question are detailed sequentially below with analytic details

aligned to each method. We conclude with a mixed method integration of results.

Did Metaphor Skill Demonstrate Concurrent Validity?

Concurrent validity appeared to be high based on cross-sectional data from the second

post-training time point. Bivariate correlations with the rated creativity of teachers' metaphor

demonstrated some convergent and discriminant validity. Divergent thinking fluency ($r = .54$, p

<.001), flexibility ($r = .64$, $p < .001$), and originality ($r = .63$, $p < .001$) each demonstrated large

correlations with teachers' metaphoric creativity. Teachers' creative anxiety ($r = -.36$, $p = .009$)

demonstrated a medium negative correlation with metaphoric creativity. Teachers fixed creative

mindset did not demonstrate a statistically significant correlation ($r = .15$, $p = .027$).

What Metaphoric Gestures Did Teachers Produce?

Teachers incorporated a variety of themes and vehicles to explore and represent the

meaning of different creativity concepts they chose from the training, including autonomy

(29%), belonging (33%), competency (24%), creative ideation (5%), risk-taking (3%), tolerance

for ambiguity (3%), and structured uncertainty (3%). Teachers chose the concept of "belonging"

most frequently to explore with creative gesture. This concept produced the most consistent

gestural vehicles or themes of *encircling* or *interlocking*, which teachers expressed with a variety

of hand, arm, and full-body movement. For instance, one researcher annotated a gestural

response as "the participant smiles then raises hands to face height with palms inward and all

fingers extending outward, fingers overlap starting with pinkies and resolve in a clasping shake."

Though the enactive metaphor vehicles of encircling and interlocking were common across many teachers' responses, teachers added unique gestural elaborations to explore a variety of themes detailed in Table 5. Raters found the line between metaphoric and representational to be frequently ambiguous. For example, one gesture for belonging involved crossing arms across the chest, squeezing shoulders and wiggling side-to-side. One coder interpreted this gesture to be a hug—representational—and the other interpreted this gesture as metaphoric of a safe place.

Autonomy

Teachers produced a wide variety of gestures to explore the meaning of autonomy with themes such as dancing with oneself, resisting pressures from others, protecting against threat, and being able to physically move in flexible ways. Of the concepts addressed, autonomy appeared to yield the broadest variation of personal meaning across teachers. While many of the gestures for autonomy evoked ideas like strength emerging from the support of others (i.e., many fingers moving in concert followed by one finger rising independently), other gestures seemed to be in opposition to or protection from external forces that might challenge autonomy (i.e., drawing a box shape around one's head).

Of the 11 participants who created a gesture for autonomy, the three male teachers made a gesture that evoked personal physical strength, resistance to authority, or protective self-preservation—all political themes. Generally, these gestures were also more aggressive than the gestures generated by the female teachers. One of these male participants wrote this description for his gesture:

> Hold up your hand with five fingers spread out. With the other hand, point to each
>
> finger in succession with a firm look on your face as if you are ordering it to do
>
> something. As you point to each finger, slowly lower that finger until you get to

the last finger on your hand. Point several times at that finger, but have it refuse to

lower as the other fingers did.

Autonomy for him exists in contrast to authority. These subtle differences highlight the many

sources of meaning that gestural representations incorporate, and how they might reveal

philosophical underpinnings to the pedagogy of a teacher. It is possible that these male teachers

approach teaching with a more authoritarian style. One researcher annotated another male

teachers' gesture as "his left-hand clenches fist, brings thumb to center of chest, raises clenched

fist above left shoulder while flexing arm muscles; mouth turns down." In contrast, the female

teachers incorporated a variety of vehicles to represent autonomy reflecting themes such as

independence, interconnectedness, growth, and creation from multiple forces. One researcher

annotated one teacher's response that incorporated some of these themes as

Lifts hands in front of chest, wrists toward each other, hands alternating and

rotating clockwise 2 rotations while fingers extend outwards. Hands come

together forming hollowed space, right hand extends upward into upright rigid

extention, while left forms a resting platform, abrupt downward jerk with hands in

'plinth and platform' shape, right hand points index finger at camera while left

hand remains as supporting platform.

Ratings for Metaphoric and Creative Gestures

Across the 42 gestures that were rated, two researchers were able to code for the gestural

metaphor being representational or metaphoric with 98% agreement after hashing out three cases

with initial disagreement. They were able to code for gestural metaphor being novel/creative or

common/uncreative with 95% agreement after hashing out three cases with initial disagreement.

Overall, based on these ratings, the frequency of creative or metaphoric gesture appeared to be

slightly higher than generic or representational gesture. Twenty-five out of 42 gestures, or 60%, were rated as creative. Additionally, 28 of the 42, or 67% of gestures were metaphoric compared to physically representative. Though exploratory, this additional coding and analysis provides some evidence of feasibility and utility of this analytic approach to assess an embodied approach to creative metaphor generation. The creative and metaphoric gestures provided another process and form of meaning-making and expression for teacher participants in their understanding of foundational concepts related to creative engagement. As an exploratory step, we analyzed the correlations between creative and metaphoric gesture and the creative linguistic generation and found no statistically significant correlations.

Did Teachers Improve Metaphor Creativity and Metaphor Quality?

Within-subject ANOVA tests were conducted; statistics are provided in Table 4. Prior to conducting analyses, distributions and plots of standardized residuals were visually inspected to test the assumption of normality and homogeneity of variance; no issues were detected. Creativity increased at a statistically significant medium effect size, Cohen's $d = 0.54$. Remoteness increased at a statistically significant very large effect size, Cohen's $d = 1.17$. Novelty increased at a statistically significant medium effect size, Cohen's $d = 0.57$. Cleverness did not increase at a statistically significant level. Aptness increased at a statistically significant small-to-medium effect size, Cohen's $d = 0.31$. The composite score that included a mean of all criteria increased at a statistically significant medium effect size, Cohen's $d = 0.57$. Remoteness demonstrated the largest increase from pre- to post-assessment—an effect size more than twice as large as the effect detected in novelty and creativity, the next largest changes. This finding suggests the possibility that at post-training assessment, teachers may have made the largest improvement in their ability or effort to identify metaphor vehicles that were more distant in

association from the topic. Interestingly, the mean level of aptness and remoteness was nearly identical at post-assessment. Table 6 presents samples of the pre- and post-training assessment responses for each topic from one participant per topic, selected at random.

How Did Teachers Envision Integrating Metaphor into their Classrooms?

At the end of the Foundation Course and then at the end of the summer institute, teachers were asked to design an activity for their classroom using creative strategies introduced. They shared ideas through an open discussion forum in the online training platform. Through inductive coding we found a substantial number of teachers contributed ideas that incorporated metaphor at two distinct levels: (a) how metaphor could guide their instructional and curricular design and (b) how metaphor could drive the student learning experience. Table 7 presents eight teacher examples to illustrate how teachers made sense of the affordances of metaphor within the classroom and began to imagine possibilities.

Among these early-stage innovations, there are several noteworthy insights that emerge. First, several teachers used an over-arching metaphor for their learning unit to provide a variety of imaginative and creative opportunities for students to engage and explore. For instance, a high school English teacher envisioned his whole yearlong class as a *metaphorest* that students would *enter*, using metaphorical thinking to link survival tools for the forest to literary analysis techniques. Bringing this level of imaginative play into a high school classroom is noteworthy. Other teachers paralleled this idea within their context, envisioning how they could invite students' creativity into distance learning through an overarching metaphor of exploration. Two teachers gravitated toward the potential of metaphor as a tool for emotional awareness, expression, and skill development. Two teachers envisioned helping students learn vocabulary and abstract concepts with metaphor. One of those teachers focused on linguistic metaphor and

another sought to replicate the gestural metaphor exercise they completed in the course for learning new vocabulary, engaging the enactive gestural metaphor modality for science learning.

Integration of Mixed Method Results

Results from each part of this mixed method study integrate on several dimensions. First, creative linguistic metaphor generation correlated positively with divergent thinking and negatively with creative anxiety suggesting some validity as measure of creative performance for teachers; however, creative linguistic metaphor did not correlate with gestural creativity and metaphor in this exploratory study, suggesting enactive metaphor may draw on distinct creative process from linguistic metaphor. It is also possible that teachers responded differently in the prescribed topics and properties provided in the linguistic metaphor generation task than they did in the gestural metaphor task, which asked them to choose a creativity concept from their recent learning and create, record, and share a gestural metaphor with peers. This result may be similar to the contrast between creative thinking assessments, in general, and real-world creative production with an authentic audience. Third, teacher scores on different dimensions of metaphor creativity increased from pre- to post-training, which demonstrates the potential for malleability and responsiveness to training with this creative skill. However, without the counterfactual of a control group it is not possible to clarify how much of this change is attributable to training and skill development versus other explanations, such as a positive retesting effect. Fourth, teachers' ideas about how to integrate metaphor in teaching and learning suggested new familiarity and enthusiasm for metaphor's potential to enhance student learning. Together, these results provide new methodological and practical insights about the role metaphor can play in facilitating and researching teacher development of creativity for the classroom.

Discussion

Findings reinforced how metaphor generation in human meaning-making and expression is multimodal (Lakoff & Johnson, 1980). The results of this exploratory study illustrate how multimodal metaphor generation skill could be relevant for (a) research on teacher creative development, (b) as an embedded aspect of teacher training for creative teaching and teaching for creativity, and (c) as a catalyst for instructional innovations. The teacher training program appeared to contribute to teacher skill development to generate more creative, novel, remote, and effective language-based metaphor and to ideate different ways to integrate metaphor into their instruction. Research with more controls and greater internal validity is needed to evaluate training effects. This study extends the work of past researchers in creativity and metaphor (Beaty & Silvia, 2013; Chiappe & Chiappe, 2007; Gallagher & Lindgren, 2014; Lakoff & Johnson, 1980) and adds new insights about the creative meaning-making potential of multimodal metaphor in the social and cultural context of teacher professional development toward creativity in the classroom.

Malleability of Metaphor Skill

Results build on past research illustrating that metaphor generation skill is likely malleable and contains distinguishable components, such as remoteness and aptness (Beaty & Silvia, 2013; Chiappe & Chiappe, 2007). In another study, this same sample of teachers also demonstrated positive shifts in their creative self-efficacy, mindset, and values toward creativity in teaching and learning (Anderson, Katz-Buonincontro, Bousselot, Land et al., 2022). Those paralleled improvements provide some additional support for the interpretation that the change detected in this study may reflect some skill development rather than being fully explained by retesting practice effects or other factors.

Though exploratory, findings in this study present a possible sequence in teachers' metaphor skill development that future research can explore further with a larger sample and more measurement occasions. Given remoteness and novelty demonstrated the largest effect sizes, teachers' associative flexibility to ideate metaphor vehicles that were more remote and novel may develop more readily than their consideration for aptness or cleverness. Given the divergent thinking process embedded within this creative metaphor generation task, the *dual pathway model* may help explain that process underway (Nijstad et al., 2010; Anderson & Graham, 2021). The model proposes that creative ideation proceeds through a cognitive flexibility pathway engaging further remoteness in categories of ideas or through a persistence pathway engaging higher production of ideas regardless of remoteness—the notion that lots of ideas are likely to produce one that is creative. The very large effect size change for remoteness emphasizes a *cognitive flexibility pathway* in teachers increase of creative metaphor vehicle generation; however, that theory extension needs more testing, such as by asking participants to list as many possible metaphor vehicles they can think of before selecting one for elaboration. A key aspect of determining the rating for cleverness was humor, which is often naturally embedded within metaphor but more challenging and sophisticated to achieve (Müller, 2015). Given the result of no increase in this factor, cleverness may require more or different kinds of practice and training.

It is possible that the training experience teachers underwent in this study may have promoted teachers' risk-taking to be creative with their metaphors—leading to the big increase in remoteness—ahead of their understanding about what makes a metaphor apt and clever. In research on creative behaviors beyond metaphor generation, intellectual risk-taking moderated the effect of creative self-efficacy on creative achievement and activity (Beghetto et al., 2021). If

effort at remoteness in metaphor generation represents risk-taking, to a degree, the result in this current study may reflect a similar mechanism to that past research, worthy of future research.

Implications of Creative and Enactive Metaphor in Gesture

Many teachers produced creative enactive metaphor through gesture and movement to explore and represent complex concepts related to creative engagement in teaching and learning. Differences in the format for those two data sources reflects the distinction between "sitting" and "enactive" metaphor and offers insights for future research on metaphor skill assessment and development. For instance, a study could explore the difference in asking respondents to make a gestural metaphor then linguistic metaphor about a pre-selected or chosen topic and switch the order for half the sample to learn about any effect in that ordering. While some teachers illustrated abstract concepts using generic or typical metaphors and gestures, such as *new ideas popping into and out of one's mind,* other gestures and metaphors took time and effort to unpack and held potential to develop new connections for the creator and viewer. For instance, one teachers' gesture to signify autonomy held meaning around the internal process and independent choices a person makes and the turning points along an individual's pathway that autonomy requires a person to take responsibility to manage. The fact that all male teachers who chose autonomy generated a gestural metaphor representing resistance to authority and strength demonstrates conceptual metaphor theory (Lakoff & Johnson, 1980) at work, revealing distinct philosophical perspectives with potential pedagogical implications.

Scaffolding Skill Development

Past research on enactive metaphor has suggested huge potential to create more durable learning and understanding of concepts (Gallagher & Lindgren, 2014); however, a scaffolded approach to learning and adapting this skill that moves learners from conventional and generic

metaphor to creative and remote is needed to advance both research methods and teaching practices. Results in this study illustrate how teachers may process complex and abstract ideas in unique and compelling ways that may help them individually and contribute new ways of thinking about a topic shared within a community of learners. However, a multi-phase process that includes explanation for the details included in the enactive metaphor and feedback loops to correct inaccuracies may help to bring this skill into the developmental context of classrooms.

Methodological Innovations

Methodologically, this study provides several innovations that need continued work. We transcribed the movements in a single gesture captured on video (usually from the waist up while sitting at a laptop) to code and analyze different aspects of embodied cognition— specifically, whether the gesture was simulated and representational or metaphoric and symbolic in nature (Alibali & Nathan, 2012). That coding process also allowed for a comparison across participant responses to identify the different meanings teachers related with their enactive metaphoric process. To study the individual or collaborative process, embodied interactionism and an ethnographic approach (Scherr et al., 2013) could be used to help understand how the embodied process unfolds to shape meaning about abstract and complex ideas. This process would also potentially reveal the funds of knowledge and cultural perspectives (González et al., 2006) participants bring with them to learning.

Sources of Ambiguity

Documenting sources of ambiguity in rating creative work has been proposed recently as an essential evolution of current methods in creativity assessment and research to align philosophically with the disruptive quality and uncertainty latent in creative work (Anderson et al., 2023). As such, the line between representational gesture and metaphoric gesture in this

study became fuzzy for two independent researchers. For instance, in the example of belonging, a gesture that appeared to represent a hug could be interpreted as representational simulation of an action when one feels belonging; it could also be interpreted as metaphoric, considering that a sense of belonging holds the *feeling* and *meaning* of a hug and is not literally a hug.

Another source of ambiguity seemed to come from how the participants may interpret and make meaning of the idea very differently than other responders and the raters themselves. One rater saw the gesture for belonging from a participant to represent the meaning of belonging associated with possession, as in *this book belongs to me*. The other researcher focused on the coming together motion of the hands in space as metaphoric of people experiencing a sense of belonging. Similarly, should we consider the gesture of a hand coming to the heart in terms of belonging as a metaphoric expression of love or representational or of ownership over something? What do these two interpretations imply about philosophical and cultural values and norms? In this way, metaphor is an explicitly sociocultural form of creative expression, and, as such, may be a fitting method for research and practice to continue exploring in response to recent calls from the field (Gălveanu et al., 2019).

The identities and cultural background people carry into the context of this creative and interpretative challenge will likely influence the generation of a metaphoric gesture and the meaning-making that others engage to interpret the gesture. For instance, the vehicles and themes generated by male teachers for autonomy and belonging appeared to reflect a more individualistic rather than collectivist perspective (e.g., power, strength, individuality, and protection from others). When metaphoric gestures are generic and common, it may be hard to distinguish them from representational gestures (e.g., superhero for competency). Along these lines, questions arise: When might simulation (sewing and competency) be metaphoric? Is

sewing representing practice and repetition that is required for developing competency, therefore metaphoric in nature? These fuzzy distinctions reflect the difficulty in differentiating the different ways, such as simulation or symbolic representation, we use embodied cognition in meaning-making and expression (Alibali & Nathan, 2012).

Outside the narrow focus of this study, there is a huge spectrum in the complexity of gestural enactive metaphor, building from playful pretense in early childhood (Gallagher & Lindgren, 2014)—even before language development—to sophisticated choreography used to investigate laws in physics (Coates & Demers, 2019). With that broad spectrum in mind, the fields of educational practice and creativity research could benefit from a developmental framework of enactive metaphor and an enactive glossary for concepts in different domains that could help anchor developmental levels.

Implications for Education

This study frames creative work with metaphor in both language and gesture as an effective and adaptable skill for teacher development and pathway for their design of multidisciplinary and creative learning experiences, such as arts integration (Anderson et al., 2020). The exploratory nature of this study represents an early phase of development. It sets the stage for future research to investigate if these forms of skill with metaphor transfer to instructional design that actualize in creative learning with metaphor for students. For instance, one high school English teacher imagined framing the yearlong curriculum as a *metaphorest*, where students would "hunt and gather" for meaning. To actualize in creative learning, this approach would need to go further to build consistent opportunities to engage with the academic content through linguistic and enactive metaphorical thinking and acting and provide students ways to creatively contribute to the overarching metaphor that the teacher established—the

difference between creative teaching and teaching for student creativity (Jeffrey & Craft, 2004). Another teacher imagined creating a whole story of a forest journey with her students where the objects they bring in from home become the catalyst for new events that unfold in the imaginary world they co-construct, drawing on the power of metaphoric pretense and play in learning (Gallagher & Lindgren, 2014). This example also points to an important practice in culturally responsive teaching of inviting students to share about their lives outside of school (Hammond, 2015).

Though metaphor was applied to learning interventions in the past (e.g., Christidou et al., 1997; Duit, 1991; Gentner & Wolff, 2000; Winner et al., 1979), most of that research took place more than two decades ago. It remains an understudied aspect of creativity and education research. Because metaphor is a universal means of sensemaking (Lakoff & Johnson, 1980), metaphor could be a catalyst for teachers' responsiveness to students' diversity of culture and creativity. Studying the creativity of metaphor may also be a more culturally appropriate and accessible approach in creativity research, which needs new methods that honor the sociocultural nature of creativity (Glăveanu, 2020). It is possible that the use of the body in enactive metaphor may be a strong cultural match for some students compared to language-based forms only (Rosebery & Warren, 2008). As a learning tool for teachers working with students to help them grasp science concepts, for instance (Anderson, Irvin et al., 2022; Christidou, 1997), this process could be collaborative with each student offering and explaining a gestural element to explain a scientific model. Peers and teachers could help question or correct inaccuracies in the metaphor vehicle. These areas of potential in classroom learning warrant more research.

Conclusions

This mixed method study was exploratory, limited by a small sample, the introduction of new methods, and the unique context in education of distance learning during the COVID-19 pandemic school closures. Findings leave more questions than answers: Can assessed metaphor skill actually translate to creative and effective uses of metaphor in the classroom? What may be lost if assessments force respondents to create metaphor from pre-specified topics chosen by the researcher? Would creativity in enactive metaphor and linguistic metaphor correlate in a replication with more analytic power? Still, results contribute new evidence that teachers' creative skill in metaphor generation may be malleable and add to their creative agency as instructional designers and educators (Anderson, Katz-Buonincontro, Livie et al., 2022). Additional research will be needed to test further the premise that skill development with metaphor can promote teacher competency and creativity for interdisciplinary instructional and curricular design and generate more culturally responsive and creative learning for diverse students.

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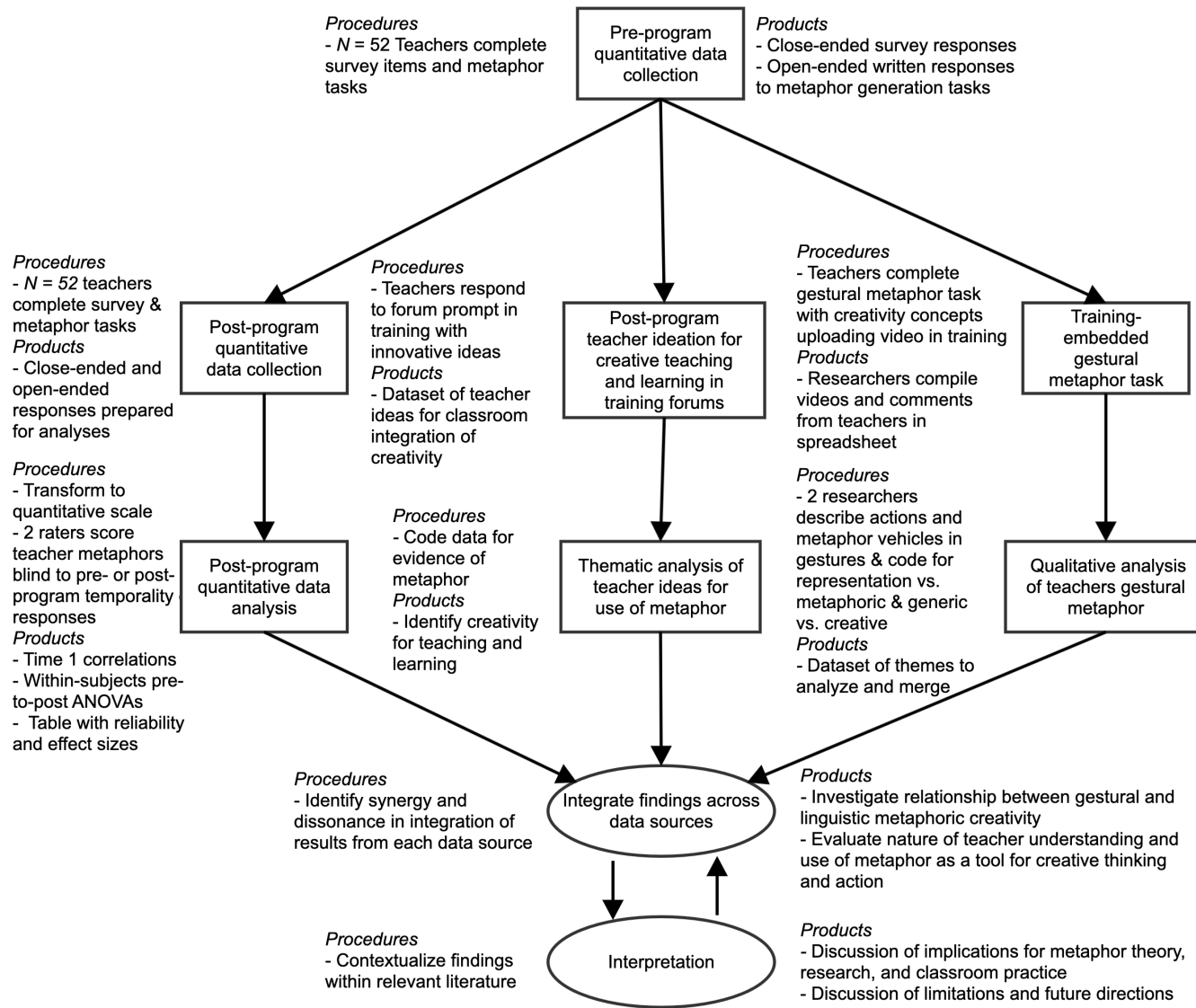
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Figure 1

Sequence of mixed method data collection, analysis, and integration

Procedures
- *N* = 52 Teachers complete survey items and metaphor tasks

Pre-program quantitative data collection

Products
- Close-ended survey responses
- Open-ended written responses to metaphor generation tasks

Procedures
- *N* = 52 teachers complete survey & metaphor tasks
Products
- Close-ended and open-ended responses prepared for analyses

Post-program quantitative data collection

Procedures
- Teachers respond to forum prompt in training with innovative ideas
Products
- Dataset of teacher ideas for classroom integration of creativity

Post-program teacher ideation for creative teaching and learning in training forums

Procedures
- Teachers complete gestural metaphor task with creativity concepts uploading video in training
Products
- Researchers compile videos and comments from teachers in spreadsheet

Training-embedded gestural metaphor task

Procedures
- Transform to quantitative scale
- 2 raters score teacher metaphors blind to pre- or post-program temporality responses
Products
- Time 1 correlations
- Within-subjects pre-to-post ANOVAs
- Table with reliability and effect sizes

Post-program quantitative data analysis

Procedures
- Code data for evidence of metaphor
Products
- Identify creativity for teaching and learning

Thematic analysis of teacher ideas for use of metaphor

Procedures
- 2 researchers describe actions and metaphor vehicles in gestures & code for representation vs. metaphoric & generic vs. creative
Products
- Dataset of themes to analyze and merge

Qualitative analysis of teachers gestural metaphor

Procedures
- Identify synergy and dissonance in integration of results from each data source

Integrate findings across data sources

Products
- Investigate relationship between gestural and linguistic metaphoric creativity
- Evaluate nature of teacher understanding and use of metaphor as a tool for creative thinking and action

Procedures
- Contextualize findings within relevant literature

Interpretation

Products
- Discussion of implications for metaphor theory, research, and classroom practice
- Discussion of limitations and future directions
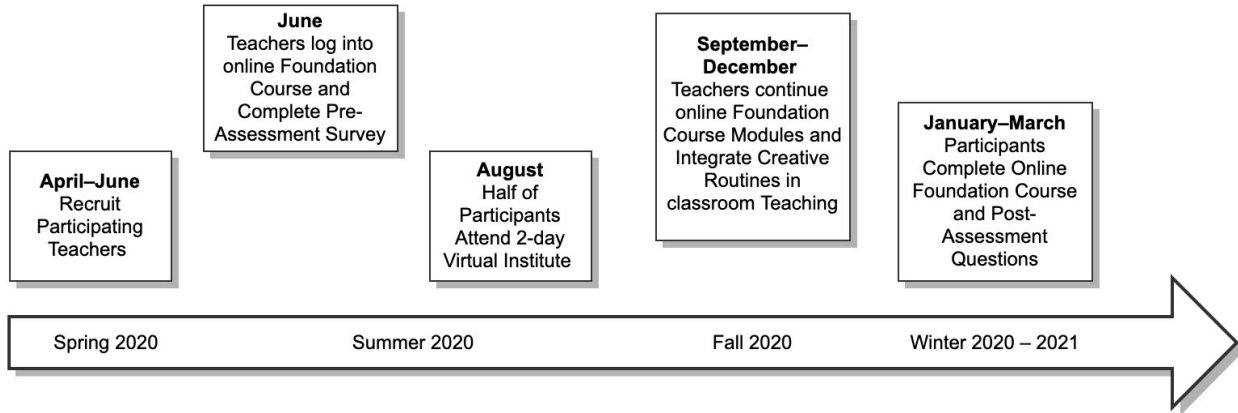
Figure 2

Sample creative and artistic exercise in the online professional development course in creativity

and arts integration showing the activity prompt and sharing function

Figure 3

Timeline of participant recruitment, course engagement and completion, and assessments.

Table 1

Scope and Sequence for makeSPACE Foundation Course for Creative Engagement in Arts Integration—The River Journey (Metaphor Used Across the Course)

Welcome and Orientation	
Mile 1	Lessons: makeSPACE for creativity; Introducing the creative resources
What is creativity? How am I creative?	
Mile 2	Lessons: Creativity through the lends of ourselves and others; Stories of creative risk-taking and growth with arts integration in the classroom; Reflecting on the development of personal creative resources
Mile 3	Lessons: Teachers as artists of pedagogy
Mile 4	Lessons: How are you creative? How are you creative? Creative resources as teaching tools; Making your creative avatar
How do I makeSPACE for creativity?	
Mile 5	Lessons: Conditions for creative engagement; Flow stories; Meaning-making through creative engagement; Patterns; Cultivating conditions and planning for creative engagement
Mile 6	Lessons: Creative routines; Routines and intentions; Why creative routines? Vocabulary gesture reflection; Many uses game and reflection; 10-minute routines; Implementation idea; Choose a routine
What is arts integration?	
Mile 7	Lessons: Role of artistic practice; Skills and sensibilities; Art is a verb! Learning through the arts; Treasure hunt; Still life
Mile 8	Lessons: What is arts integration? Tools for integration
How do I begin to integrate?	
Mile 9	Lessons: Arts integration: How? Refining intentions and review; Designing for quality arts integration; When you integrate the arts…; Core practices; Share your avatar; Which routine did you practice?
Mile 10	Lessons: Metaphorical thinking; Metaphor hunting; A metaphor for the self; Metaphor gestures and homework
Mile 11	Lessons: Reflective practices; Why reflection? Your selfie; Reflective routines; Metaphor card reflection; Opportunities to reflect; Notice…; Share your reflections
Final stretch	
Mile 12	Lessons: Braided channel; Portage; Entering the delta; Share the experience you designed; The take-out; Congratulations

Table 2

Topics and Properties Provided from The Metaphor Generation Task

Topics	Property Provided
Some jobs	Confining and constraining, and make you feel like you are just putting in time.
Love	Can be difficult, provides you with many experiences, and you never know what is going to happen next.
Her family	Something that keeps her stable and prevents her from drifting into danger.
Smiles	Help to attract other people.
Some tempers	Slowly build up and then suddenly explode.
The earth	Very busy and full of people all going about their business.
Some friendships	Bind people together and keep them together for a long time.
Distance learning	The consequence of an unforeseen crisis.

Note. The assessment began with the following prompt: "Think about the topic and consider a metaphor that can represent that topic. Use the property description as a starting point to help you think of something that shares similarities with the topic but is seemingly unrelated. Feel free to think beyond the given property to elaborate on your metaphor and have fun with it."

Table 3

Intraclass Coefficient of Two Raters and Cronbach's Alpha Reliability for Metaphor Scores

Criteria	ICC Item 1	ICC Item 4	ICC Item 8	Cronbach's ∝ Pre-Assessment	Cronbach's ∝ Post-Assessment
Creativity	.86	.84	.84	.86	.79
Remoteness	.82	.87	.84	.86	.72
Novelty	.76	.77	.84	.78	.69
Cleverness	.71	.79	.75	.85	.82
Aptness	.78	.73	.74	.90	.79
Composite Score	-	-	-	.88	.82

Table 4

Results of Within-Teacher ANOVA for Creativity, Remoteness, Novelty, Cleverness, and Aptness of Metaphors

Metaphor Criteria	Period	Mean (SD)	F(df)	p-value	Cohen's d
Creativity	Pretest	2.50 (0.70)	$F(1, 51) = 14.95$	<.001	0.54
	Posttest	2.84 (0.56)			
Remoteness	Pretest	2.49 (0.71)	$F(1, 51) = 80.91$	<.001	1.17
	Posttest	3.20 (0.48)			
Novelty	Pretest	2.44 (0.80)	$F(1, 51) = 15.27$	<.001	0.57
	Posttest	2.85 (0.63)			
Cleverness	Pretest	2.17 (0.72)	$F(1, 51) = 2.39$	.128	0.22
	Posttest	2.32 (0.65)			
Aptness	Pretest	2.98 (0.79)	$F(1, 51) = 5.55$	.022	0.31
	Posttest	3.19 (0.52)			
Composite Score	Pretest	2.52 (0.72)	$F(1, 52) = 18.49$	<.001	0.57
	Posttest	2.88 (0.53)			

Note. Effect size follows Cohen's d index*: d = .20 is small, d = .50 is medium, and d = .80 is large (Cohen, 1992)

Table 5

Teacher-Generated Metaphoric Gestures and Themes Representing Creativity Concepts

Creativity Concept	Sample Gestures	Metaphor Vehicles and Themes
Autonomy	Hands rotating in a circular way in motion and then stopping suddenly with one hand landing on the other, which turns into one hand standing up tall with the pointer finger pointing forward; Hands go out in a question, then one finger goes to the head, and person spins around that finger with a final *Tada* pose to finish; Clasping hands into a fist and pulling into chest; Movement from low to mid to tall and then on tippy toes; Flexing arm muscles	Processing, thinking, moving; Coming to a turning point; Standing tall and confident and making a choice; Ownership and responsibility; Resisting pressure from others; Dancing with oneself; Preserving choice and independence; Freedom and flexibility; Physical strength as a symbol of independence; Movement in different ways as the flexibility in independence
Belonging	One finger pointing on its own and then all fingers falling in together and enmeshing; Circular motions with arms and hands; Hands cupped and locked; Hugging motion; One finger up on each hand encircling and making contact then raising all five fingers on each hand; Fingers outstretched interweave and clasp	Simultaneous individuality and enmeshment with others; Physical closeness and interdependency; Joining with others; Encircled; Inclusion; Love and care; Embracing oneself and others; Linked and connected; Safe; Possessing
Competency	Hands rotating in a circular way in motion and then stopping suddenly with one hand landing on the other which turns into one hand standing up tall on the other and then the pointer finger pointing forward; Hands tying a knot; Hands sewing; "Jazz" hands; Hands knitting; Mini-explosions from the head; Superman pose; Fist pump ("Yes!")	Forward directionality; Practice and repetition; Feeling competent and confident; Energized; Enthusiasm and excitement about success; Rising motion for growth; Having composure when tested; Strength; Tying a knot; Sewing with precision
Creative ideation	Fingers cupped, reaching toward head and then out as if the ideas were literally emerging from one's head, showing confidence to share with the world	Gestures representative of generic idea that ideas pop into our head. It is a recognizable action we associate with ideas.
Risk-taking	Pointer finger traces straight across the screen. Then the finger returns to the center and zooms off, up and away.	Choosing a non-linear approach; not knowing of where a risk will take you; Fa
Tolerance for ambiguity	A shoulder shrug (indicating confusion or "I don't know") followed with a thumbs up as in "it's ok not to always know"	Confusion and acceptance
Structure uncertainty	One hand is made into a blind and the other hand emerges from behind the blind in different forms	Structures with uncertainty allow surprises to emerge, such as different forms could be unique interpretations from students or different directions the class might go based on students' ideas.

Table 6

Teacher-Generated Metaphors for Each Topic Changed from Pre-Assessment to Post-Assessment

Topic	Pre-Assessment	Post-Assessment
Some jobs	Some jobs are like the seasons. It doesn't really matter what you do, the same thing is just going to keep happening over and over again.	Some jobs are like filling a swimming pool with a garden hose. It doesn't feel like you're getting anywhere
Love	Love is an earnest prayer for goodness and grace.	Love is a stew made of our whatever's in the refrigerator; as long as nothing was rotten in the first place it will likely work out great.
Her family	Her family was string tied to a balloon.	Family is a thick blanket; soothing in times of stress and easy to adjust to get the amount of warmth you need.
Smiles	Warmth and comfort	Smiles are Buy 1 Get 1 Free signs
Some tempers	Some tempers are like running with a coke bottle in your pocket; it looks fine to open and take a drink, but there's no stopping the explosion to come.	Some tempers are like a campfire, they need more fuel to burn hotter.
Some friendships	Some friendships are a rock climbing knot providing strength, connection, and support.	Some friendships are the kiln firing a freshly glazed piece of pottery. The tests of the heat, confined space and time make the pottery inseparable from the glaze, by surviving those trials together, the newly fused piece can withstand future obstacles like the dishwasher.
The earth	The earth is Disneyland. Once you get there it's really expensive. Some of the rides are scary, some are fun, some are annoying, but they are usually over before you know it.	The earth is the gaming floor at the MGM Grand. Some people are winning. Some are losing. What are so many people smoking?
Distance learning	Distance learning is the bad tattoo after a night of drinking.	Distance learning is the belly ache after Thanksgiving gorging.

Note. The pre- and post-assessment examples for each topic were generated by the same participant. These examples were chosen at random.

Table 7

Teachers Application and Adaption of Metaphor to Classroom Teaching and Learning

	Metaphor in Teaching	Metaphor in Learning
1	Using "Metaphorest" as an overarching metaphor for how to design the curriculum and instruction for the year in high school English class.	Students would explore and hunt for metaphor in the content they engage with for the year. They would gather supplies for the expedition—metaphorical boots, binoculars, maps, etc.—to prepare them.
2	Recognizing description and understanding of character development and virtue in middle school English language arts as a metaphorical exercise.	Students create and share metaphor in gesture and through an object to describe a virtue of their own that they value, then do the same for the virtues they identify in characters in the texts they read.
3	Seeing metaphor as a way for kids to express how they feel emotionally.	As part of the challenge of creating a collage about themselves, students add a metaphor about how they feel about coming back to school online.
4	Using the metaphor of a hike through the forest to design the student and teacher experience for Advisory and Homeroom in middle school.	Students think about their school days as daily expeditions, with songs for hiking, pictures and other artifacts they collect and organize along the way, etc.
5	Employ the metaphor of a forest journey in a first-grade class. Using Bear as the main character, the class selects one student-provided object at a time to act as the prompt for the next event in the story of Bear's journey through the forest to first grade.	Each student will bring an object - any object to the online "classroom". The class builds the story together over the course of a week and then publishes with an illustration from each student.
6	Use the metaphor of *rough waters* to have students generate ideas of various people in their lives.	Students list "characters" with virtues they choice and describe how they've acted as *anchors* in their lives.
7	Vocabulary is key to learning in social studies. Giving kids a chance to be creative and use metaphor will help them to gain a deeper understanding of terms and provide opportunities for personal expression.	Students would find a metaphor for each vocabulary word assigned, and then reflect on why they choose that metaphor for that word. Follow with discussion and reflection to create learning far beyond the text.
8	Science students are expected to learn so much vocabulary. Some of it is abstract. Using the vocabulary gesture routine helps students think metaphorically and divergently to understand the term more deeply. Asking students to apply a new gesture definition to a phenomenon makes their understanding more concrete.	Have students develop gestures (as a class or individually) to represent science terms. For example, a unit on Newton's laws of motion, the gestures may represent force, acceleration, inertia, mass, speed, action, reaction, etc. Students then refer to this gesture glossary when describing these science concepts through phenomena they observe.