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A Distributed Intelligence Approach to Multidisciplinarity: Encouraging Divergent Thinking in Complex Science Issues in Society.

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A Distributed Intelligence Approach to Multidisciplinarity: Encouraging Divergent Thinking in Complex Science Issues in Society.

Abstract

The scientific issues that face society today are increasingly complex, open-ended and tentative (Sadler, 2004). Finding solutions to these issues, not only requires an understanding of the science, but also, concurrently dealing with political, social, and economic dimensions that exist (Hodson, 2003). For example, 40 years after the first congressional hearing on climate change held by Al Gore in 1976, the 2012 Intergovernmental Panel on Climate Change (IPCC) report states that climate change is still getting worse, despite efforts by governments, businesses, social actors such as Non-Government Organizations, and scientists. With the top minds in the world, across all disciplines, backed with government and corporate funding pursuing the same goal of resolving human impact on climate change, *why* haven't we resolved the situation? What strategies might be employed to increase effective action?

Author/Artist Bio

Jarod Kawasaki is currently a doctoral student at the UCLA Graduate School of Education and Information Studies, his dissertation focuses on teachers' beliefs about the purpose of science education and their relationship to teachers' instructional practice. Kawasaki's research interests focus on ways that K-12 education builds the capacity of students to engage with science in their everyday lives. Kawasaki is interested in the design of learning environments that encourage students to creativity to address controversial and public science issues. Before graduate school, Kawasaki was a science teacher at an urban high school in Los Angeles and completed a MA in Educational Technology from Cal State Northridge. Currently, Kawasaki is working for the Teacher Education Program at UCLA, conducting research with a 5-year US Department of Education grant investigating the effectiveness of an urban teacher residency program in preparing pre-service teachers and evaluating teaching quality. Previously, Kawasaki worked on a Spencer Foundation grant that examined the use of student data by teachers to inform instructional decisions in small pilot school in Los Angeles and at the UCLA National Center for Evaluation, Standards, and Student Testing (CRESST) developing assessments aligned with the Common Core State Standards. Kawasaki currently lives in Culver City, CA with his wife and two daughters (5 years old & 6 months old). Dai Toyofuku was born and raised in Los Angeles, where he also lives and works. He has a profound interest in the cultures of animal and plant communities that share the Los Angeles urban landscape. The artist received a BFA from California Institute of the Arts and an MFA from the Claremont Graduate University. Dai has collaborated with biologists and other artists in order to explore the relationship between art and science. In 2011, he had his first solo show at Steve Turner Contemporary. In 2012, He and seven other artists collaborated with a biologist to create an exhibition supporting endangered species at the College Art Association's 100th annual Convention. He is currently working on a body of work combining the four seasons and the Japanese tea ceremony, growing an indoor California-native Bonsai garden, and cultivating plants to feed caterpillars endemic to Los Angeles. In the near future, he hopes to breed Neurergus kaiseri, a newt that is now extinct in the wild

Keywords

Art, Distributed Intelligence Approach, Climate Change, Multidisciplinarity, Divergent Thinking, Science Issues in Society

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A Distributed Intelligence Approach to Multidisciplinarity: Encouraging Divergent Thinking in Complex Science Issues in Society.

Jarod N. Kawasaki & Dai Toyofuku

The scientific issues that face society today are increasingly complex, open-ended and tentative (Sadler, 2004). Finding solutions to these issues, not only requires an understanding of the science, but also, concurrently dealing with political, social, and economic dimensions that exist (Hodson, 2003). For example, 40 years after the first congressional hearing on climate change held by Al Gore in 1976, the 2012 Intergovernmental Panel on Climate Change (IPCC) report states that climate change is still getting worse, despite efforts by governments, businesses, social actors such as Non-Government Organizations, and scientists. With the top minds in the world, across all disciplines, backed with government and corporate funding pursuing the same goal of resolving human impact on climate change, *why* haven't we resolved the situation? What strategies might be employed to increase effective action?

Distributed Intelligence Framework

We are taking a distributed intelligence approach (Pea, 1993) to envision new ways to tackle scientific issues within society. Distributed intelligence, as a learning theory, views intelligence as a collective endeavor, where individuals, their goals, and the tools available make up a system of cognition. Approaching cognition from a systems perspective (as opposed to individual) distinguishes distributed intelligence from other major learning theories. In addition, distributed intelligence pays close attention to the tools within the system and how individuals use these tools to advance their goals. Our goal for this article is to posit the distributed intelligence framework onto a multidisciplinary approach, focusing on tools that are and might be available to individuals within systems of intelligence that lead to creative and innovative ways of thinking - divergent thinking - to address complex science issues. First, though, it seems warranted to discuss some obstacles in the way of multidisciplinarity from a distributed perspective.

One obstacle preventing effective multidisciplinary solutions is the prevalence of convergent thinking in Science, Technology, Engineering, and Math (STEM) related fields. Convergent thinking focuses on coming up with a single, well-established answer to a problem (Guilford, 1956). Utilizing multiple strategies when solving a problem tends to enhance performance and especially when those strategies are informed by alternative views and minority influence (Nemeth & Kwan, 1987). If the collaborative individuals themselves are entrenched in disciplines that strive for singular, well-established outcomes, it is unreasonable to expect them to embrace innovative, alternate views, minority influence, or diversified solutions that may be required to effectively address complex issues.

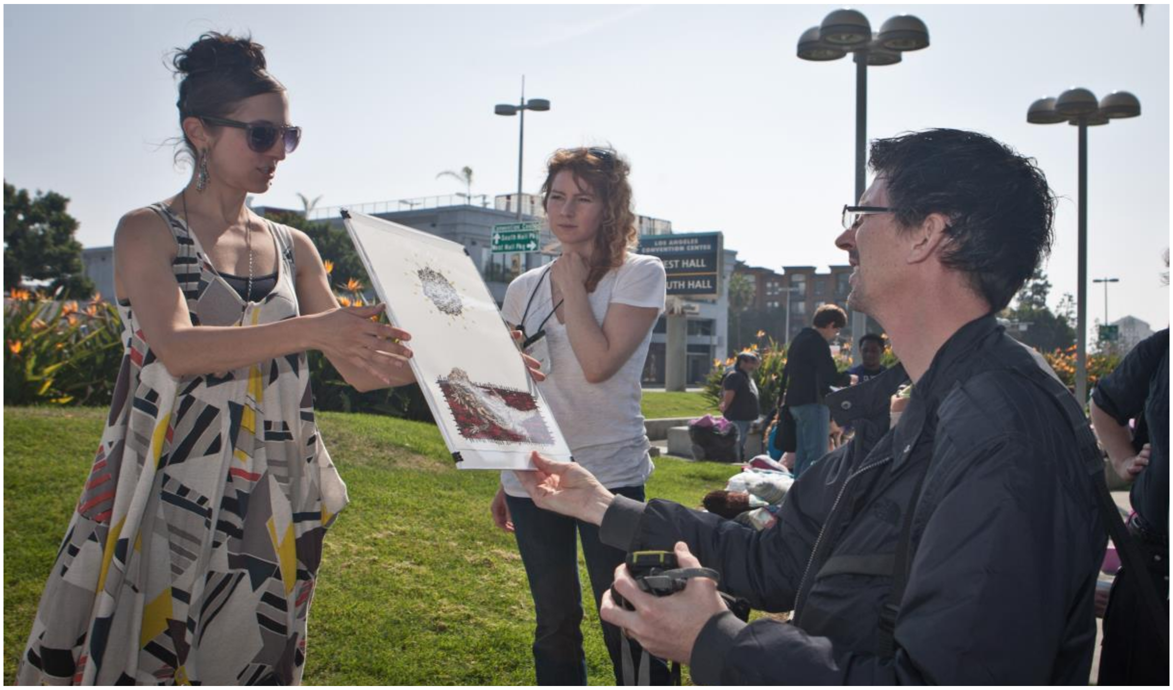
In addition, every discipline has their own tools, thus limiting communication between disciplines. Multidisciplinary collaboration is extremely difficult, as illustrated in Environmentalist James P. Collins and Biologist Martha L. Crump's, 'Extinction in Our Times: Global Amphibian Decline', in which they describe the process of collaborative efforts among different types of scientists:

> *"Collaboration requires more than assembling researchers with diverse skills. Collaborators must trust and respect each other while learning to 'speak' the new scientific 'languages of diverse colleagues'* (2009, p. 178).

This problem becomes more pronounced when collaboration involves non-scientists, such as policy makers, educators, and the general public. Nevertheless, all these groups are required to implement effective actions. Collins and Crump (2009) acknowledge, *"scientists by themselves cannot save amphibians- or any group of animals- from extinction. Everyone must be part of the solution"* (p. 34).

In response to these obstacles, we argue that multidisciplinarity, from a distributed intelligence approach, provides a new way to view collaborative efforts addressing complex science issues. Collaborations between disciplines already exist (scientists producing reports that go to politicians). Through the lens of distributed intelligence, these collaborations can be viewed as individuals (scientists and policymakers) that share the same goal (addressing global warming), and the same tools (data and legislation). Yet, this multidisciplinary collaboration does not seem to lead to any significant lasting change. If the goal is to encourage creative and innovative ideas to approach pressing science issues, such as global warming and biodiversity loss, then the tools that these disciplines use must fundamentally shift towards ones that encourage creativity, open communication, and innovation. The well-established tools that are utilized by scientists and policymakers tend to be discipline specific (politicians legislate for their constituents and scientists collect data to report to funders), causing individuals to adhere to established, convergent ideas, effectively suppressing more creative, divergent thinking. We suggest that additional tools are required in order to connect different disciplines, and provide affordances that are more conducive to intentional creative spaces.

So, how can we produce lasting, divergent thinking and clear communication between disciplines? Obviously, there is no easy answer to this question, but at this point it seems appropriate to ask, why STEAM instead of STEM education? Implementing creative tools such as artistic processes help to provide secure environments in which collaborators from non-artistic disciplines can play with new ideas and explore alternatives, by delaying judgment (correct versus incorrect) voiced by convergent thinkers. Also, artistic processes might create new ways of communicating between disciplines, integrating complexity rather than reducing it. A successful artistic process would seek to create multiple solutions, provide secure environments that encouraged divergent thinking, and focus on strengthening relationships and open dialogue



In a Landscape Where Nothing Officially Exists

between different disciplines. Given the catastrophic consequences of global warming, biodiversity loss, health and nutrition it seems the work of art is needed, now, more than ever before. In the following section, we discuss two examples from our own work, using a distributed intelligence approach to multidisciplinary, collaborative projects that illustrate how art, as a tool, inspired divergent thinking between different disciplines around a common goal of addressing complex science issues in society.

Science-Art Collaborative on Biodiversity

'In a Landscape Where Nothing Officially Exists' (ILWNOE) was exhibited at the College Art Association's 100th annual conference at the Los Angeles Convention Center on

February 25th, 2012. It was a part of 'Un-Space Ground', curated by Deborah Oliver and Ed Woodham. The goal of the project was to provide the public with an experience that personally connected them to endangered species and the loss of biodiversity. ILWNOE was a collaborative effort between Biologist and Public Lands Deserts Director for Center for Biological Diversity, Ileene Anderson, and artists Alicia Escott, Jenny Kendler, Erin Payne, Courtney Quirin, Christopher Reiger, Molly Schafer, Sara Schnadt, and the second author (Dai). We created thirty-five art works representing 35 different endangered species existing in and around southern California. The works included paintings, drawings, sculptures, prints, and conceptual works. Viewers took the art works for free, with the stipulation that they would complete the project by posting an image of the art work on the Internet, providing a shared experience between biologists, artists, and the public. Information about each species was also distributed, accompanied by a catalog that included articles by Los Angeles Times' art critic and professor at Claremont Graduate University, David Pagel and Director at the Environmental Analysis Program at Pomona College, Char Miller. So far, ILWNOE's online presence includes artists, academics, writers, conservation organizations, biologists, and concerned citizens. This project sought to blur the lines between artist and audience, collaborating with people from multiple disciplines, and also viewers, to simultaneously produce art objects and establish an ongoing, multidisciplinary network.

Science Documentary Filmmaking by High School Students

During the summer of 2011, the lead author taught a summer enrichment class for a group of high school students. This course illustrates how a distributed intelligence framework might encourage divergent thinking around public science issues. Students in this class created a documentary film on a topic of their choice utilizing various sources of information (scientists, media, parents, and peers). The documentary film provided students with a tool that bridged multiple disciplines and encourages divergent thinking. Through creating a film students had a space to play and be creative agents—unlike traditional school research projects—yet concurrently, students took the convergent ideas from typically authoritative information sources (textbook, teacher, news), and critiqued and synthesized them for the purpose of taking a personal position on an issue. The documentary film and/or the process of building the film is the tool around which students experimented with creative solutions, synthesizing the multiple perspectives they gathered from various sources of information. The goal of building a film, especially its creative and agentive affordances, provided students with creative and critical tools to form distinct individual opinions and positions.

Conclusion

Through this article, we have tried to depict how art as a tool within a distributed intelligence framework can inspire divergent thinking within multidisciplinary collaborations. Modeling multidisciplinary collaborations around diverse perspectives, shared ideas across disciplines, and creative spaces/tools for innovation lends itself to encouraging divergent thinking (Thompson & Brajkovich, 2003). In the science-art collaborative, the art pieces distributed at the auction, transformed scientific knowledge about endangered species into a personal, emotional, and social experience, leading to creative ways to disseminate this science information. In the case of the high school students, creating a documentary film provided a space for students to pull together the perspectives of multiple disciplines and question, respond and, critique their notions of science. It seems that better understanding of the individuals, goals, and tools that foster productive collaboration around complex science issues is needed in future research.

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References

Collins, J. P., & Crump, M. L. (2009). *Extinction in our Times: Global Amphibian Decline*. New York, NY: Oxford University Press.

Guilford, J. P. (1956). The structure of intellect. *Psychological Bulletin, 53*(4), 267-293.

Hodson, D. (2003). Time for Action: Science Education for an Alternative Future. *International Journal of Science Education, 25*(6), 645-670.

Intergovernmental Panel on Climate Change (IPCC), 2012: Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 1-19.

Nemeth, C. J., & Kwan, J. L. (1987). Minority Influence, Divergent Thinking and Detection of Correct Solutions. *Journal of Applied Social Psychology*, *17*(9), 788-799.

Pea, R. D. (1993). Practices of distributed intelligence and designs for education. In R. D. Pea & J. S. Brown (Eds.), *Learning in doing: Social, cognitive, and computational perspectives*. New York, NY: Cambridge University Press.

Sadler, T.D. (2004). Informal Reasoning Regarding Socioscientific Issues: A Critical Review of Research. *Journal of Research in Science Teaching*, *41*(5), 513-536.

Thompson, L., & Brajkovich, L. F. (2003). Improving the Creativity of Organizational Work Groups [and Executive Commentary]. *The Academy of Management Executive (1993-2005), 17*(1), 96-111.