

EDUC 844: Creativity and Innovation in STEM Education

Ph.D. Program, School of Education, Drexel University

Instructor: Jen Katz-Buonincontro

Contact Information: jkb@drexel.edu, 215-571-3670

Office Hours: By appointment, Office 372, 3401 Market St.

Classroom Location: Rm #340, 3401 Market St.

Time: 9am-12pm Wednesdays

Term: Spring 2017

1. Course Description

The purpose of this PhD elective course is to develop a high quality, cutting-edge educational project that integrates the most recent educational standards, teaching strategies and creativity research, in a specific STEM field in either PK-12, higher education or other learning context e.g. museum, industry, or corporate setting. Students will study models of creativity and innovation as described by seminal scholars, and develop a theoretical model of how those strategies can be operationalized in a designated curriculum unit/course in their STEM area of interest (engineering, mathematics, science education, or technology/computer education). Students will produce applied, hands-on educational materials that purposively integrate and adapt creative thinking or creative problem solving for rigorous STEM learning. The project will also include the careful development of instructional strategies, peer learning strategies, learning assessments and plans for cognitive measurement. Students may use the project in conjunction with other larger projects such as dissertation work, manuscripts and/or grant applications.

2. Course Goals

1. Learn about and critically analyze selected educational standards (e.g. *Next Generation Science Standards, 21st Century Skills Movement Standards*) with respect to “creativity” and innovation.
2. Develop a substantive educational project that includes identifying a specific creative thinking or creative problem solving strategy that can be successfully integrated into STEM teaching, learning and assessment.
3. Plan for future research in this STEM area related to a larger educational research project such as a dissertation.
4. Target a grant to apply for in the area of creativity in STEM learning.

3. Essential Learning Questions

1. *What is the definition of creativity, can people learn to be creative and if so, what are the most prevalent models?*
2. *How do I evaluate critically contrasting models of creative thinking and problem solving in order to make sound pedagogical judgments for teaching in a specific STEM area?*
3. *How do key educational policymakers and/or professional accrediting organizations define and categorize creativity with respect to a particular STEM subject (selected by student)?*
4. *How is creativity related to other cognitive and social aspects e.g. motivation, affect, and goal-setting in a specific STEM area?*
5. *How do peer, parent and teacher relationships shape expectations and norms for creative thinking and problem solving in STEM learning experiences?*
6. *How is culture, race and/or gender a part of creativity and learning in a STEM discipline?*
7. *What’s the best way to tailor STEM learning assessments based on the choice of the instructional strategy incorporating creative thinking or problem solving?*

4. Texts – Required

Books:

- Beghetto, R. A., Kaufman, J., & Baer, J. (2015). *Teaching for creativity in the common core classroom*. New York: Teacher's College Press.
- Kaufman, J., Plucker, J. A., & Baer, J. (2008). *Essentials of creativity assessment*. Hoboken, NJ: John Wiley & Sons.

Selected education articles:

- Linn, M., Gerard, L., Matuk, C., McElhaney, K. W. (2016). Science education: from separation to integration. *Review of Research in Education, 40*, 529-587.
- Murphy, P. K., & Knight, S. L. (2016, March). Exploring a century of advancements in the science of learning. *Review of Research in Education, 40*, 402-456.
- Pelligrino, J. W. (2016). *21st Century Science assessment: The future is now*. (SRI Education White Paper). Menlo Park, CA: SRI International.
- Sandoval, W. A., Greene, J. A., & Braten, I. (2016, March). Understanding and promoting thinking about knowledge: origins, issues, and future directions of research on epistemic cognition. *Review of Research in Education, 40*, 457-496.
- Schoenfeld, A. H. (2016, March). Research in mathematics education. *Review of Research in Education, 40*, 497-528.
- Sternberg, R. J., Jarvin, L., Birney, D. P., Naples, A., Stemler, S. E., Newman, T., Otterbach, R., Parish, C., & Grigorenko, E. L. (2014). Testing the theory of successful intelligence in teaching grade 4 language arts, mathematics, and science. *Journal of Educational Psychology, 106*(3), 881-899.

Selected creativity articles:

- Agogue, M., Le Masson, P., Dalmasso, C, Houde, O., Cassotti, M. (2015). Resisting classical solutions: the creative mind of industrial designers and engineers. *Psychology of Aesthetics, Creativity, and the Arts, 9*(3), 313-318.

Darwin, C. (1838). In Weisberg (2006). Firsthand accounts of insight and discovery.

Feist, G. F. (1998). A meta-analysis of personality in scientific and artistic creativity. *Personality and Social Psychology Review 2*(4), 290-309.

Gardner, H. (1988). Creative lives and creative works: a synthetic scientific approach. In R. J. Sternberg (Ed.) *The nature of creativity: Contemporary psychological perspectives* (pp. 125-147). New York: Cambridge University Press.

Kekule in Ghiselin, B. (1952). (Ed). *The creative process*. Berkeley: University of California Press.

Poincare, H. (1921). *The foundations of science*. New York: Science Press.

Weisberg, R. W. (2006). *Creativity: Understanding innovation in problem solving, science, and invention, and the arts*. Hoboken, NJ: John Wiley & Sons.

Amabile, T. M. (1982). Social psychology of creativity: A consensual assessment technique. *Journal of Personality and Social Psychology*, 43(5), 997–1013. This article will help students learn to consider novelty and quality in creative works.

Aristotle (ND) in Hofstadter, A. & R. Kuhns (Eds). (1964). *Philosophies of art and beauty: selected readings in aesthetics from Plato to Heidegger*. Chicago, IL: The University of Chicago Press. The article by Aristotle provides an historical basis for producing value judgments of art and aesthetic qualities, which is related to analyzing creativity.

Wallas, G. (1926). *The art of thought*. London: C.A. Watts. Selected chapters.
This work discusses the applied value of creative thinking and problem solving in life and work.

Multicultural views of creativity:

Chang, J-H., Sue, J. C., & H-C, Chen. (2015). Cultural distance between parents' and children's creativity: A within-country approach in Taiwan, *Cultural Diversity and Ethnic Minority Psychology*, 21(3), 477-485.

Joncich, G. (1964). A culture-bound concept of creativity: A social historian's critique, centering on a recent American research report. *Educational Theory*, 14, 133-143.

5. Recommended Texts: Journals

[Journal of Engineering Education](#)

Mathematics Teacher

Teaching Mathematics in the Middle School

Journal of Research in Science Teaching

[ACM transactions on computing](#)

[education & Computer Science Education](#)

Roeper Review

Psychology of Aesthetics, Creativity & the Arts

Thinking Skills & Creativity

Journal of Creative Behavior

6. Web Resources: Standards and Organizations

[Mathematics Standards](#) (Common Core)

Next Generation Science Standards

National Science Foundation

Institute of Education Sciences

National Research Council

National Academy of Science

8. Weekly Schedule

Wk#1 04/05: OVERVIEW: Goals, Project Overview & Introduction to Major Creativity Models.
Read for next wk: Murphy & Knight; Sandoval, et al; Selected chapters Beghetto et al.
 To Do: Locate, review and print the national standards in your STEM subject.

Wk #2 04/12: TEACHING: Developing an educational philosophy, Educational Standards.
Read for next wk: Schoenfeld. Selected chapters Beghetto et al.
Guest speaker: Dr. Fredricka Reisman, Education, 11:15- 11:45 am

Wk #3 04/19: INSTRUCTIONAL STRATEGIES, Continued. **Assignment #1 Due.**
Read for next week: 1 Article on Peer Learning; Selected chapters Beghetto et al.
Guest Panel "STEM Creativity in Practice at Drexel:" 11am-12pm
Dr. Abi Aghayere, Department of Civil, Architectural and Environmental Engineering;
Dr. Fraser Fleming, Chemistry; Dr. Gary Friedman, Electrical Engineering,
Dr. Paul Gondek, Marketing; Dr. Gary Rosenberg, Department of Biodiversity, Earth &
Environmental Science

Wk #4 04/26: YOUTH DEVELOPMENT, Peer Learning Strategies.
Read for next wk: Chang, J-H., Sue, J. C., & H-C, Chen; Joncich; Beghetto et al.
Guest speaker: Dr. Baptiste Barbot, Psychology, Pace University, 11am-12pm

Wk #5 05/03: CULTURE & CREATIVE IDENTITY. Assignment #2 due.
Read for next wk: Amabile. Selected chapters in Kaufman, et al.
Guest speaker: Dr. Lisa Min Tang, Business Psychology, University of Applied
Management, Germany, 9:15 AM-9:45am

Wk #6 05/10: CREATIVITY ASSESSMENT & MEASUREMENT.
Read for next week: Sternberg, et al.; Linn, M., Gerard, L., Matuk, C., & McElhaney, K. W.;
 Pelligrino.
Guest speaker: Dr. Rick Hass, Psychology, Philadelphia University, 10am

Wk #7 05/17: LEARNING ASSESSMENT.
Read for next wk: Selected chapters in Kaufman, et al.
 To Do: Review and print Guidelines for DU Assessment Conference Proposal
Guest speaker: Dr. Nancy Songer, Dean, Distinguished University Professor, Science
Education, 11am

Wk #8 05/24: TYING LEARNING OUTCOMES TO PROGRAM LEVEL OUTCOMES.
Guest Speaker: Dr. Steve DiPietro, Vice Provost, Assessment, Accreditation & Effectiveness
10:30-11:15am
Assignment #3 Due.
Read for next week: Agogue, M., Le Masson, P., Dalmasso, C, Houde, O., & Cassotti, M.;
 Selected chapters in Kaufman, et al.

Wk #9 05/31: ALTERNATIVE WAYS TO DOCUMENT LEARNING: Cognitive Maps, Photos,
 Sketches, Art, Biomarkers.
Guest speaker: Dr. Kevin Hallinan, Professor, Mechanical and Aerospace Engineering,
University of Dayton, 11-11:30am
 To Do: Review and print APA Proposal Guidelines; Locate grant opportunity, review and print.

Week #10 06/07: STRATEGIES for PROPOSALWRITING & GRANT FUNDING.
Assignment #4 Due. Presentations on First Draft of Conference Proposals & Critical Peer
 Feedback.

9. Course Participation Expectations

General participation: 2 pts. / week. Students in this course are expected to be active learners and participants, requiring all students to take an active role in their own learning and to share the learning process with the class.

Evidence of active learning includes:

- ◆ *Reading all assigned materials, responding to peers, and making note of questions, areas of interest, and connections to coursework completed and new readings.*
- ◆ *Active participation in weekly discussions, posing questions to panelists and guest speaker sessions, Each student has an equally important story to share based on his or her own experiences and each student will benefit from the viewpoints of their classmates.*
- ◆ *Attendance/Participation: As a student in this course, it is expected that you will complete and submit assignments on time. Assignments are due no later than the assigned due date. *If you need an extension for a weekly assignment you will require permission of the instructor before the due date.**

10. Grading Policy

Grading Scale	A = 100-93	A- = 92-90	B+ = 89-87	B = 86-83	B- = 82-80
	C+ = 79-77	C = 76-73	C- = 72-70	F = 62 and below	

11. Important Information

The course registration adjustment period for adding or dropping courses begins with the opening of a student's time ticket assignment for course registration and closes Friday, January 6th (end of Week 1) at 11:59 pm via the Web.

Students with disabilities are encouraged to request accommodations and services at Drexel University.

The Office of Disability Resources will meet with you to determine what accommodations can be made to support your success. It is the student's responsibility to present a current accommodation verification letter (AVL) to faculty at the start of each quarter before accommodations can be made. AVL's are issued by the Office of Disability Resources. For additional information, contact the Office of Disability Resources at <http://www.drexel.edu/oed/disabilityResources/students/>

Academic Integrity

A. STATEMENT OF POLICY

Drexel University expects all members of its community to uphold the highest values of academic integrity. In upholding these values, the University is committed to investigating any allegation of violations of academic integrity against a student. Violations include, but are not limited to: plagiarism, cheating, fabrication, and academic misconduct.

Sanctions for violations of academic integrity are administered through the Office of Student Conduct and Community Standards in conjunction with the Office of the Provost and other University offices as deemed appropriate. It is generally the responsibility of the faculty member overseeing the academic activity to report the violation to the Office of Student Conduct and Community Standards and to determine the appropriate sanction. A student who believes he/she has been wrongly sanctioned has a right to an appeals process.

In addition to any other sanction, the University reserves the right in its sole discretion to withdraw an earned degree even though it has been granted should it be discovered at any time that the work upon which the degree was based, or the academic records in support of such degree, have been falsified. In that situation, the degree will be

withdrawn promptly upon discovery of the falsification and the academic record will be updated to reflect the withdrawal of degree.

B. DEFINITIONS

Plagiarism

Plagiarism is the inclusion of someone's previously documented words, ideas, or data in one's own new and original work. When a student submits work for credit that includes the words, ideas or data of others, including one's own previously submitted work, the source of that information must be acknowledged through complete, accurate and specific references, and, if verbatim statements are included, through quotation marks as well. By placing his/her name on work submitted for credit, the student certifies the originality of all work not otherwise identified by appropriate acknowledgments. A student must obtain permission from the current instructor, prior to submission, to use his or her previously submitted work in a new and original work.

Plagiarism covers unpublished as well as published sources. Examples of plagiarism include, but are not limited to:

- Quoting another person's actual words, complete sentences or paragraphs, or an entire piece of written work without acknowledgment of the source
- Using another person's ideas, opinions, or theory, even if it is completely paraphrased in one's own words, without acknowledgment of the source
- Using one's own previously submitted work as new and original without permission from the instructor
- Using facts, statistics, or other illustrative materials that are not clearly common knowledge without acknowledgment of the source
- Copying another student's essay examination
- Copying, or allowing another student to copy, a document or computer file that contains another student's assignment, and submitting it, in part or in its entirety, as one's own
- Collaborating on an assignment or sharing computer files and/or programs, and then submitting individual copies of the assignment as one's own individual work. Students are urged to consult with individual faculty members, academic departments, or recognized handbooks in their field if in doubt regarding issues of plagiarism.

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Cheating

Cheating is an act or an attempted act of deception by which a student seeks to misrepresent that he/she has mastered information or a skill on an academic evaluation instrument, such as (by example, not limitation) a test, exam, quiz, that has not in fact been mastered. Examples include, but are not limited to:

- Copying from another student's examination paper
- Allowing another student to copy from your examination paper, text, quiz, or similar evaluation instrument
- Unauthorized use of a course textbook or other materials, such as (by example, not limitation) a notebook, to complete an examination or other assignment
- Collaborating on an examination, test, quiz, or other project with any other person(s) without authorization
- Using or processing specifically prepared materials during an examination such as (by example, not limitation) notes, formula lists, notes written on the students clothing, calculators, and/or smart devices, that are not authorized
- Taking an examination for someone else or permitting someone else to take an examination for you

Fabrication

Fabrication is the use of invented information or the falsification of research or other findings. Examples include, but are not limited to:

- Citation of information not taken from the source indicated; this may include the incorrect documentation of secondary source materials
- Listing sources in a bibliography not used in the academic product

- Submission in a paper, thesis, lab report, or other academic exercise of falsified, invented, or fictitious data or evidence, or deliberate and knowing concealment or distortion of the true nature, origin, or function of such data or evidence
- Submitting as your own any written work, printing, sculpture, or other material prepared in whole or in part by another
- Other forms of scientific misconduct

Academic Misconduct

Academic misconduct includes academically dishonest acts such as tampering with grades or taking part in obtaining or distributing any part of an administered or unadministered examination, test, quiz, project, or similar evaluation instrument. Examples include, but are not limited to:

- Stealing, buying, or otherwise obtaining all or part of an administered or unadministered examination
- Selling or distributing all or part of an administered or unadministered test including questions and/or answers
- Bribing a person to obtain an administered or unadministered test or any information about the test
- Entering a University building or office for the purpose of obtaining an administered or unadministered test
- Signing-in, swiping-in, or logging-in as someone else or permitting someone to sign-in, swipe-in, or log-in for you in any academic setting such as, but not limited to, classes or common exams
- Any unauthorized action taken for the purpose of changing a grade or grade record
- Changing, altering, or being an accessory to the changing and/or altering of a grade in a grade book, on a test, a "change of grade" form, or other official academic record of the University that relates to grades
- Continuing to work on an examination or project after the specified allotted time has elapsed
- Buying or otherwise acquiring in any way a theme, report, term paper, essay, computer software, other written work, painting, drawing, sculpture, or other scholastic art work, and submitting it as your own work to fulfill academic requirements
- Selling, distributing, or otherwise supplying in any way a theme, report, term paper, essay, computer software, other written work, painting, drawing, sculpture, or other scholastic art work to another student for that student's use in fulfilling academic requirements

[Student Handbook](#)

