



2015 HAWAII UNIVERSITY INTERNATIONAL CONFERENCES
ARTS, HUMANITIES, SOCIAL SCIENCES & EDUCATION
JANUARY 03 - 06, 2015
ALA MOANA HOTEL, HONOLULU, HAWAII

21ST CENTURY TEACHING METHODS

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Synopsis:

An overview of the courses that were developed for teaching pre-service teachers for the 21st Century culturally and technologically enriched classrooms.

21st Century Teaching Methods

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INTRODUCTION AND OVERVIEW

This paper will provide an overview of the courses the university faculty have developed for teaching 21st century pre-service teachers within culturally and technologically enriched classrooms. These courses are designed to provide pre-service students with access to appropriate tools, such as digital fabrication, physical computing and programming, to ensure pre-service teachers are empowered to instruct K-12 students innovatively and systematically so they are able to solve real world problems.

The last 25 years have seen an exponential increase in the use of technology to enhance traditional instruction. Students are arriving in their K-12 classrooms, as early as first grade, able to use computers and tablets at a remarkably sophisticated level. All the while standardized math and science tests scores of American have trended to fall below scores of students from other nations. To address the need to improve students' comprehension of math, science and technology, we have designed a teacher education program to promote the progress of science.

PROGRAM DESCRIPTION

The Bachelor of Arts in Interdisciplinary Studies with a Preliminary Multiple Subject Teaching Credential with an emphasis in Science, Technology, Engineering, and Mathematics (STEM) provides a rigorous education that prepares candidates for a career as a teacher at the elementary school level (grades K-8). This program prepares candidates for professional work as multiple subject teachers in a constantly changing digitalized classroom environment. According to the information found on the CA Department of Education web site, STEM education can be an interdisciplinary or trans-disciplinary approach to learning where rigorous academic concepts are coupled with real-world problem-based and performance-based lessons. Developing reflective practitioners in the 21st Century is essential in this era of standards-based instruction. This course will prove to be a venue to build a teaching repertoire that will be the basis for all future teaching opportunities. Moreover, candidates will also complete five hours of observing, teaching, and assisting in a classroom.

The Bachelor of Arts in Interdisciplinary Studies with a Preliminary Multiple Subject Credential provides a rigorous education that prepares candidates for a career as a teacher at the elementary school level (grades K-8). The program stresses preparing candidates for teaching in the digital classroom as multiple subject teachers in a constantly changing environment presented in an ever increasing digitalized classroom. CA Department of Education web site states that STEM

education can be an interdisciplinary or trans-disciplinary approach to learning where rigorous academic concepts are coupled with real-world problem-based and performance-based lessons. At this level, STEM education exemplifies the axiom “the whole is more than the sum of the parts.” STEM education in the elementary grades: (1) provides the introductory and foundational STEM courses that lead to success in challenging and applied courses in secondary grades; (2) introduces awareness of STEM fields and occupations; (3) provides standards-based, structured inquiry-based and real-world problem-based learning that interconnects STEM subjects; (4) stimulates student interest in “wanting to” rather than “having to” take further STEM related courses; and bridges and connects in-school and out-of-school learning opportunities.

PROGRAM COURSES

TED 306: 21st Century Teaching Method - this course is designed to prepare teacher candidates to become highly-qualified multiple-subject teachers in the 21st Century culturally diverse and technology enriched classrooms. Pre-service teachers will develop the knowledge and skills necessary to teach students in grades K-8 science, technology, engineering, and mathematics (STEM). This includes developing rigorous, standards-based lessons that are engaging, enjoyable, and meaningful to students. Opportunities will also be provided to explore, analyze, and incorporate digital resources for teaching STEM for students in grades K-8. Furthermore, the STEM education curriculum that teacher candidates will be introduced to is trans-disciplinary in its overall approach; driven by standards that complement the trans-disciplinary philosophy; uses the backward mapping techniques advocated in Understanding by Design; uses both problem-based and performance-based teaching and learning; uses the 5E teaching and learning cycle to plan units and activities within the curriculum; uses digital format coupled with digital teaching technologies such as whiteboards, tablets, student response systems, etc.; and uses both formative and summative assessments with task and non-task specific rubrics.

Learning Objectives

- Candidates will describe the features of key digital input technologies and explain how each can be used in support of teaching and learning.
- Candidates will discuss the features of key digital output technologies and explain how each can be used in support of teaching and learning.
- Candidates will analyze and explain the issues associated with using digital technologies in the classroom.

- Summarize key emerging digital technologies that may be useful to teachers and learners in the future and explain their potential implementation.
- Candidates will find and evaluate sample classroom management and academic tools available on the Web.

TED 351 - Teaching Science, Technology, Engineering, & Mathematics (STEM) for Elementary Teacher Candidates in Grades K-8 – this course is designed to prepare teacher candidates to become highly-qualified multiple-subject teachers in the 21st Century culturally diverse and technology enriched classrooms. Pre-service teachers will develop the knowledge and skills necessary to teach students in grades K-8 science, technology, engineering, and mathematics (STEM). This includes developing rigorous, standards-based lessons that are engaging, enjoyable, and meaningful to students. Opportunities will also be provided to explore, analyze, and incorporate digital resources for teaching STEM for students in grades K-8. Furthermore, the STEM education curriculum that teacher candidates will be introduced to is trans-disciplinary in its overall approach; driven by standards that complement the trans-disciplinary philosophy; uses the backward mapping techniques advocated in Understanding by Design; uses both problem-based and performance-based teaching and learning; uses the 5E teaching and learning cycle to plan units and activities within the curriculum; uses digital format coupled with digital teaching technologies such as whiteboards, tablets, student response systems, etc.; and uses both formative and summative assessments with task and non-task specific rubrics.

Learning Objectives

- Candidates will research and analyze the profound gap between the knowledge and skills most students learn in school and the knowledge and skills needed to meet the nation's current workforce development needs in STEM related fields.
- Candidates will research and analyze the nation's current workforce development needs in STEM related fields.
- Candidates will research and analyze STEM assessment.
- Candidates will research and analyze how to teach STEM using a Holistic Approach.
- Candidates will research and analyze the knowledge and skills most students learn in school and the knowledge and skills needed to meet the nation's current workforce development needs in STEM related fields.

- Candidates will research and assess the knowledge and skills needed to meet the nation's current workforce development needs in STEM related fields.
- Candidates will research and analyze the knowledge and skills needed to move STEM into the Main Streams
- Describe how to integrate Science, Technology, Engineering, and Mathematics in a 21st Century Digital Classroom.
- Prepare a minimum of 5 standards-based STEM lesson plans for K-8 students.
- Reflect on their own and other's instruction as a means for self-improvement and self-understanding.
- Demonstrate the ability to access resources that help improve instruction, advance the knowledge and practice of the field, and develop professionalism.

Program Learning Outcomes

- Demonstrate how to integrate Science, Technology, Engineering, and Mathematics (STEM) to meet the needs of all learners.
- Explain how to support growth in cognitive, social, physical, and emotional domains.
- Create positive learning environments that ensure healthy human growth.
- Utilize systematic observations, documentation, and other assessment strategies to facilitate and account for learning and to support positive growth.
- Design, implement, and evaluate standards-based lesson plans for learning and achievement in content areas.
- Demonstrate professional standards and ethics.
- Utilize different teaching strategies to accomplish teaching and learning goals.

References

- Collins, A. (2009). *Rethinking education in the age of technology: The digital revolution and schooling in America (Technology, Education—Connections)*: New York, NY: Teacher College Press.
- Drew, D. E. (2011). *STEM the tide: Reforming science, technology, engineering, and math education in America*. Baltimore, MD: The John Hopkins University Press.
- Jacobs, H. H. (Eds.). (2010). *Curriculum 21: Essential education for a changing world*. Alexandria, VA: ASCD
- National Research Council: Committee on highly successful schools or programs in K-12 STEM education (2011). *Successful K-12 STEM education: Identifying effective approaches in science, technology, engineering, and mathematics*.
- Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for life in our times*. San Francisco, CA: Jossey-Bass.
- Vasquez, J. A., Sneider, C., and Comer, M. (2013). *STEM learning essentials, grades 3-8: Integrating science, technology, engineering, and mathematics*. Portsmouth, NH: Heinemann.

Related Resources (Web Sites)

- CA Department of Education: <http://www.cde.ca.gov/index.asp>
- STEM Education Coalition: <http://www.stemedcoalition.org/wp-content/uploads/2011/09/STEM-Ed-Coalition-One-Pager-9-6-11.pdf>
- PBS TeacherLine: <http://www.pbs.org/teacherline>
- STEM: [Inspire Elementary Students with Engineering](#) (PBS National)
- NSDA: <http://nsdl.org/search/resource/2200/20100713193536578T/n=10&q=STEM%20for%20elementary%20teachers>
- CA Department of Education: Science, Technology, Engineering, and Mathematics. <http://www.cde.ca.gov/pd/ca/sc/stemintrod.asp>
- Scaling STEM: Transforming education matters. <http://newschoolsproject.org/2012stemconference/sessions.html>
- Creative Learning Systems: www.creativelearningsystems.com
- <http://cslnet.org/resources/>Jacobs, H. H. (Eds.).(2010). *Curriculum 21: Essential education for a changing world*. Alexandria, VA: ASCD.
- CA Department of Education: <http://www.cde.ca.gov/index.asp>
- STEM Education Coalition: <http://www.stemedcoalition.org/wp-content/uploads/2011/09/STEM-Ed-Coalition-One-Pager-9-6-11.pdf>
- PBS TeacherLine: <http://www.pbs.org/teacherline>
- STEM: [Inspire Elementary Students with Engineering](#) (PBS National)
- NSDA: <http://nsdl.org/search/resource/2200/20100713193536578T/n=10&q=STEM%20for%20elementary%20teachers>
- CA Department of Education: Science, Technology, Engineering, and Mathematics. <http://www.cde.ca.gov/pd/ca/sc/stemintrod.asp>

Alexander Street Press: Education in Video Database

- [Behind the Design](#) in [Looking at Learning...Again, Part 2](#) Episode 1 (Annenberg Learner, 2000) 57:40 min
- [The Bloodhound SSC Project](#) in [Secondary STEM](#) Episode 1 (Teachers TV/UK Department of Education, 2010) 14:02 min
- [The Mind's Intelligences](#) in [Looking at Learning...Again, Part 1](#) Episode 6 (Annenberg Learner, 1999) 58:40 min
- [Connecting Other Subjects to Inquiry](#) directed by [Morris, Bob](#), in [Learning Science Through Inquiry](#) Episode 8 (Annenberg Learner, 2000) 58:49 min
- [Secondary](#) in [Formative Assessment and Personalised Learning](#) (Teachers TV/UK Department of Education, 2007) 30:14 min
- [Pulling It All Together: Creating Classrooms and Schools That Support Learning in The Learning Classroom: Theory Into Practice](#) Episode 13 (Annenberg Learner, 2003) 28:23 min

Annotated YouTube Videos

Transforming Teaching and Learning through STEM Education. July 14, 2013. <http://youtu.be/bT8EJsENFU8>. 65:33 min

Dr. Diana Wehrello-Grabowski conducts hands-on-minds-on, inquiry and standards-based STEM teacher training throughout the nation and world. In the following STEM teacher training powerpoint/ movie Dr. Diana Wehrell-Grabowski provides photos and videos of teachers conducting hands-on STEM investigations. Teachers are introduced to STEM practices and content, the engineering design process, reflective journaling in the STEM classroom, and how STEM education helps to build the 4C's : creativity, critical thinking, communication and collaboration. During the STEM teacher training sessions Dr. Wehrell-Grabowski conducts teachers are actively engaged in the learning process, they become transformed. Dr. Wehrell-Grabowski believes that STEM education will play a major role in transforming education in our nation and the world. Traditionally, our educational systems have not allowed or promoted creativity, critical thinking, communication and collaboration in our students or the teachers. STEM education indeed may be one of the answers to turning around our educational system and workforce.

Head Start Teachers Attend STEM Teacher Training. Mar 20, 2013

<http://youtu.be/jgTUmcdgwmA>. 2:35 min. Thirty Indiana Head Start teachers recently attended a three-hour hands-on-minds-on, inquiry-based science, technology, engineering, and math (STEM) teacher training workshop conducted by Dr. Diana Wehrell-Grabowski. During the three hour STEM teacher training session Dr. Diana Wehrell-Grabowski introduced early childhood teachers to: STEM philosophy and practices, journaling in the early childhood classroom, exploring shapes and patterns in nature and man-made structures, building 2 and 3-D structures with readily available materials, using blocks to explore STEM concepts, using toys to teach STEM concepts, toy engineers, ramp science, and using children's literature to introduce and reinforce STEM concepts. To find out more about the STEM teacher training workshops Dr. Diana Wehrell-Grabowski provides year-round, nation and worldwide check out her website at: <http://www.drdianateachertraining.com>

Exploring STEM Concepts in the Early Childhood Classroom. Feb 12, 2013

<http://youtu.be/HglYz0h2n2E>. 5:04 min

Dr. Diana Wehrell-Grabowski, science education consultant provides hands-on STEM teacher training workshops throughout the nation and world. In the following video Dr. Diana Wehrell-Grabowski shows highlights of a recent hands-on STEM lesson she conducted for four-six year olds in a voluntary preschool classroom. Implementing STEM practices in the early childhood classroom makes perfect sense. Many early childhood teachers are already implementing and exploring STEM practices and concepts without realizing it. The perfect example is at the Block Center. While young children build with blocks they are indeed learning about many STEM concepts, as well as communication and collaboration skills. In the following video young children rotated freely to a numerous centers to explore STEM concepts. In addition, teachers and students were introduced to numerous children's literature that reinforces STEM concepts. To find out more about STEM teacher training opportunities check out Dr. Diana Wehrell-Grabowski's site at: <http://www.drdianateachertraining.com>

STEM Teacher Training Workshop for Primary Teachers. Nov 20, 2012.

<http://youtu.be/hk0KANaCamU>. 10:36 min

Dr. Diana Wehrell-Grabowski conducts a Science, technology, engineering, and math (STEM) teacher training workshop for K and 1st Grade teachers. Teachers are introduced to STEM philosophy and concepts, engineering design process, and reflective journaling. Teachers conducted numerous investigations over a two-day period to explore the following concepts: structure and function, biomimicry, math and architecture, boat engineering, materials science, ramp science, reverse engineering, and sound engineering. To find out more about the science, technology, engineering, and math (STEM) teacher training workshops Dr. Diana Wehrell-Grabowski conducts nation and worldwide to teachers of all grade levels check out her site at: <http://www.drdianateachertraining.com>

STEM Teacher Training 21st Century Community Learning Centers. Nov 16, 2011.
<http://youtu.be/vz1sNHqR65M>. 9:01 min

Video clips of 21st Century Community Learning Center staff conducting hands-on investigations during a two-day Science, technology, engineering, and math (STEM) professional staff development training. The STEM training was conducted by Dr. Diana Wehrell-Grabowski. Teachers explored a wide-array of STEM concepts via conducting hands-on-minds-on inquiry-based investigations.

Teachers explored the following concepts:

structure and function, patterns and shapes in nature and in man-made objects, biomimicry, nanotechnology, materials science, bridge building, geodesic dome structures, aeronautical and aviation concepts, seed dispersal, building air powered vehicles from recycled and re-use items, force, motion, and energy concepts, and reverse engineering. For more information about the science teacher training workshops Dr. Diana Wehrell-Grabowski offers nation and worldwide visit her website at: <http://www.drdianateachertraining.com>

STEM Teacher Training: Investigation Building Balloon Powered Cars. Oct 15, 2011.
<http://youtu.be/VkyTGZodbG0>, 2:29 min

Teachers built balloon powered cars during a STEM teacher training workshop conducted by Dr. Diana Wehrell-Grabowski. Teachers worked in small groups to design, construct, test, and re-design models. Cars were made from everyday household materials, and recycled water bottles. For more information about science, technology, engineering, and math (STEM) teacher training workshops Dr. Diana Wehrell-Grabowski offers nation and worldwide visit her site at: <http://www.drdianateachertraining.com>

STEM Teacher Training Workshop Investigation: Designing and Constructing Parachutes. Sep 6, 2011.
<http://youtu.be/f0n6V6PQGfK>. 5:19 min

Video footage taken from several Science, Technology, Engineering, and Math (STEM) teacher training workshops I have conducted recently. The selected footage is of teachers being introduced to parachute design. To begin the investigation teachers analyze seeds and seed dispersal. We make connections to biomimicry concepts (seeds to parachutes). We further explore Leonardo da Vinci's triangular shaped parachute inspired from nature (seed dispersal). Teachers then analyze and test a variety of pre-made parachutes. They are given a wide-array of materials to build their own parachutes from. Teachers then design, construct, and test their own designs. Re-designing if necessary. Terms and concepts relative to parachutes such as: aerodynamic, surface area, air resistance, kinetic and potential energy, gravity, etc.. are discussed during the investigation. To find out more about the STEM teacher training workshops I conduct nation and worldwide visit my website at: <http://www.drdianateachertraining.com> Quand Onest Deux music by Frank Harper.

STEM Explorations in the Early Childhood Classroom. Jul 16, 2011 <http://youtu.be/p-B3GjmAbyY>. 6:28 min

Early childhood teachers are introduced to hands-on-minds-on inquiry-based science, technology, engineering, and math (STEM) explorations during a teacher training workshop conducted by nationally recognized science education consultant, Dr. Diana Wehrell-Grabowski. Teachers were actively engaged in exploring STEM concepts through hands-on explorations. Additionally, teachers were introduced to early childhood and primary level children's literature with STEM related concepts. Books such as Iggy Peck The Architect, Block City, Three Little Pigs: An Architectural Tale, and many more books were reviewed during the teacher training workshop. For a list of the books and unique building blocks used during the workshop, and to find out more about Dr. Diana Wehrell-Grabowski's teacher training workshops she offers nation and worldwide please visit her site at: <http://www.drdianateachertraining.com>

Dr. Diana Wehrell-Grabowski Interactive Keynote Workshop Expanding Your Horizons Conference 2010. Mar 7, 2010. <http://youtu.be/b9ISM4zDrNo>, 9:59 min

Dr. Diana Wehrell-Grabowski provided an interactive keynote presentation for parents attending the Expanding Your Horizons Conference held at UCF, Feb. 2010. Participants conducted a wide-array of hands-on-minds-on investigations to explore science, technology, engineering, and math (STEM) concepts.

Participants observed:

Calloway hexagonal golf balls, compound eyes of horse shoe crab, kaleidoscopes, bird feather, model airplane wings, seeds, spiral shells, model cars, and more. Participants made connections to the structures, design, and mathematical patterns found in nature to how man has used these models in modern-day inventions, engineering, architecture, etc.. Connections to biomimicry were made throughout the presentation. The goal of the Expanding Your Horizons organization is to expose middle-school female students to science, technology, engineering, and careers by attending a one-day conference. Girls attend hands-on STEM workshops, parents also attend workshops designed for the parent audience. <http://www.women.cecs.ucf.edu/eyh/>

Expanding Your Horizons Organization website: <http://www.expandingyourhorizons.org>

Dr. Diana Wehrell-Grabowski is available for interactive keynote presentations and teacher training nationwide, check out her website at: <http://www.drdianateachertraining.com> and <http://www.drdianakeynotespeaker.com>