ONLINE INQUIRY-BASED PHYSICS CONTENT AND PEDAGOGY FOR THE ENHANCEMENT OF SCIENCE TEACHER DEVELOPMENT: ELEMENTARY AND MIDDLE GRADES

GG04Tue 01/07, 12:50PM - 1:00PM

Chuck Fidler PhD
Department of Earth and Environment
Florida International University

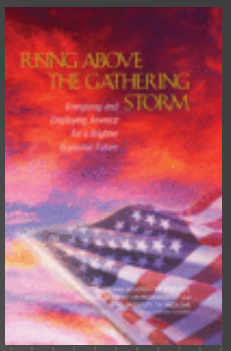
ABSTRACT

- With the advent of digital learning platforms, approaches to providing inquiry-based professional development can facilitate physics education for pre- and in-service teachers. This approach uses research-based methods of online techniques and combines a best-practice approach to learner-centered experimental-based physics education. The cohort-model design employs flexibility within an instructor-paced program, uses digital platforms accessible from off-campus web-based environments, and is cost-effective. Proving these types of experience proved to be a valuable mechanism for promoting successful physics education to educational professionals. Results (n=20) demonstrated this approach provides a sustainable platform for the growth and access to exceptional physics teacher development structure within the elementary and middle school levels. Specific design strategies encompassed sustainability concerns including access, cost, time, attendance, resources, availability, peer-collaboration, and professional application. Program development was supported by NASA.

TEACHING JOURNAL

SCIENCE TEACHER ENHANCEMENT PROJECT (STEP)

2010 2.5 year NASA earmark



IDENTIFYING THE NEED

Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future (NAS 2007)
Promote current STEM education efforts among elementary teachers
Inspire more students to enter into STEM fields
Helping schools raise the level of quality STEM education
Accessible and flexible learning environment

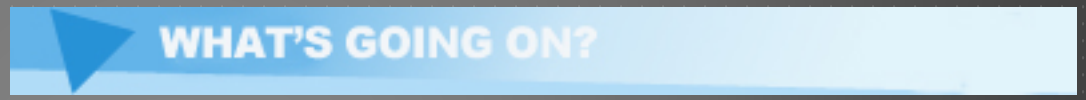
INQUIRY AND SCIENCE NOTEBOOK

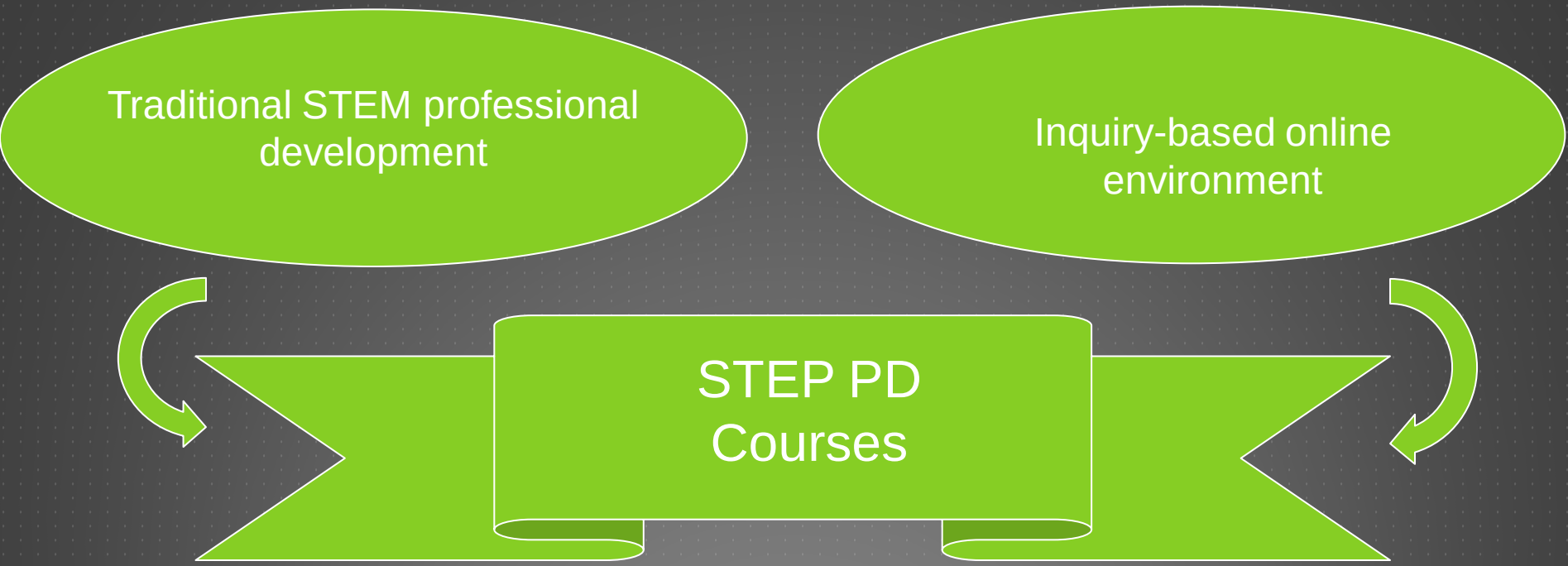
PROFESSIONAL DEVELOPMENT COURSE DESIGN FRAMEWORKS

- The field of *online* STEM professional development is fairly new
- Model inquiry-based teaching
- Based on AAAS (Benchmarks Project 2061) and NCTM (Common Core Standards)
- Grounded in Universal Design for Learning (UDL)
- Household based materials for experiments
- Build confidence teaching and learning STEM

TECHNOLOGICAL DEVELOPMENT OF LMS

- Contracted a design firm to facilitate Moodle design and Instructional designer
- Engaging design
- Robust functionality (embedded video, hyperlinking, grade books, unlimited page development, Turnitin.com, etc.)
- Open source program
- Technological support through hosting
- Modern collaborative system




Traditional STEM professional development
Inquiry-based online environment
STEP PD Courses

Messages
No messages waiting
Messages

Calendar
February 2012
Sun Mon Tue Wed Thu Fri Sat
1 2 3 4
5 6 7 8 9 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24 25
26 27 28 29
Events key
Global Course
Group User

Google Apps
Gapps Gmail
Gapps Domain not set.

Navigation
Home
My home
Site pages
My profile
My courses
Physical Science
Participants
Reports
Teaching and Learning Physical Science
25 October - 31 October
1 November - 7 November
8 November - 14 November
15 November - 21 November

Weekly outline

Teaching and Learning Physical Science

Welcome to Teaching and Learning Physical Science! This online course is meant help you better understand some physical science content as well as model more effective pedagogical strategies of teaching science.

To begin, read the *Welcome Letter* linked below then view the *Syllabus* link on the right side of the page to better aquaint yourself with the course. To better aquaint yourself with Moodle, review the *Student Moodle Guide* also linked on the right hand side of the page.

If you run into any technical issues, please contact (Technical Support Number here). If you have course related questions please contact Dr. Chuck Fidler at cfidler@wheelock.edu. We hope you enjoy your time in this course!

- Welcome Letter
- General Discussion Forum
- Instructor Announcements

25 October - 31 October

Lectures, Activities, and Assignments

Below are direct links to all of the activities and assignments you need to complete this week. The Weekly To Do List offers an at-a-glance view of all of the deliverables for the week.

- Week One To Do List

Introductory Assignments

- Introduce Yourself

Unit 1: Introduction

- Lesson 1.1: Course Goals
- Lesson 1.2: Instructor Introduction
- Lesson 1.3: Syllabus Review
- Lesson 1.4: Technical Requirements
  - Lesson 1.4: Technical Requirements Digital Dropbox
- Lesson 1.5: My Introduction
  - Lesson 1.5: My Introduction Forum
- Lesson 1.6: Establishing an Online Learning Community
  - Lesson 1.6: Establishing an Online Learning Community Forum
- Lesson 1.7: Science Notebooks

1 November - 7 November

Lessons, Activities, and Assignments

Course Information
Syllabus (to come)
Overview and Schedule (to come)
Technical Requirements
Student Moodle Guide (to come)

Week 1 Resource Bank
Articles
Other Resources

Week 2 Resource Bank
Articles
Other Resources

Week 3 Resource Bank
Articles
Other Resources

Week 4 Resource Bank
Articles
Other Resources

Week 5 Resource Bank
Articles

Elementary Science
- Participants
- Reports
- General
- Topic 1: Introductions
- Topic 2
- Topic 3
  - Weeks Five, Six, and Seven To Do List
  - Lesson 3.1: Pre-Assessment
  - Lesson 3.1: Pre-Assessment Assignment
  - Lesson 3.2: Elements of Science Notebooks
  - Lesson 3.2: Science Notebook Discussion Forum
  - Lesson 3.3: Water and Other Liquids Explorations
  - ...on 3.3: Water and Other Liquids Summary Assignment
  - Lesson 3.4: How Teacher Questions Support Inquiry
  - ...n 3.4: How Teacher Questions

You will need to following materials:

- a stove top pot large enough to hold 8 cups
- 6 cups of tap water
- 1 cup of macaroni

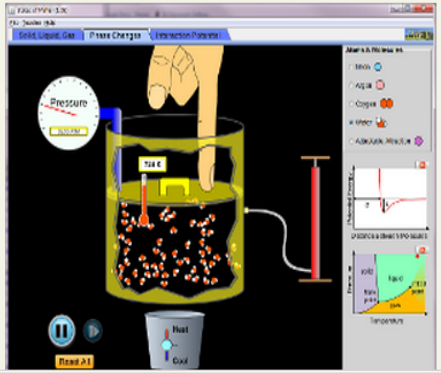
INQUIRY AND SCIENCE NOTEBOOK

Fill your stove top pot with 6 cups of tap water and add in the macaroni. Place the pot on your stove top, uncovered, and turn the stove burner on high.In your Science Notebook create a data table of qualitative observations when ever you observe a change in the macaroni/water combination. Repeat numerous times carefully writing down your observations. After the macaroni has come to a full boil, turn off the burner and let the macaroni cool. Conitnue to make observations as to the state of macaroni /water combination until the macaroni ultimately come to rest. In your Science Notebooks answer the following questions:

1. Explain how the macaroni changed it's state of motion while the water was heating up and cooling down.
2. When the water was boiling desribe the motion of the macaroni.
3. How can you use this macaroni as a model to lean about temperature?
4. Can you apply this concept to different states of matter?

INQUIRY AND SCIENCE NOTEBOOK

Engage the simulation of the particulate structure of solids, liquids and gases from PhET of University of Colorado at Boulder. This simulation allows you to view states of matter as if the particles making them up were magnified many times. Following these directions while using the simulation and record the answers to these following prompts in your Science Notebook.



QUALITATIVE RESULTS, I

- 33 pages of written text demonstrated some common themes including:
- *I feel that not only have I increased the depth of my own scientific knowledge but I have learned new ways to enhance my teaching of physical science concepts that can be applied to all areas of scientific inquiry.*
- The course also helped me see how inquiry can also stretch across grade levels. This was helpful in my *curriculum as I often create four week units, so I can create a unit that progresses through the inquiry steps*
- I definitely feel that my understanding of inquiry teaching has changed as a result of this class. Before *taking this class, I had little understanding of inquiry teaching.* I basically believed that inquiry involved students participating in independent investigations and not much more. I have come to realize that inquiry teaching is a constructive approach that guides students into *identifying misconceptions and creating conceptual changes* in their thinking by constructing a balance between investigations, questions, and discussions

Note: Coding paradigm in development

QUALITATIVE RESULTS, 2

- I think the biggest part I will bring back *immediately is the science notebook*. I had forgotten how important it was to document ideas and make those little drawings and charts that further explained thinking.
- Taking this class was the breath of fresh air I needed *to refocus me on meaningful science teaching.*
- Just as students using the Inquiry Model will return to an earlier stage as they conduct a science investigation, I too, *found myself returning to my science notebook as I progressed* through the course. I used my notes taken during the various lessons to support my opinion, or findings on an experiment. *The goal is not to fill students with facts, but to make them truly understand and be curious about finding out more.*
- Throughout this course my understanding regarding inquiry teaching has grown little by little. Science inquiry is more than asking a lot of questions. The kinds of questions we ask students are questions that cannot be found quickly in the text… *require reflective thinking and investigation…students should make observations, raise questions, and formulate hypotheses but not in a linear fashion.*

Note: Coding paradigm in development

CONTENT AND PEDAGOGY

- Overall results from qualitative data showed 'trends' that increased participant understanding of:
  - science inquiry
  - Properties of objects
  - Force and Motion
  - Student misconceptions
  - Teacher misconceptions


students
liquids
always
feedback
plan
background
level
different
implement
better
make
knowledge
helped
based
concepts
teacher
result
back
teach
way
opportunity
misconceptions
water
meaningful
importance
developing
teachers
away
elementary
stage
practice
experience
tension
also
get
Inquiry
teaching
investigations
many
thought
definitely
understanding
lesson
concept
Reflection
enjoyed
change
curriculum
lessons
gained
even
Science
taken
like
notebooks
questions
various
one
able
understand
take
videos
since
unit
using
oil
information
scientists
help
never
made
summer
first
thinking
grade
subject
class
learned
become
time
year
ve
inquiry
want
lot
ask
topic
set
curious
appreciated
properties
work
materials
another
believe
need
changed
look
skills
found
children
use
think
learners
online
much
discussions
changes
new
used
taking
implementing
solids
really
communication
science
ideas
matter
reading
just
activities
results
classroom
well
experiences
learning
experiments
feel
know
discussion
see
ways
scientific
course
motion
focused
student
school
readings
aware
don
great
part
now
deeper
surface
read
especially
important
notebook

QUESTIONS AND DISCUSSION

- Thank you any questions?
- cfidler@fiu.edu