Internet of Things (IoT) at UCF

UNIVERSITY OF CENTRAL FLORIDA

UCF RET Site: Collaborative Multidisciplinary Engineering Design Experiences for Teachers

High School: Math for College Readiness

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Math for College Readiness

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Background

Bringing the RET experience into the mathematics classroom is the desired goal. The math course exemplified for the process is Math for College Readiness (MCR). This course is an example of a typical intensive high school math course offered to students desiring assistance with algebraic fundamentals. Mastery of these algebraic fundamentals are expected before reaching college level mathematics, and all aspects of the curriculum and lesson plans of the course are geared to this very end. Because of the nature of MCR, aspects of STEM – more specifically the exposure of engineering and computer science disciplines and their applications in relation to mathematics – are often neglected (i.e. not infused within the lesson of an intensive math course). The justification for this lack stems from the premise that MCR was formed for the remedial student; i.e. advanced topics such as programming are not fitting or advantageous to such a student and not advantageous for the teaching of the course. The general sentiment is that STEM disciplines are reserved for students in courses such as Advanced Placement or IB programs. For this purpose, this survey counters the misconception that applicable STEM disciplines should only be pushed to academically rigorous secondary math courses. In other words, this lesson plan's proposition is that STEM exposure in remedial classes, specifically engineering and computer science principles, will increase student learning, promote the educational desired effect of increased STEM awareness, and potentially impact long term career choices for the average student.

In Figure 1, 75% of all U.S. 12th grade seniors are not proficient at secondary math and not performing at grade level. To say it another way, 75% of most high school seniors are taking some form of remedial math (The National Assessment of Educational Progress Report Cards). Studies on introduced STEM into secondary education suggest better outcomes for increased student participation in STEM fields (Vennix, J., den Brok, P., & Taconis, R., 2017). Many studies often focus on high performing students and not much on remedial courses at the secondary level. Though it is widely believed that STEM introduced into any course level has positive impacts. But for some reason, intensive and remedial courses are not emphasized..

PERCENTAGE OF STUDENTS AT OR ABOVE *Proficient*	Grade 4	Grade 8	Grade 12
CIVICS	27% 2010	23% 2014	24% 2010
ECONOMICS	—	—	42% 2012
GEOGRAPHY	21% 2010	27% 2014	20% 2010
MATHEMATICS	40% 2015	33% 2015	25% 2015
READING	36% 2015	34% 2015	37% 2015
SCIENCE	38% 2015	34% 2015	22% 2015
TECHNOLOGY & ENGINEERING LITERACY	—	43% 2014	—
U.S. HISTORY	20% 2010	18% 2014	12% 2010
WRITING	—	27% 2011	27% 2011

Figure 1

In Figure 2, *The Marzano Art and Science of Teaching Framework Learning MAP* outlines the desired outcomes for teachers in regard to numerous teaching areas.

The Marazano Art and Science of Teaching Framework encourages high expectations for low expectancy students (figure 3). DQ 9 states:

DQ9: Communicating High Expectations for All Students

39. Demonstrating Value and Respect for Low Expectancy Students

40. Asking Questions of Low Expectancy Students

41. Probing Incorrect Answers with Low Expectancy Students (N.a., 2013)

By infusing computer science and engineering principles into intensive mathematics courses the educator, by nature of the rigor required for engineering disciplines, communicates high expectations for low expectancy students. The benefits would be the equity of introduced STEM being pushed to all students and the research experience gained from RET can be implemented in the classroom and potentially impact students who normally are not exposed to STEM. The impact would further reach all students including students with an IEP. These students statistically have a higher enrollment in intensive math courses than students who do not - tough the majority of high school seniors will enroll into remedial math An IEP is:

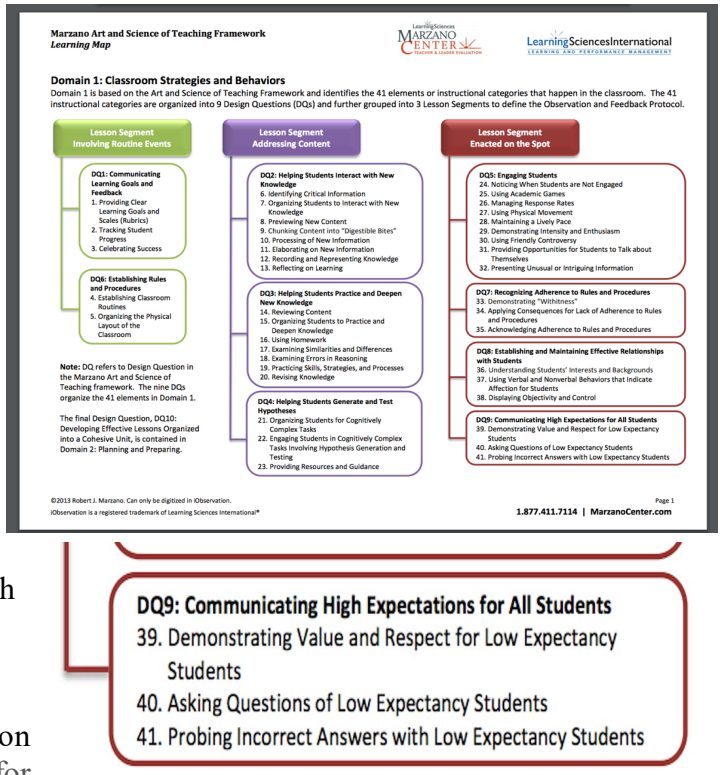

Figure 2

> …Individualized Education Program is a written plan for students with identified disabilities which sets the conditions for the specific accommodations, materials, and instructional approaches needed in order for the students to learn effectively. A federal law called ID EA (the Individuals with Educational Disabilities Act) mandates that all students with identified disabilities have an IEP. The IEP is a team-driven process that prioritizes services and supports for the student in order to best meet his or her educational needs. Students with disabilities and their families are an important source of information and experience in helping to ensure that the plans and their implementation work specifically and effectively for each individual (N.a., 2007).

The developed lesson from the RET program will prove to be a mentally intensive STEM lesson for MCR students. It will challenge and provide a real framework for potential careers for students in these courses. Programming and the concepts therein are not exposed to students who do not take a computer science class in high school. Unfortunately, many high schools do not offer a computer science class and if so, may have requirements that must be met before taking that may hinder interested but academically stagnant students from enrolling. Due to the nature of programming in relation to standards based education, there are no courses that can include computer science concepts at a surface level where the teacher still maintains adherence to the content area and standards but can freely infuse CS principles. The accompanied lesson plan proposes an implementation of programming concepts into math for college readiness in order to effectively challenge students, explain concepts, and introduce students to potential careers that they have not considered. A further analysis of research activities conducted through RET are detailed that can be implemented in lessons and include other computer science and engineering experiences.

RET Site: CoMET Lesson/Unit Plan

Course(s): Math for College Readiness
Grade Level: 12
Suggested Length of Lesson: 1 – 2 days

Materials/Technology Needed
- Computer
- Internet Access
- Paper
- Pen/pencils

Where this Fits
- Solving Equations, Order of Operations, Examining Inequalities

Lesson Objective(s)/Learning Goal(s)
- Practice variable assignments, solve equations, utilize order of operations, and examine the use of inequalities in the context of programming using a PHP sandbox (https://www.tehplayground.com)

Standard(s)/Benchmark(s) Addressed
- *Standards:*
  - MAFS.912.A-REI.1.1 - Solve Equations, Inequalities, Apply problem solving to real world scenarios

Standards for Mathematical Practice
- Solve and simplify simple equations and inequalities

Evidence of Learning (Assessment Plan)
- Showing the needed step to solve a simple equation or inequality
- Using operational properties to justify the step used.
- Operational Properties Page completed in their individual interactive notebook (digital or analog)

Instructional Strategies
- Identify Critical Information
- Organizing Students
- Previewing
- Chunking Information
- Helping to Process
- Helping to Elaborate (Canvas Discussion Board)
- Helping to Record/Represent (Students individually write their own math programs to represent what they learned)

Description of Lesson Activity/Experiences

1. Pre-test
2. PowerPoint - Showing the needed steps to solve simple equations or inequality

   - Using operational properties to justify the step used.

3. Notes - Operational Properties practiced on paper
4. PHP sandbox practice solving equations and expressions on PHP Sandbox
5. Post-test

Recommended Assessment(s) and Steps
- Pre-test using a Google Form - https://goo.gl/forms/O7RbSwtjqQdyavvI2
- Post-test using a Google Form - https://goo.gl/forms/99BMZTrpur5DTUJu1
- Discussion Board helping to process, elaborate, and record/represent knowledge of content

List of Materials/Resources Used
- Google Forms
- Canvas Discussion Board
- PHP Sandbox
- PowerPoint

Important Vocabulary

Term	Definition
Code	a system of words, letters, figures, or other symbols substituted for other words, letters, etc.
Programming	the action or process of writing computer programs
Computer Science	the study of the principles and use of computers
Variables	(of a quantity) able to assume different numerical values.
Conditions	set prior requirements on (something) before it can occur or be done
Variable Assignment	the setting of variables

Troubleshooting Tips

Access all browser related links and materials using Google's Chrome.

Supplement Readings/Exercises

For further exposure to programming concepts checkout Khan Academy's Hour of Code: https://www.khanacademy.org/hourofcode

Attachments

All screenshots of attachments are separate files uploaded.

I. PowerPoints for lecture

II. Electronic Handouts

III. Answer Keys

IV. Coding

```php
<?php
$x = 5;
$y = 4;
$z = 12;
$w = -5;
$answer = "";

// if x is greater than 4 solve the equation
if ($x > 4 ) {
    $answer = $x + $y * $w + 100;
    echo "The first answer is ".$answer."\n";
    $x = 3;
}

echo "<hr>";

// if x is less than 4 solve the equation
if ($x < 4 ) {
    $answer = $x + $y * $w;
    echo "The second answer is ".$answer."\n";
}

// if z is greater than 12 solve the equation
if ($z > 12 ) {
    $answer = $z + $y * $w;
    echo "The answer is ".$answer."\n";
}

// if w equals 0 solve the equation
if ($w == 0 ) {
    $answer = $x + $y * $w;
    echo $answer;
}
```

Post-Test

Complete each question. Do your best, but do not worry if you not familar with the concepts or that you do not know.

* Required

Again, Do your Best!!

Name (Last, First) *

Your answer

Period *

Choose

Observe the code below

```
$x = 5;
$y = 4;
$z = 12;
$w = -5;
$answer = "";

// if x is greater than 4 solve the equation
if ($x > 4 ) {
    $answer = $x + $y * $w + 100;
    echo "The first answer is ".$answer."\n";
    $x = 3;
}
```

1. What programming language is the code above written in? * 10 points

- PHP
- Megatron
- HTML
- Python
- WordPress
- I don't know


```
$x = 5;
$y = 4;
$z = 12;
$w = -5;
$answer = "";

// if x is greater than 4 solve the equation
if ($x > 4 ) {
    $answer = $x + $y * $w + 100;
    echo "The first answer is ".$answer."\n";
    $x = 3;
}
```


2. Which variable has the highest quantity? * 10 points

- z
- $z
- $answer

Operations on Real Numbers, Order of Operations, Solving Equations

Day 1

1

Adding Real Numbers

Add.

a. $(-7)+(-2)=-9$ Same sign

b. $(-6)+2=-4$ Different signs

c. $\frac{9}{10}+\left(-\frac{2}{10}\right)=\frac{7}{10}$ Different signs

d. $(-11.9)+(-3.4)=-15.3$ Same signs

2

Subtracting Real Numbers

Subtract

•a. $-21-15=-21+(-15)=-36$

•b. $8-(-5)=8+5=13$

•c. $9-11=9+(-11)=-2$

3

More Examples...

Subtract.

a. $5-8=-3$

b. $-9-(-10)=1$

c. $(-4)-5-(-2)=-7$

4

More Examples...

Subtract.

a. $5.9-(-0.8)=5.9+0.8=6.7$

b. $-\frac{3}{4}-\left(-\frac{4}{5}\right)=-\frac{3}{4}+\frac{4}{5}=\frac{1}{20}$

5

Multiplying Real Numbers

Multiply.

a. $4(-9)=-36$

b. $-7(-8)=56$

c. $9(-5.2)=-55.8$

d. $-\frac{3}{4}\cdot\frac{1}{7}=-\frac{3\cdot1}{4\cdot7}=-\frac{3}{28}$

6

Product Property of 0

$a\cdot0=0$. Also $0\cdot a=0$.

Example:
Multiply. $-6\cdot0$

$-6\cdot0=0$

Example:
Multiply. $0\cdot125$

$0\cdot125=0$

7

Quotient of Two Real Numbers

Divide.

a. $\frac{-20}{-4}=5$

b. $\frac{36}{-3}=-12$

c. $\frac{56}{-0.8}=-70$

8

Examples

a. Find the quotient. $\frac{36}{-12}$

$\frac{36}{-12}=36\div(-12)=-3$

b. Find the quotient. $\frac{3}{2}\div\frac{1}{6}$

$\frac{3}{2}\div\frac{5}{6}=\frac{3}{2}\cdot\frac{6}{5}=\frac{3\cdot6}{2\cdot5}=\frac{3\cdot3\cdot2}{2\cdot5}=\frac{9}{5}$

9

Simplifying Real Numbers

If ***a*** and ***b*** are real numbers, and $b\neq0$,

$$\frac{a}{-b}=\frac{-a}{b}=-\frac{a}{b}$$

10

The Order of Operations

PEMDAS

- Parenthesis
- Exponents
- Multiplication
- Division
- Addition
- Subtraction

The Order of Operations

Order of Operations
Simplify expressions using the order that follows. If grouping symbols such as parentheses are present, simplify expression within those first, starting with the innermost set. If fraction bars are present, simplify the numerator and denominator separately.
1. Evaluate exponential expressions, roots, or absolute values in order from left to right.
2. Multiply or divide in order from left to right.
3. Add or subtract in order from left to right.

Example

Use order of operations to evaluate each expression.

a. $7(-9)+2(-6)=-63-12=-75$

b. $\frac{8-3(-2)}{-9-2(-3)}=\frac{8-(-6)}{-9-(-6)}=\frac{8+6}{-9+6}=\frac{14}{-3}=-\frac{14}{3}$

Example

Simplify each expression.

a. $-9-5+11-(-7)=-9+(-5)+11+7=4$

b. $3^2-8+\left[-5-(-9)\right]=3^2-8+\left[-5+9\right]$
$=3^2-8+\left[4\right]$
$=9+(-8)+4$
$=1+4$
$=5$

Example

Evaluate: $\frac{6+9\div3}{3^2}$

$\frac{6+9\div3}{3^2}=\frac{6+9\div3}{(9)}$ ← Write 3^2 as 9.

$=\frac{6+(3)}{9}$ ← Divide 9 by 3.

$=\frac{9}{9}$ ← Add 3 to 6.

$=1$ ← Divide 9 by 9.

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