Incorporating Quantitative Reasoning in Your Course: Examples From Across Disciplines

Northern Essex Community College

Presenters:

Maria Carles – Associate Professor of Natural Sciences
Euthemia Gilman – Program Coordinator and Adjunct Faculty, Elementary and Middle High School Education Programs
Patricia Machado – Associate Professor of Economics, Liberal Arts Program Coordinator
Rory Putnam – Assistant Professor, Clinical and EMT Basic Program Coordinator, EMS/Paramedic Program Clinical Coordinator
Ellen Wentland – Associate Dean, Academic and Institutional Effectiveness
NECC’s Core Academic Skills

- Oral Communication
- Written Communication
- Global Awareness
- Information Literacy
- Quantitative Reasoning
- Science and Technology
Process: Creating Core Skills Intensive Courses

- Faculty submit applications
- Each application includes:
  - Skill definition
  - Intensive course criteria
  - VALUE rubrics derived learning outcomes to be included on course syllabi
Quantitative Reasoning

Students will learn to interpret and manipulate quantitative information and apply mathematical concepts and skills to solve real-world problems.
Diversity and Multiculturalism in Education

Euthemia I Gilman, Ed.M.
Quantitative Literacy Value Rubric

QL Rubric
- Interpretation
- Representation
- Calculation
- Application/Analysis
- Assumptions
- Communications

Diversity & Multiculturalism
- DESE School/District Profiles
- School/District Improvement Plans
- Compliance of Accommodation Services
- Action Plans, District Reviews
- District Analysis, Review
Interpretation

• Explain trend data shown in graphs and make reasonable predictions regarding what the data suggest about future events

• The Condition of Education 2012
• Indicator 6 Racial/Ethnic enrollment in public schools
• Indicator 7 Family Characteristics
• DESE School district Accountability 2012
• Andover, North Andover
• Haverhill
• Lawrence
• Methuen
• Pentucket Regional (Groveland, Merrimac, West Newbury)
Interpretation

- Explain trend data shown in graphs and make reasonable predictions regarding what the data suggest about future events
- Global Awareness

- The Condition of Education 2012
  - Indicator 23 Reading Performance
  - Indicator 24 Mathematics Performance
  - Indicator 25 History, Geography, Civics Performance
  - Indicator 26 International Reading, Math, Science Proficiency
Representation

- Converts information into an insightful mathematical portrayal that contributes to a deeper understanding

- Demographic information (median household income, household/family size, racial make-up)
- Development of possible trends
- Development of possible challenges for schools
Calculation

- Clear and concise attempts to solve problems
- Accuracy of data source
- Budget projections
- Title I School Improvement Plans
- Charter School application
- Innovative School Planning
Application/Analysis

• Qualitative analysis data used to base judgments, draw conclusions

• The Condition of Education 2012
  • Indicator 12 Characteristics of Elementary/Secondary Schools
  • Indicator 13 Eligibility for Free/Reduced Lunch
  • Indicator 14 School Crime and Safety

• District and School Improvement Plans
Assumptions

- Ability to make and evaluate important assumptions in estimation, modeling, and data analysis
- Global Awareness

- The Condition of Education 2012
  - Indicator 17/18 Characteristics of Teachers/Administrators
  - Indicator 19 Public School Revenues
  - Indicator 20 Public School Expenditures
  - Indicator 21 Variations in Instruction Expenditures
  - Indicator 22 Education Expenditures by country
Communication

- Expression of quantitative evidence in effective format
- Small Group written/oral presentation to simulate School Staff
- Individual written responses
- Final Projects
Anatomy and Physiology I & II

Maria Carles, Associate Professor
The Nervous System and Drugs

How drugs affect the nervous system

Adapted from Biology by Sylvia Mader’s in class activities (McGraw-Hill)
Activity Objectives

During this activity the students will:

- Explain the basic modes of action of several drugs and chemicals that affect the central nervous system
  - Interpretation
  - Communication

- Draw a graph that demonstrates the effect of organophosphates and carbamates on acetylcholine esterase activity
  - Calculation
  - Interpretation
  - Representation
  - Application/analysis
  - Assumptions
Demonstrate understanding of the action of benzodiazepines by explaining how those could be used in a sinister/illegal fashion as a “date rape” drug.

- Interpretation
- Communication
- Analysis
The Nervous System and Drugs

- Students will work in groups of four
- Students will assume the role of a student in the process of finishing a pharmacy technician program
- Reinforce and understand the modes of action of certain drugs and chemicals in the CNS using examples that may be familiar to the students
- Students will be called on to present their group’s answers to class.
Activity

• How do Selective Serotonin Reuptake Inhibitors (SSRIs) work?

• Rationale for using carbamates as Alzheimer’s treatment.
  – Graph of AChE activity vs. OP or carbamate concentrations.

• Effect of benzodiazepines on CNS
  – Explaining how those could be used in a sinister/illegal fashion as a “date rape” drug.
How do Selective Serotonin Reuptake Inhibitors (SSRIs) Work?

• Inhibit transporter that takes up the serotonin that is released from serotonergic nerve terminals, so that serotonin stays in the synaptic cleft longer and has an effect on expression of post synaptic receptors.

• SSRIs are used to treat depression.

Decipher and explain information presented in words
Rationale for Using Carbamates as Alzheimer’s Treatment

• Alzheimer’s dementia is often associated with a decrease in activity in CNS neurons that are stimulated by acetylcholine.
• Carbamates block AChE and increase acetylcholine concentration in the synaptic cleft.
• “The dose makes the poison” – Low Dose.
• Increase acetylcholine concentration at the synapse to counteract the loss of cholinergic neurons. Just a treatment for symptoms.

Successfully perform calculations required to solve a given problem.
Convert relevant information into mathematical forms, interpret and evaluate data, use quantitative information to support assertions and/or to solve real world problems.
Effect of Benzodiazepines in CNS

• GABA is an inhibitory neurotransmitter, causes neurons to become hyperpolarized → less likely to initiate action potential → calming effect.

• Drugs such as Valium, Xanax act on GABA receptors and intensify the effect.

• Rohypnol is 10X more potent → extreme sedation and amnesia → Date Rape Drug

Use quantitative information to support assertions and/or to solve real world problems
Macroeconomics & Microeconomics

Patricia Machado, PhD
Associate Professor of Economics
Program Coordinator for Liberal Arts
Northern Essex Community College
Sample Lessons

• Macroeconomics – Does the Penny Make Cents?
  ➢ Interpretation
  ➢ Representation
  ➢ Application/analysis
  ➢ Assumptions
  ➢ Communication

• Microeconomics – Cash-Strapped Farmers Feed Candy to Cows
  ➢ Interpretation
  ➢ Representation
  ➢ Application/analysis
  ➢ Communication
Sample Lessons (continued)

• Macroeconomics example of calculation:
  – GDP = C + I + G + (X − M)
  – Did you know that 70% of the US Economy is driven by C? Does anyone know what C stands for?

• Microeconomics example of calculation:
  – PED = % change in QD / % change in P
  – In other words, change in QD divided by average Q all divided by change in P divided by average P
Summary of Quantitative Reasoning Selection

• Northern Essex Community College focus on Core Academic Skills
• Global Awareness, Writing, Information Literacy
• Natural Fit to Quantitative Reasoning
• Inherent versus Intentional
• Intentionality raises the importance of Quantitative Reasoning, Core Academic Skills, and Quantitative Literacy Value Rubric
EMT 104 Pharmacology for the Paramedic

Rory S. Putnam, AA, NREMT-P, I/C
Quantitative Reasoning Principles in EMT 104

• Demonstrate the ability to administer medications safely and effectively within the scope of practice for a paramedic including successfully performing drug calculations required to solve a given problem.

• Use quantitative information to support assertions and/or to solve real world math problems relevant to pharmacology and drug calculations.
Principles (cont’d)

• Convert relevant information into various mathematical forms such as equations, diagrams and tables specifically related to drug calculations including charts and equations/formulas for medication administration dosing.

• Use Metric/English math system calculations in terms of drug administration, patient weights and other pharmacological applications.
Drug Dosage Calculations

• What we cover:
  – The metric system & equivalents to English system
  – Common conversions
  – Multiplying and dividing fractions
  – Equivalencies and determining parts
  – Understand and interpret statistical data related to pharmacokinetics (action of drugs, efficacy rates, etc.), factors altering drug responses (half-lives), etc.
More…

• Methods (equations) for figuring:
  – Patient weights based on metric (kg from lbs)
  – Medication and fluid infusion (drip) rates
  – Medication doses for single administration (IV, PO, SL, etc.)
  – Medication dose by weight
  – Medication dose by time (mg/min)
All of these include a multi-part mathematical equation for the student. They must be able to determine:

- The dose for the patient
- How it is to be administered
- What the concentration of the medication is on hand
- How to achieve the desired dose
EMT 104...by the numbers!

- Medication administration charts are also used to avoid lengthy calculations & drug errors to simplify the paramedic’s job.
- Example: the Lidocaine or dopamine clock
- Medication dose charts
How do we do it?

• Classroom discussions and exercises
• Real world scenarios in lab exercises
  – Meds math
  – IV stations
  – Medication stations
  – ‘Megacode’ stations (‘putting it all together’)
• Quizzing and testing
• Evaluation based on QR learning and outcomes criteria