CORE LEARNING AT NOVA: QUANTITATIVE LITERACY ASSESSMENT

Linda Baughman, General Education Coordinator

Office of Institutional Effectiveness and Student Success
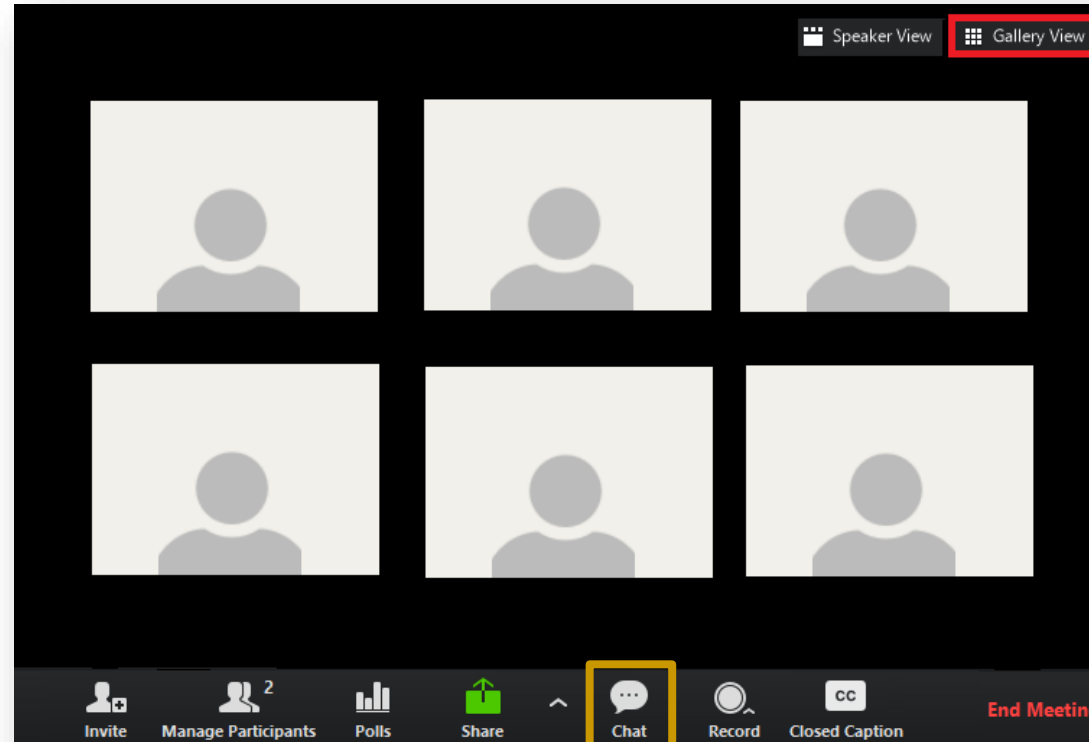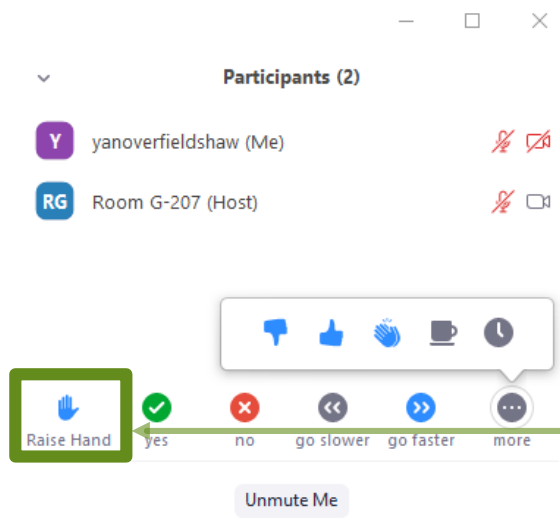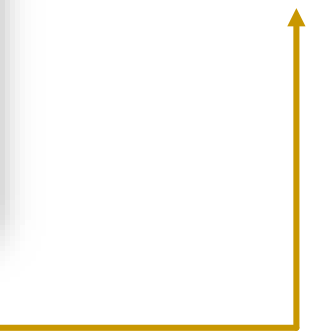*Office of Academic Assessment*

ZOOM CONTROLS

To Raise Your Hand

- Click the "Raise Hand" option if you would like to contribute to the discussion and/or have a question.

Polling and Chatting
- Use the chat feature to:
  - ✓ Extend on answers from polls
  - ✓ Comment on topics
  - ✓ Ask questions

Speaker View | Gallery View

Invite | Manage Participants | Polls | Share | Chat | Record | Closed Caption | End Meeting

Participants (2)

Y yanoverfieldshaw (Me)

RG Room G-207 (Host)

Raise Hand | yes | no | go slower | go faster | more

Unmute Me

ANSWERING 6 FUNDAMENTAL QUESTIONS

I. What is General Education/Core Learning Assessment at NOVA?

II. Why does Assessing Quantitative Literacy Matter?

III. How has Quantitative Literacy looked in the Past (2017-2018) at NOVA?

IV. What is Quantitative Literacy?

V. What are Resources to Assess Quantitative Literacy?

GENERAL EDUCATION = CORE LEARNING AT NOVA

A core set of knowledge, abilities, and skills essential to the undergraduate curriculum to optimize student success for work and life.

Core Learning at NOVA

NOVA's degrees incorporate instruction across the curriculum in six Core Competencies which employers rank as important for all graduates.

Civic Engagement

Critical Thinking

Professional Readiness

Quantitative Literacy

Scientific Literacy

Written Communication

Top Skills Employers Find Important*

Oral Communication
Ethical Behavior
Teamwork
Problem Solving
Written Communication
Ability to Work with Diverse Groups
Autonomy (e.g., Time Management)
Self-Motivation (e.g., Proactive Ideas)
Skilled with Math and Statistics
Critical Thinking

*National Data from 2018 Hart Report on Higher Education

Office of Institutional Effectiveness and Student Success

Reaching Student Success at NOVA:
Quantitative Literacy

20 *NOVA educational programs and disciplines assessed the quantitative literacy skills of 1,880 students. 67% of students exceeded or met Quantitative Literacy targets.*

67.3%
of Students
Met or Exceeded the Target
(N = 1266 students)

13.8%
of Students
Partially Met the Target
(N = 260 students)

18.8%
of Students
Did Not Meet the Target
(N = 354 students)

Samples of Quantitative Literacy Outcomes

100 Courses

"Students will synthesize their knowledge of the fundamentals and practices of engineering technology"
- Engineering Technology, A.A.S.

"Students will interpret and present quantitative information, analyze thoughtfully, communicate quantitatively, and problem solve."
- Social Sciences, A.S.
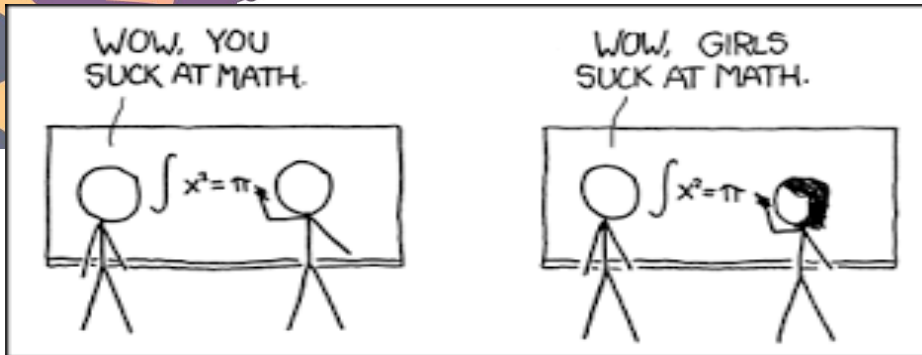
200 Courses

"Students will be able to calculate the basic impact of marginal costs for the production of goods in a capitalist system."
- Business Administration, A.S. and Business Management, A.A.S.

""Students will appropriately interpret graphic depictions of ventilator waveforms."
- Respiratory Therapy, A.A.S.

WHY DOES ASSESSING QL MATTER?
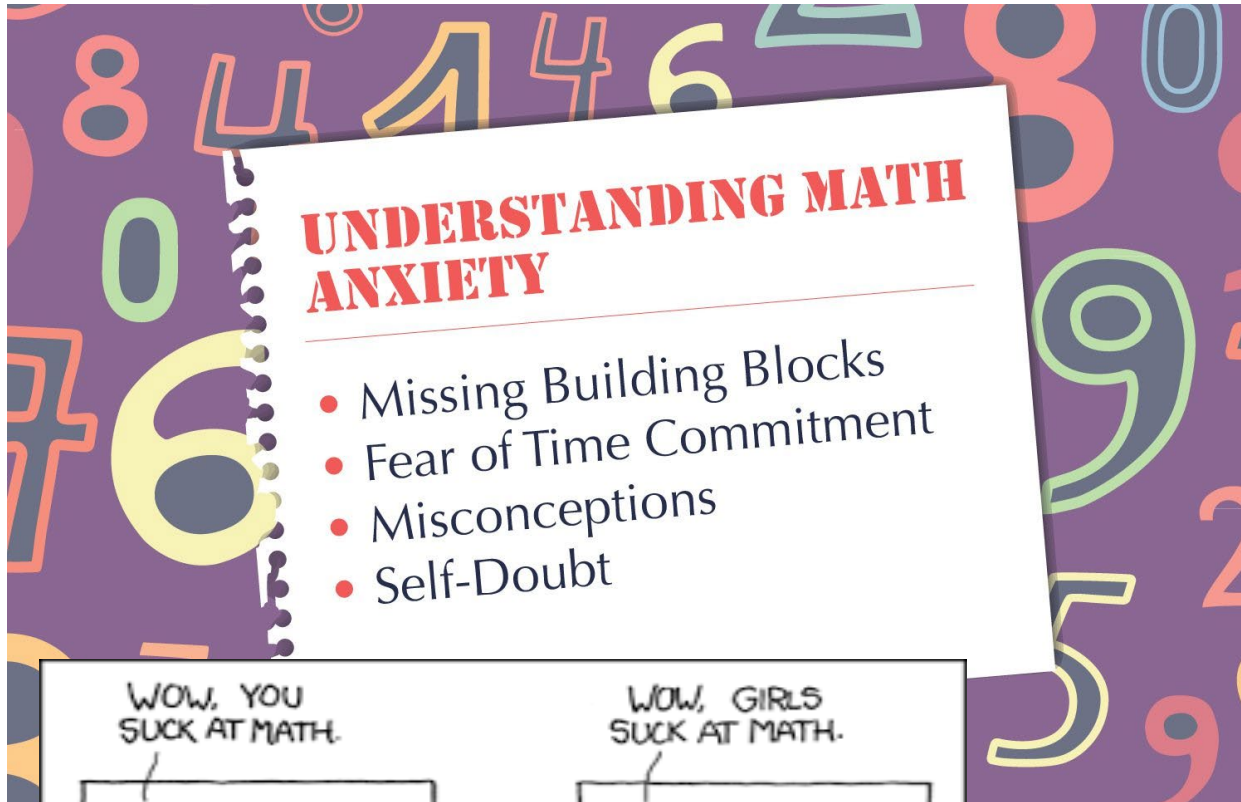
Xkcd.com

▸ As early as first grade nearly half of students studied were "moderately nervous" or "very, very nervous" about math.

▸ 25% of students at four-year colleges experience moderate or high levels of math anxiety.

▸ 11% of American university students are so afraid, they require counseling.

YouTube

overcoming mathematics phobia in schools

And that's how it works.

▶ ▶| 🔊 1:43 / 14:41   CC ⚙ 🖼 ▢ ⛶

Five Principles of Extraordinary Math Teaching | Dan Finkel | TEDxRainier

FYI…Lots of great videos on teaching quantitative literacy on Youtube.

MATHEMATICAL THINKING
MATHEMATICAL THINKING
STAT # 2

DFTBA!
CRASH COURSE

John Green

STATISTICS PREVIEW
CRASH COURSE: STATISTICS PREVIEW EPISODE WOO! WOO! WOO!
STATS # 0

BE THE COMIC

xkcd VR
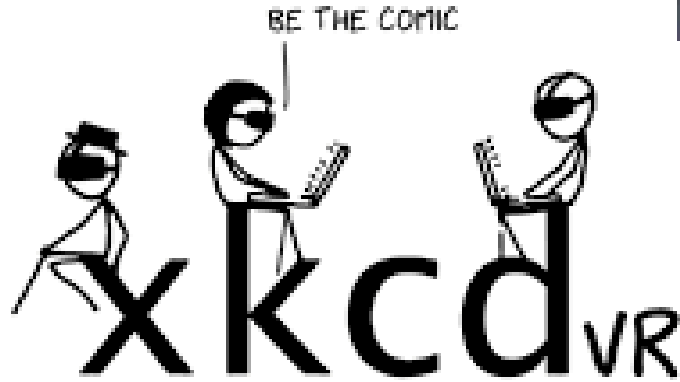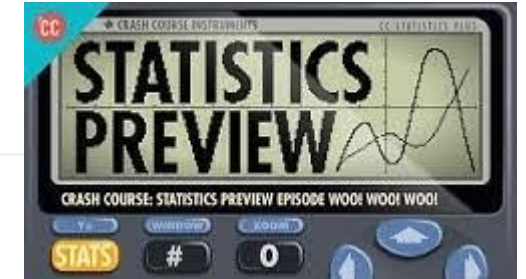
A webcomic of romance, sarcasm, math, and language.

When the crown was finished, the king suspected that it was not made by pure gold.

SKILLS AND KNOWLEDGES EMPLOYERS FIND IMPORTANT:

Effective oral communication	**90 %**
Ethical judgment and decision-making	87 %
Work effectively with others in teams	**87 %**
Apply knowledge in a real world setting	87 %
Work independently (time management)	**85 %**
Self-Motivation (proactive ideas/solutions)	85 %
Critical thinking and analytical reasoning skills	**84 %**
Effective written communication	78 %
Problem solve w/people from diff. backgrounds	**73 %**
Ability to work with numbers and statistics	55 %

"Fulfilling the American Dream: Liberal Education and the Future of Work." Hart Research Associates for the AAC&U. 2018.

HOW DOES ASSESSING QL HELP?

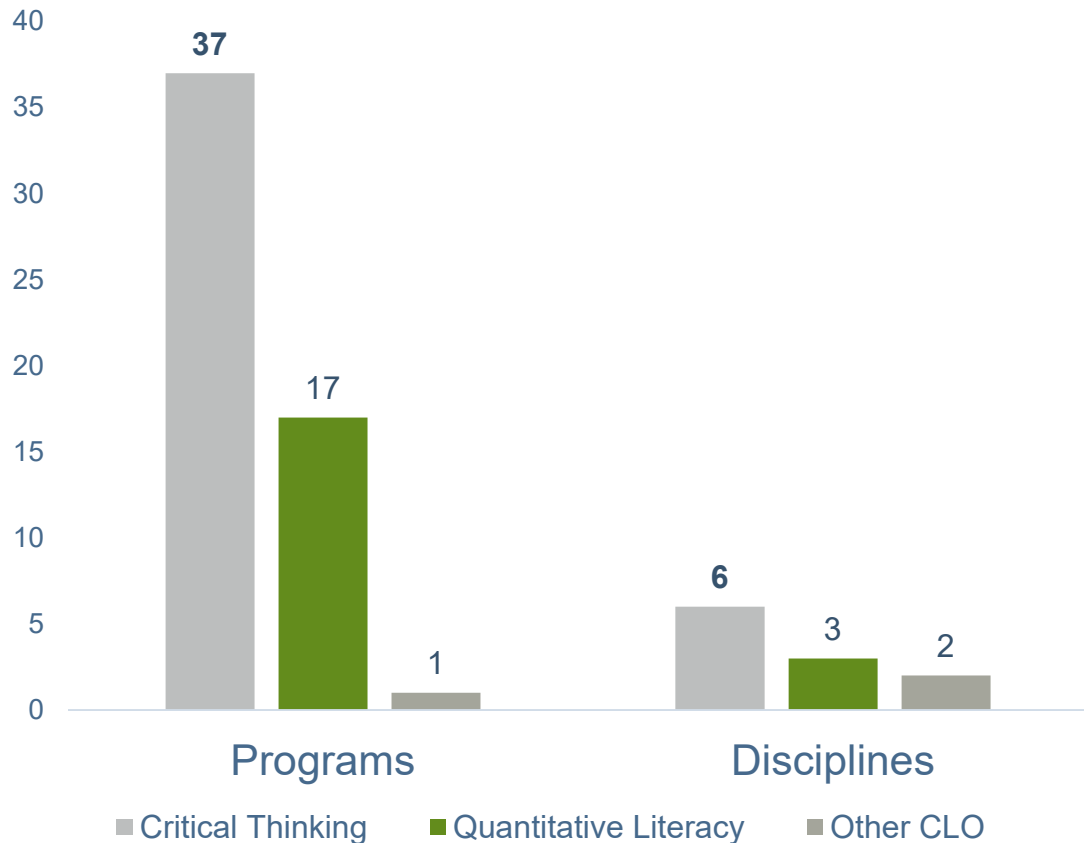Assessment refines learning goals.

- *SLOs & CLOs become persuasive tools.*

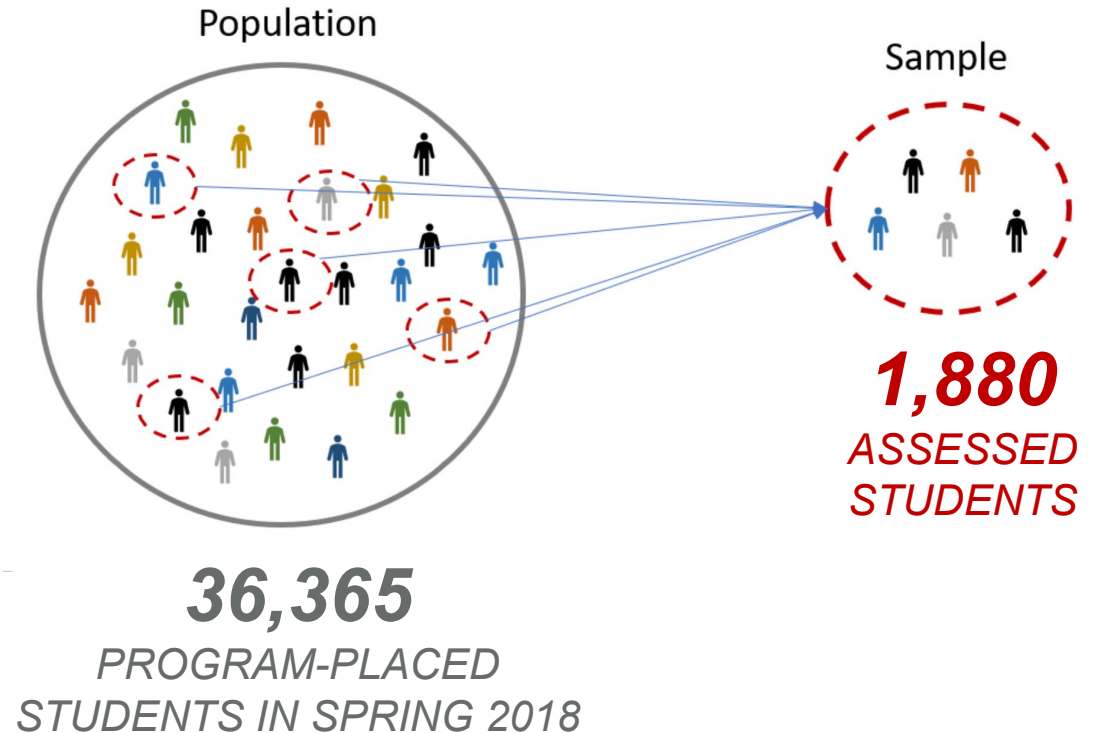Gives us the language to tell students what they are learning.

- *SLOs and CLOs on course descriptions/summaries, syllabi, assignment descriptions, rubrics, on exams*

- *SLOs and the college CLOs should be a part of your students' lexicon*

- *So later they can describe what they've learned*

2017-2018 ASSESSMENT OF QUANTITATIVE LITERACY

Programs/Discipline Assessment

Bar chart — values:

	Critical Thinking	Quantitative Literacy	Other CLO
Programs	37	17	1
Disciplines	6	3	2

■ Critical Thinking ■ Quantitative Literacy ■ Other CLO

Student Sample Size

Population

Sample

1,880 ASSESSED STUDENTS
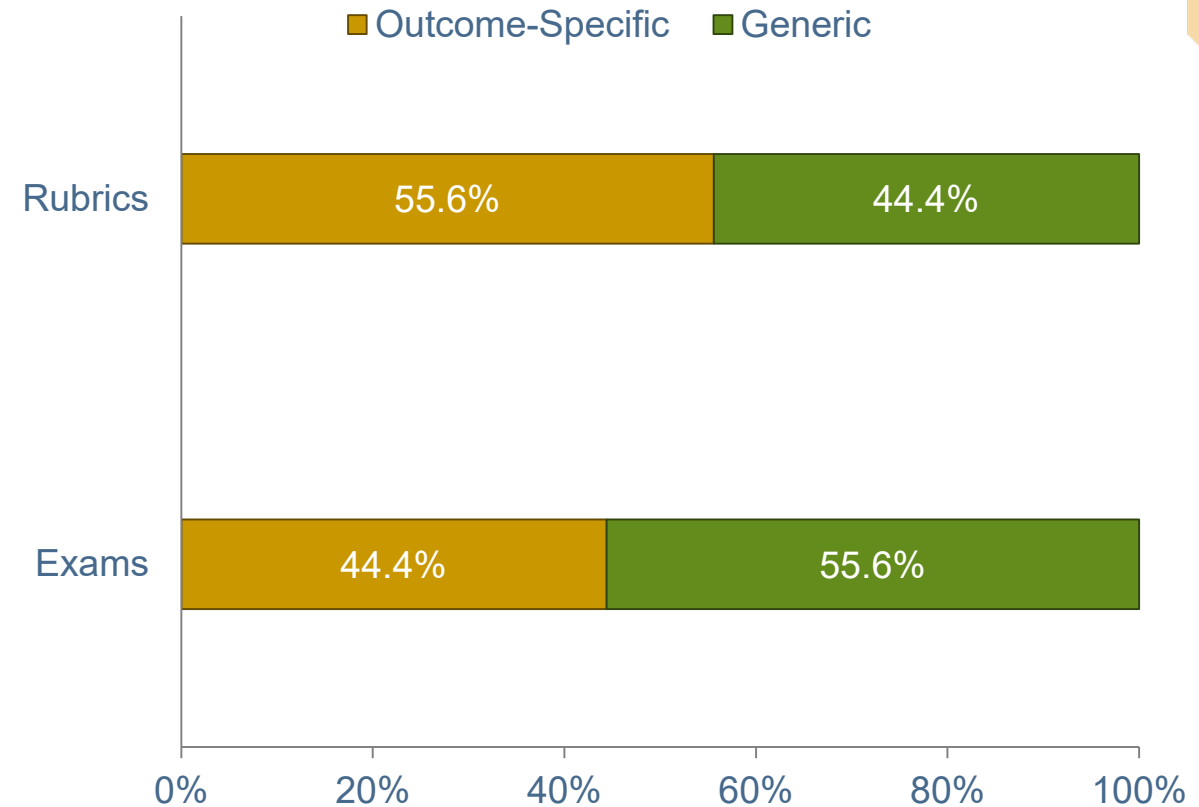
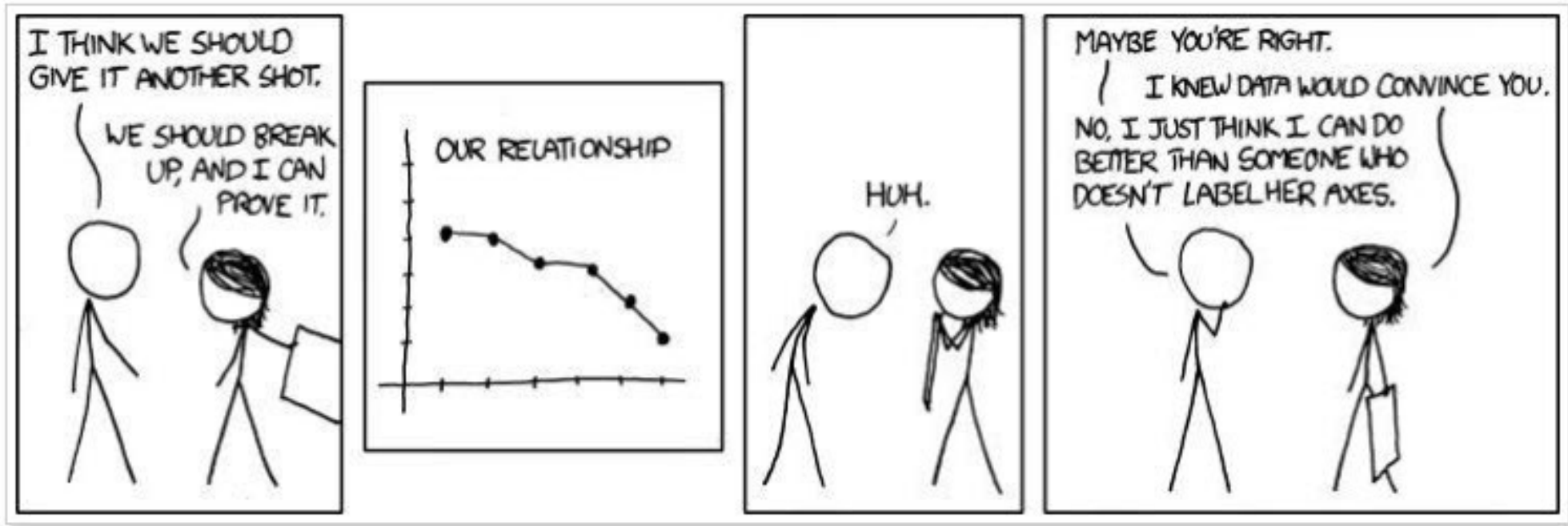**36,365** PROGRAM-PLACED STUDENTS IN SPRING 2018

EMBEDDED COURSE ASSESSMENT

Assessing Quantitative Literacy

Rubric/ Measure	Assignment-Specific Rubric (ASR): 1. Clear description of grading criteria/grading scale is provided. 2. Provides purpose of assignment
	Generic Rubric (GR): Does not directly evaluate the CLO being assessed: is too generic; a grading scale is not provided; and/or no purpose is presented.
Examination	Outcome-Specific Examination (OS): The exam questions evaluate the assessed CLO by addressing 3 or more aspects of the CLO.
	Generic Examination (GE): The exam questions do not fully evaluate the assessed CLO. Only assessed 2 or fewer of the concepts and/or is unrelated to the CLO.

Legend: ■ Outcome-Specific ■ Generic

	Outcome-Specific	Generic
Rubrics	55.6%	44.4%
Exams	44.4%	55.6%

0%   20%   40%   60%   80%   100%

Source: xkcd.com

# WHAT IS QUANTITATIVE LITERACY?

WHAT IS QUANTITATIVE LITERACY?

"The ability to perform calculations, interpret quantitative information, apply and analyze relevant numerical data, and use results to support conclusions. Degree graduates will calculate, interpret, and use numerical and quantitative information in a variety of settings."

QUANTITATIVE LITERACY CATEGORIES

Category	Description
Data Interpretation (DI)	Rubric assesses students' ability to interpret data in a thoughtful and critical manner.
Presentation of Quantitative Information (PQ)	Rubric assesses students' ability to graphically depict important information (e.g., charts, graphs, etc.).
Calculation (C)	Rubric assesses students' ability to identify the right formula and/or perform the calculation correctly.
Application/Analysis (AA)	Rubric assesses students' ability to analyze quantitative information and/or use it as justification for solutions or as a persuasion technique.
Assumptions (A)	Rubric assesses students' ability to identify the assumptions from data.
Communication (COM)	Rubric assesses students' ability to present quantitative information properly and effectively to an audience (e.g., stakeholders, classroom, etc).

ASSESSING Operational Definitions, rubrics and exams.
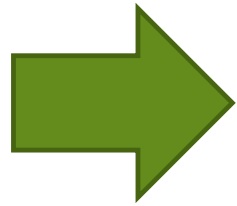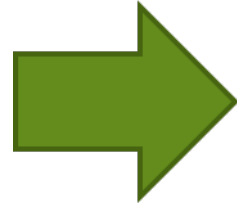
Category	Description
Operationalization (O)	Program/discipline provided an operationalized definition of the CLO that was clear and measurable; _includes actions students will take to demonstrate learning of this outcome (e.g., demonstrate proficiency in, analyze data, interpret information, etc.)_
Rubric/Measure	**_Rubric in APER (R):_** _Separate Rubric/assessment measure and/or grading scale was not provided but was explained in the APER._
	No Rubric Provided (NRP): _No rubric was provided either with the APER submission email or in the APER._
	Assignment-Specific Rubric (ASR): _Rubric designed to evaluate the CLO being assessed and one or both of the following aspects: 1. Clear description of grading criteria/grading scale is provided. 2. Provides purpose of assignment_
	Generic Rubric (GR): _Does not directly evaluate the CLO being assessed, is too generic, grading scale not provided, no purpose presented._
Examination	**Outcome-Specific Examination (OS):** The exam questions evaluate the assessed CLO by addressing 3 or more aspects of the CLO.
	Generic Examination (GE): The exam questions do not fully evaluate the assessed CLO. Only assessed 2 or fewer of the concepts and/or is unrelated to the CLO.

OPERATIONALIZING QUANTITATIVE LITERACY/ ASSESSMENT METHOD: GREAT EXAMPLE

1. Students will be able to describe how buildings are constructed

    Project demonstrates the students' ability to research building materials and methods.

    Project demonstrates the students' ability to assemble building components.

    Project demonstrates the students' ability to design construction details.

    Project demonstrates the students' ability to graphically communicate construction systems.

OPERATIONALIZING QUANTITATIVE LITERACY/ ASSESSMENT METHOD: GREAT EXAMPLES

2. Students will be able to calculate the basic impact of marginal cost for the production of goods in a capitalist system.

Calculate the average total, fixed and marginal costs for a "competitive" firm given a certain production cost schedule.
1. determining the efficient level of output
2. calculating output based on market price
3. calculating total profit

OPERATIONALIZING QUANTITATIVE LITERACY/ ASSESSMENT METHOD: GOOD EXAMPLES

1. Students will demonstrate Quantitative Literacy skills calculating superheat and sub-cooling.

2. Student will apply and demonstrate engineering problem solving methodology.

- Part A: Defining vectors of forces in 3D

- Part B: Solving the problem using simultaneous equations of 3 unknowns and 3 equations.

COMMENTS:
- Has a general sense of what is expected of the students, but not enough detail to know precisely students are doing.
- Sometimes the math part is clear, but the context is not…
- Remember your audience…

OPERATIONALIZING QUANTITATIVE LITERACY/ ASSESSMENT METHOD:
EXAMPLES NEEDING WORK

1. Course grade

2. Final exam grade

3. A comparative analysis using appropriate statistics, graphs and charts, and accurate labeling and explanation of graphs.

COMMENTS:
- Overly general
- Vague
- Lack detail
- No specific sense of what students are doing, or what particular content they are applying critical thinking to.
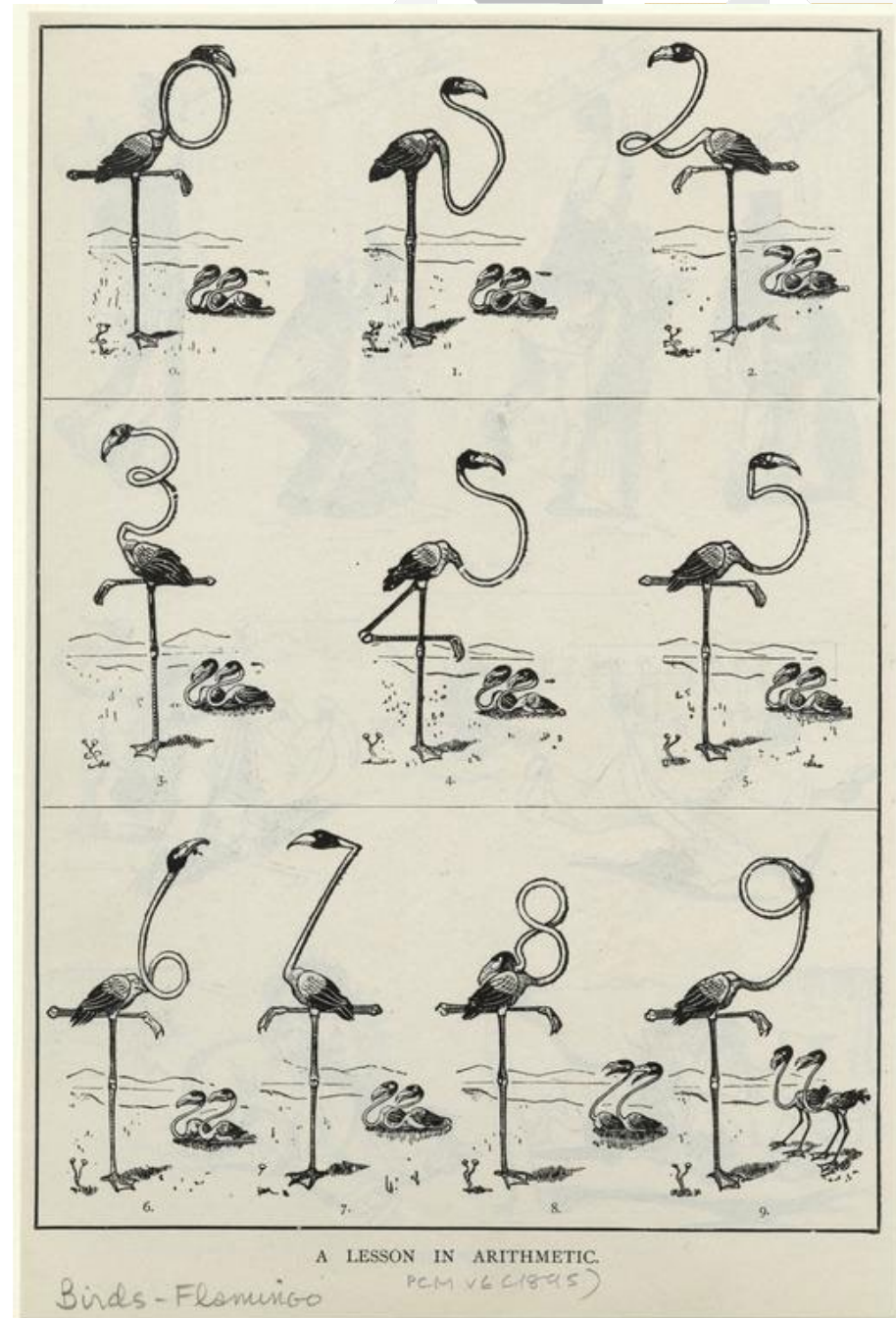
Criteria	Excellent	Good	Average	Poor	Total Points for Criteria
1. Investigation and research	❑ Subject has been ==thoroughly researched== ❑ Submits proper documentation of research and cites sources ❑ Collects ==written and visual research in a journal== ❑ Clearly organizes research ❑ Provides many ==insightful comments and analysis==	❑ Subject has been well researched ❑ Finds multiple relevant and cited sources ❑ Collects written and visual research into a journal ❑ Research is well organized ❑ Provides above average comments and analysis	❑ Subject has been researched ❑ Cites some sources ❑ Collects research into a journal ❑ Cites some sources ❑ Finds a few sources that are visual and written ❑ Research is organized ❑ Provides some comments and analysis	❑ Subject has not been researched ❑ Does not cite sources ❑ Does not collect research into a journal ❑ Does not finds sources that are visual and written ❑ Research is not organized Does not provide comments and analysis	5 points
2. Interpretation and Concept Formulation	❑ Research has been ==evaluated well-supported==, and logical conclusions have been drawn. ❑ Clearly ==communicates== the information through symbols, numbers and text. ❑ Design, composition and aesthetics support information	❑ Research has been evaluated, supported, and conclusions have been drawn. ❑ Communicates the information through symbols, numbers and text. ❑ Above average design, composition, and aesthetics support information	❑ Average solution to the problem for the assignment. ❑ Average communication of the information through symbols, numbers and text. ❑ Average design, composition, and aesthetics support information	❑ Final solution to the problem is not seen in the assignment. ❑ the information is not communicated through symbols, numbers and text. ❑ Design, composition, and aesthetics do not support information	5 points

Criteria	Excellent	Good	Average	Poor	Total Points for Criteria
3. Mathematical Visualization Proficiency	❑ Shows an excellent level of proficiency in understanding the mathematical aspects of the project ❑ Accurately executes the project using the necessary tools for graphing or charting	❑ Shows a good level of proficiency in understanding the mathematical aspects of the project ❑ Executes the project using the necessary tools with no visible problems	❑ Shows a basic level of proficiency in understanding the mathematical aspects of the project ❑ Executes the project using the necessary tools with visible problems	❑ Shows no level of proficiency in understanding the mathematical aspects of the project ❑ Improperly executes the project. ❑ Does not use the necessary tools for charting and graphing	5 points
4. Final infographic execution	❑ Thorough evidence of strong research and development. ❑ Concept is well thought out and accurate ❑ Student followed all the specified instructions for the project. ❑ Thorough level of success of the project in relationship to the assignment.	❑ Above average research and development. ❑ Concept is well thought out but needs further development. ❑ Student followed most (but not all) the specified instructions for the project. ❑ Above average level of success of the project in relationship to the assignment.	❑ Average research and development. ❑ Only a basic overall concept was thought out and was not a ❑ Student followed some (but not all) the specified instructions for the project. ❑ Average level of success of the project in relationship to the assignment.	❑ No evidence of strong research and development. ❑ Concept is not thought out and developed. ❑ Student did not follow all the specified instructions for the project. ❑ Weak level of success of the project in relationship to the assignment.	10 Points
TOTAL					25 points

Criteria	Points Earned	4-Mastering: Demonstrates a thorough understanding of the given information and the relationship between different criteria	3-Acceptable: The criteria being assessed are presented clearly and include details	2-Developing: Some aspects are incorrect, or key details are missing	1-Needs Improvement: The criteria being assessed are unclear, inappropriate, or wrong	0-Emerging: Does not attempt
Interprets Quantitatively: Explains the numerical information presented in mathematical forms (equations, formulas, graphs, diagrams, and tables).		1. Recognizes the data or facts available for answering the question. 2. Interprets logically and explains the mathematical information provided in numerical forms such as tables, graphs, and equations. (e.g., Can read the temperature from a graph and includes correct unit and the correct significant figures, etc.). 3. Draws inferences from the given information (e.g., can calculate and presents the slope of a graph correctly).	1. Recognizes most of the data or facts available for answering the question. 2. Interprets and explains the mathematical information provided in numerical forms (tables, graphs, and equations), but occasionally makes minor errors related to units (e.g., reads the temperature from a chart, but doesn't include the correct unit). 3. Draws inferences from the given information with minor errors (e.g., calculates the slope correctly but doesn't present the answer in the correct number of significant figures).	1. Recognizes some of the data or facts available for answering the question. 2. Explains the mathematical information provided in numerical forms using tables, graphs, and equations, but makes some errors related to computations and units (e.g., reads the temperature from a chart, but doesn't include the correct unit, significant figures, etc.) 3. Draws inferences from the given information with some errors in the answer (e.g., calculates the slope by using the right equation or formula but the answer is inaccurate).	1. Somewhat unclear about the data or facts available for answering the question. 2. Attempts to explain the mathematical information provided in numerical forms using tables, graphs, and equations, but the answer is unclear. 3. Draws inferences from the given information with major errors (e.g., calculates the slope using wrong values or wrong equations).	Does not attempt
Presents quantitatively: Converts the given information into mathematical forms such as tables, graphs, diagrams, and equations.		1. Represents relevant qualitative and/or quantitative data by using an efficient, correct, and simple methods of presentation, such as tables. 2. Effectively organizes and/or expresses quantitative and qualitative evidence in an appropriate form using equations, graphs, diagrams, tables, and/or words.	1. Represents relevant qualitative and/or quantitative data by using correct methods of presentation, such as tables. 2. Organizes and expresses quantitative and/or qualitative evidence in an appropriate form using equations, graphs, diagrams, tables, and/or words.	1. Represents relevant qualitative and/or quantitative data by using somewhat correct methods of presentation, such as tables. 2. Organizes and expresses quantitative and/or qualitative evidence in the form of equations, graphs, diagrams, tables and/or words with minor error (e.g. labeling or units have minor errors)	1. Creates a relevant qualitative and/or quantitative data by using incorrect methods of presentation, such as tables. 2. Organizes and expresses quantitative and/or qualitative evidence in the form of equations, graphs, diagrams, tables and/or words that are/is unorganized and have some errors.	Does not attempt

Criteria	Points Earned	4-Mastering: Demonstrates a thorough understanding of the given information and the relationship between different criteria	3-Acceptable: The criteria being assessed are presented clearly and include details	2-Developing: Some aspects are incorrect, or key details are missing	1-Needs Improvement: The criteria being assessed are unclear, inappropriate, or wrong	0-Emerging: Does not attempt
Analyzes thoughtfully: Draws relevant conclusions from provided information and data, and predicts future trends.		1. Accurately interprets the results and makes a connection to the hypothesis, theory, or the question presented. 2. Describes assumptions made and provides a clear rationale for appropriateness of each assumption. 3. Clearly evaluates and analyzes inadequacies and limitations of the data collected or the methods used. 4. Explains past trends in data clearly and predicts future trends accurately.	1. Interprets the results and makes a connection to the hypothesis, theory, or the question presented. 2. Describes assumptions made but does not provide a clear rationale for appropriateness of each assumption. 3. Mostly evaluates and analyzes inadequacies and limitations of the data collected or the methods used. 4. Explains past trends that are mostly accurate and predicts future trends.	1. Somewhat accurately interprets the results and makes a connection to the hypothesis, theory, or the question presented. 2. Somewhat describes assumptions made but does not provide a rationale for appropriateness of each assumption. 3. Somewhat evaluates, but doesn't analyze inadequacies and limitations of the data collected or the methods used. 4. Somewhat explains the past trends in data, but does not evaluate future trends.	1. Inaccurately interprets the results concerning the hypothesis, theory, or the question presented. 2. Draws incorrect assumptions and does not provide a rationale for appropriateness of each assumption. 3. Inaccurately evaluates and analyzes inadequacies and limitations of the data collected or the methods used. 4. Explains the past trends in data incorrectly and does not evaluate future trends.	Does not attempt
Communicates qualitatively and persuasively: using quantitative evidence to support the argument or purpose of the work.		1. Provides effective quantitative evidence to support the work. 2. Uses evidence and reflective reasoning to analyze and interpret numerical data in oral or written form. 3. Communicates meaning to readers with clarity and fluency.	1. Provides quantitative evidence to support the work. 2. Uses evidence and some reasoning and logic to analyze and interpret numerical data in oral or written form. 3. Communicates meaning to readers completely.	1. Provides some quantitative evidence to support the work. 2. Uses some evidence, but very little reasoning to analyze and interpret numerical data in oral or written form. 3. Communicates meaning to readers somewhat completely.	1. Provides very little quantitative evidence to support the work. 2. Uses only some evidence without reasonably analyzing the data. 3. Communicates meaning to readers incompletely.	Does not attempt.
Problem-solving: Sets up a numerical problem and calculates the solution correctly.		1. Accurately and correctly organizes the problem into clear steps. 2. Provides correct and logical steps for solving the problem. 3. Provides the correct answer to the problem including details such as correct significant figures and units. 4. Estimates the answer to mathematical problems correctly.	1. Correctly organizes the problem into steps. 2. Provides correct steps for solving the problem. 3. Provides the correct answer to the problem with some details. 4. Estimates the answer to mathematical problems almost correctly.	1. Organizes the problem somewhat correctly into steps. 2. Provides some correct steps for solving the problem. 3. Provides the answer to the problem with minor error in the unit or significant figures. 4. Estimates the answer to mathematical problems somewhat correctly.	1. The steps to the problem are disorganized and contain some errors. 2. Provides very few correct steps for solving the problem. 3. The answer to the problem is wrong. 4. Estimates the answer to mathematical problems inaccurately.	

WHAT ARE RESOURCES TO ASSESS Quantitative Literacy?

A LESSON IN ARITHMETIC.

Birds - Flamingo PCM V6 (1895)

NOVA | Northern Virginia Community College

ACADEMICS & PROGRAMS ⌄ / PAYING FOR NOVA ⌄ / SERVICES & SUPPORT ⌄ / STUDENT LIFE ⌄ / ABOUT NOVA ⌄

FACULTY/STAFF RESOURCES

You are here: 🏠 > Office of Institutional Effectiveness and Student Success > Office of Academic Assessment
> Core Learning Outcomes Assessment > Faculty/Staff Resources

IN THIS SECTION

> **Faculty/Staff Resources**

> Assessment Timeline

> Templates and Instructions

> Workshop Presentations

> Additional/External Resources

Faculty/Staff Resources

Below are links to various types of resources to help in the assessment process

Assessment Timeline: Includes information on when Core Learning Outcomes will be assessed from academic years 2017-2018 through 2022-2023.

Templates and Instructions: Includes the templates for the Core Learning Outcome Report and the Curriculum Map as well as step-by-step instructions on how to properly fill out the templates.

Workshop Presentations: Includes presentations from the Office of Academic Assessment regarding Core Learning Outcomes assessment.

Additional/External Resources: Includes additional resources to aid in the assessment of Core Learning Outcomes such as rubrics for each CLO, websites on assessing CLOs, and educating the current generation.

SUGGESTED QL ASSESSMENTS

Presentations: provide students a data-driven problem and have them answer it by performing calculations/tests, analyzing and interpreting the data, and presenting it to the class using visuals (e.g., infographic, PowerPoint, video, etc.)

Infographics: have students use data to provide information on an issue.

Project Evaluations: for programs/disciplines that require more hands-on assignments, have students perform various tasks requiring them to calculate, interpret, and solve problems based on data provided (e.g., dimensions of a space/object, number of light fixtures needed to create proper lighting, etc.)

Online Gaming Platform: include assignments that allow students to use quantitative literacy skills to survive and engage in universe building via free gaming platforms (e.g., Minecraft).
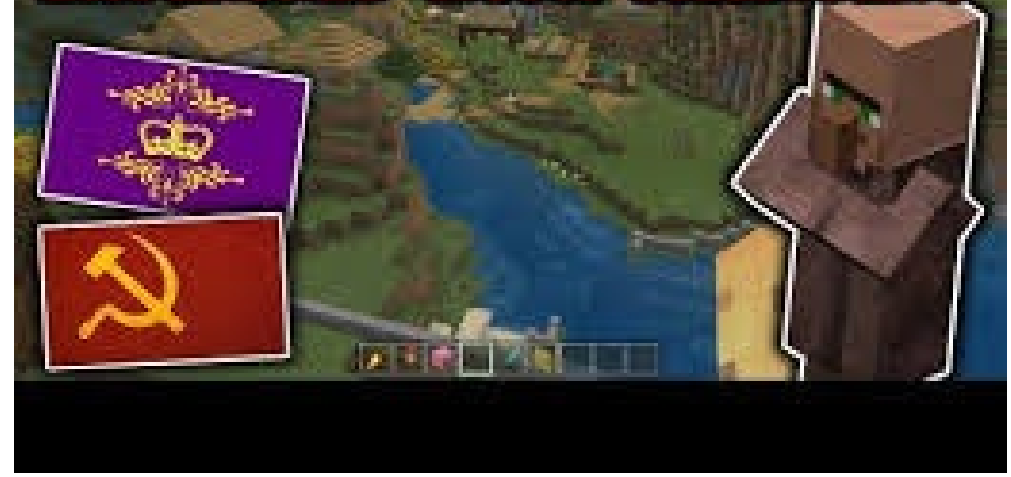
THE PHYSICS OF
MINECRAFT

EXTREMIST IDEOLOGIES
EXPLAINED WITH VILLAGERS

Learning Teamwork
and Cooperation
with Minecraft

©encouragingmomsathome.com

MINECRAFT

COUNCIL FOR
Economic
Education

Teaching Opportunity

Stanford mathematician: In reality, simulation is key to math education

by Stanford University

Online gaming before textbook study is the key to math education, Stanford's …

(PhysOrg.com) -- Role-playing games such as "World of Warcraft" could reverse the declining math proficiency of middle school students, Keith Devlin told an audience at the AAAS annual meeting in San Diego.

How World of Warcraft Taught Me to Be A Better Writer
Aaron Marsden
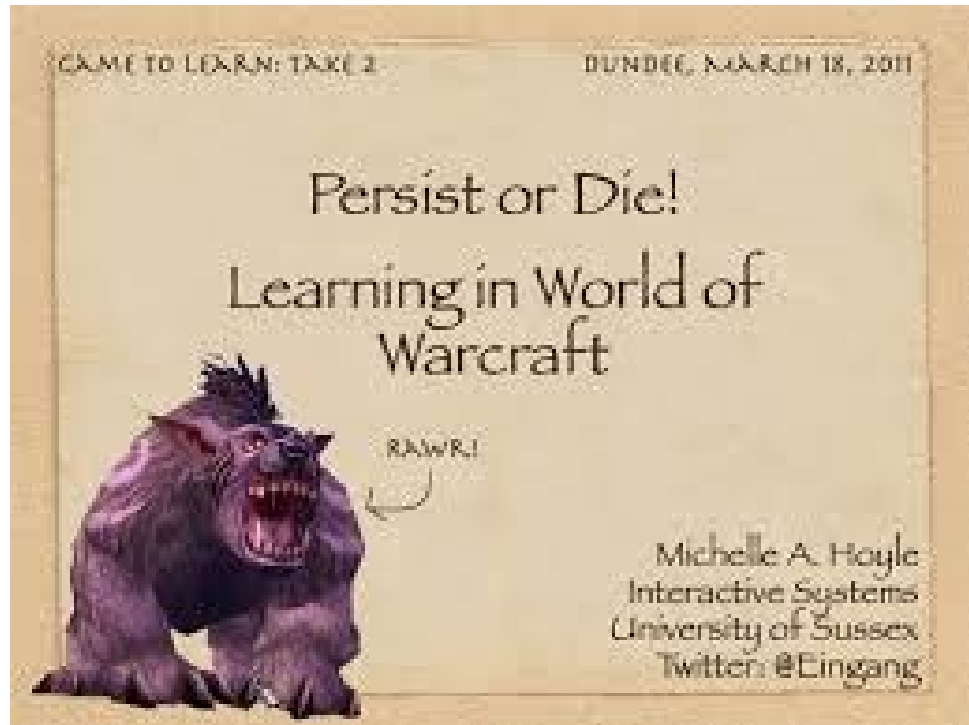
5 AWESOME GAMES FOR AWESOME LEARNING OPPORTUNITIES

APRIL 18, 2019 · MIKE WASHBURN

Let's face it, video games are not going anywhere. Instead of turning away from them, many educators have come to embrace games as another tool they can deploy to engage students and create learning opportunities. The games teachers have typically used in school though, are increasingly being shunned by students who see through the disguise - these "edu-games" are boring and tend to not have the same quality standards as more commercially available games. Students want the same experience at school with their games as they have at home. Thankfully, some educators are catching on and starting to work with real, commercially available games: the ones their students play at home.

1. Minecraft
2. Sid Meier's Civilization VI
3. The Sims
4. World of Warcraft
5. Fortnight

THE IMPACT OF QUANTITATIVE LITERACY:

"YOU ARGUE THAT STATISTICAL LITERACY GIVES CITIZENS A KIND OF POWER. WHAT DO YOU MEAN?"

At an individual level: *"If we don't have the ability to process quantitative information, we can often make* **decisions that are more based on our beliefs and our fears than based on reality."**

"As a collective We aspire to a literate society because it allows for public engagement, and I think this is also true for quantitative literacy.

The more we can get people to understand how to view the world in a quantitative way, the more successful we can be at getting past biases and beliefs and prejudices."

WHY DOES ASSESSING QUANTITATIVE LITERACY MATTER?

Building: NOVA

Panels, glasses, frames: campuses, programs/disciplines, offices, etc.

Screws: *Quantitative Literacy (and all other CLOs)*