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Making Your Students' Learning Visible: *How Can We Know What They Know?*

Handout Packet

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Student Performance Verbs by Level of Cognitive Operation in Bloom's and Anderson & Krathwohl's Taxonomies

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1. Knowledge/Remembering

arrange, choose, define, duplicate, find, identify, label, list, match, memorize, name, omit, order, recall, recite, recognize, relate, repeat, reproduce, select, spell, tell

2. Comprehension/Understanding

arrange, associate, clarify, describe, explain, express, grasp, identify, indicate, interpret, locate, paraphrase, outline, recognize, rephrase, report, restate, review, select, summarize, translate, visualize

3. Application/Applying

apply, break down, calculate, choose, compute, demonstrate, determine, dramatize, employ, give examples, illustrate, interpret, make use of, manipulate, operate, practice, schedule, sketch, solve, use, utilize

4. Analysis/Analyzing

analyze, calculate, categorize, classify, compare, contrast, criticize, deduce, derive, differentiate, discriminate, discuss, dissect, distill, distinguish, divide, examine, experiment, identify assumptions, induce, inspect, investigate, model, probe, question, simplify, test

5/6. Synthesis/Creating

adapt, arrange, assemble, build, change, collect, compose, conclude, construct, create, design, develop, discover, estimate, extend, formulate, forward, generalize, imagine, infer, integrate, invent, make up, manage, modify, originate, organize, plan, posit, predict, prepare, produce, propose, set up, suppose, theorize

6/5. Evaluation/Evaluating

agree, appraise, argue, assess, award, challenge, choose, conclude, convince, criticize, critique, debate, decide, defend, discount, discredit, disprove, dispute, evaluate, judge, justify, prioritize, persuade, rank, rate, recommend, rule on, score, select, support, validate, value, verify, weight

Depending on the use, some verbs may apply to more than one level.

Examples of Cognitive Learning Outcomes
Based on Bloom's Taxonomy of Cognitive Operations

Level	**The student will be able to...**
Knowledge	define iambic pentameter state Newton's Laws of Motion identify the major surrealist painters
Comprehension	describe the trends in the graph in her own words summarize the passage from Socrates' *Apology* properly translate into English the paragraph from Voltaire's *Candide*
Application	describe an experiment to test the influence of light and light quality on the Hill reaction of photosynthesis scan a poem for metric foot and rhyme scheme use the Archimedes Principle to determine the volume of an irregularly shaped object
Analysis	list arguments for and against human cloning determine the variables to be controlled for an experiment discuss the rationale and efficacy of isolationism in the global economy
Synthesis	write a short story in Hemingway's style compose a logical argument on assisted suicide in opposition to your personal opinion construct a helium-neon laser
Evaluation	assess the validity of certain conclusions based on the data and statistical analysis give a critical analysis of a novel with evidence to support the analysis recommend stock investments based on recent company performance and projected value

General Types of Learning Outcomes

Psychomotor – physical performance; may involve eye-hand coordination.
Examples: medical/nursing procedures; laboratory techniques; animal handling or grooming; assembling, operating, testing, or repairing machines or vehicles; singing; dancing; playing musical instruments; use of voice, face, and body in public speaking.

Affective – demonstration of appropriate emotions/affect.
Examples: demonstrating "good bedside manner"/empathy with patients; showing trustworthiness and concern for clients, customers, subordinates, or students; showing tolerance for differences; showing dynamism, relaxed confidence, conviction, audience responsiveness, etc., in public speaking.

Social – appropriate, productive interaction/behavior with other people.
Examples: cooperation and respect within a team; leadership when needed; assertive (not aggressive, passive, or passive-aggressive) behavior in dealing with conflict; negotiation and mediation skills.

Ethical – decision-making that takes into account the moral implications and repercussions (effects on other people, animals, environment) of each reasonable option.
Examples: medical/nursing decisions involving triage, transplants, withholding care, and prolonging life; lawyers' decisions about whether and how to represent a client; managerial decisions involving social, economic, political, and/or legal trade-offs.

Cognitive – thinking about facts, terms, concepts, ideas, relationships, patterns, conclusions, etc.
Examples: knowledge/remembering (lowest level), comprehension/ translation, application, analysis, synthesis/creating, evaluation (last four higher level).

Examples of Multiple True-False Items
(also Interpretive Exercises)

Demography

Nations	Birthrate (per 1000 females)	Infant Mortality Rate (per 1000 births)
Uganda	51	104
Somalia	50	122
Angola	47	137
Cambodia	46	112
Ethiopia	46	110
Pakistan	40	109
Canada	14	6.8
France	13	6.7
Denmark	13	6.6
Italy	10	8.3
Germany	10	5.9
Japan	10	4.4

Source: Information Please Almanac, 2007

If the statement is true, put "T" for "True" in the black space next to the number of the item. If the statement is false, put "F" for "False.

Which is a valid generalization based on the information in the table?

___1. In developing nations, the infant mortality rate decreases as the birthrate increases.

___2. Industrialized nations have lower birthrates and infant mortality rates than developing nations.

___3. Decreasing the infant mortality rate will limit population growth in developing nations.

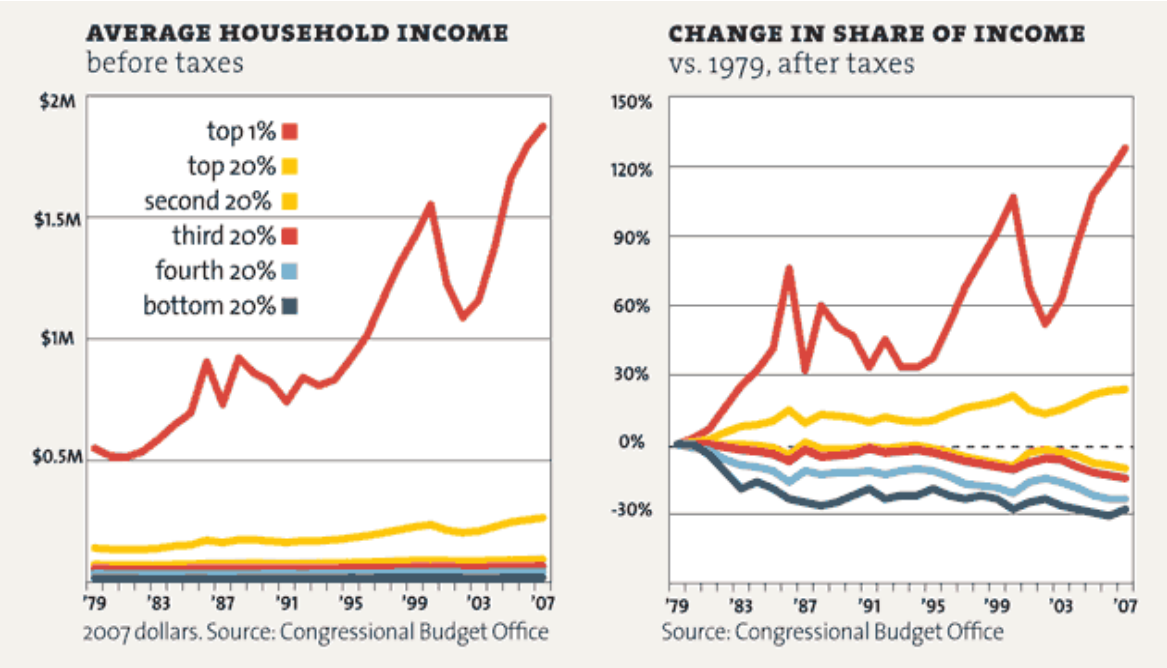
___4. Industrialized nations have higher population densities than developing nations.

___5. Developing nations have ten times the infant mortality of industrialized nations.

___6. The lowest birthrates are found in Western Europe.

___7. The highest infant mortality rates are found in Latin America.

Economics



The following items are **multiple true/false**. To the left of each statement, put "T" if it is true and "F" if it is false.

Which of the following statements is/are valid conclusions you can draw from the graphs above:

___ 1. From 1979 to 2007, household income inequality increased among the bottom 20%, fourth 20%, and third 20% of the U.S. population.
___ 2. From 1979 to 2007, the change in the share of income dropped for all but the top 1%.
___ 3. In terms of income, both the top 20% and top 1% benefited from the bull market in technology.
___ 4. The graphs supply evidence in support the trickle-down theory that President Ronald Reagan espoused.
___ 5. The graphs supply evidence of increasing polarization between the highest-income classes and the rest of society.
___ 6. The graphs supply evidence that the wealth of the bottom 80% dropped from 1979 to 2007.

Which of the following statements is/are valid conclusions you can draw from the graphs above?

___ 7. One graph analyzes income data before taxes and the other after taxes. They show that taxes have the effect of redistributing income from the higher paid to the lower-paid households.
___ 8. Because the share of income dropped for most households, the U.S. economy has less money flowing through the system.
___ 9. The stock market crash of 2000 most lowered the household income of the top 1%.
___ 10. From 1979 to 2007, the sector that lost the largest share of household income was the bottom 20%.

EXAMPLES OF INTERPRETIVE EXERCISES
(with Multiple Choice Items)

Demography

Nations	Birthrate (per 1000 females)	Infant Mortality Rate (per 1000 births)
Uganda	51	104
Somalia	50	122
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Pakistan	40	109
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Source: Information Please Almanac, 2007		

1. Which is a valid generalization based on the information in the table?

- In developing nations, the infant mortality rate decreases as the birthrate increases.
- Industrialized nations have lower birthrates and infant mortality rates than developing nations.
- Decreasing the infant mortality rate will limit population growth in developing nations.
- Industrialized nations have higher population densities than developing nations.
- Developing nations have ten times the infant mortality of industrialized nations.

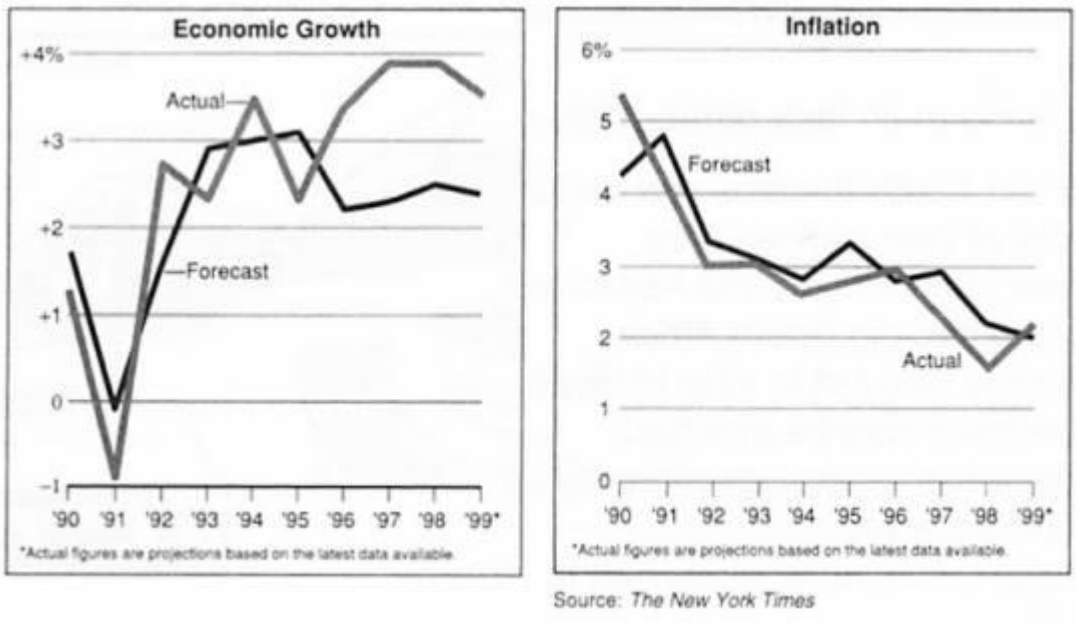
2. According to the table, the lowest birthrates are found mostly in

Western Europe Southeast Asia North America Africa Latin America

3. According to the table, the highest infant mortality rates are in

Western Europe Southeast Asia North America Africa Latin America

Economics



Source: *The New York Times*

The forecasts of economic growth consistently

- overestimated economic growth from 1990—1998
- underestimated economic growth from 1990—1998
- overestimated economic growth from 1996—1999
- underestimated economic growth from 1996—1999
- forecast correctly economic growth from 1990—1999

The forecasts of economists

- overestimated inflation
- underestimated inflation
- generally been accurate on inflation
- been less accurate than forecasts of economic growth
- been as accurate as those for economic growth

Nursing

A 14-year-old boy is brought to the emergency room with a compound fracture of the left femur. His vital signs are: BP 80/60, pulse 120, respirations 26, temperature 99.0° F (37.2° C). Which of the following fluids would the nurse expect the physician to order initially?

a. D5 in water.
b. D5 in 0.45% NaCl.
c. 0.45% NaCl.
d. Lactated Ringer's.

Poetry

BARTER

by Sara Teasdale

Life has loveliness to sell --
All beautiful and splendid things,
Blue waves whitened on a cliff,
Climbing fire that sways and sings,
And children's faces looking up
Holding wonder like a cup.

Life has loveliness to sell—
Music like a curve of gold.
Scent of pine trees in the rain,
Eyes that love you, arms that hold,
And for your spirit's still delight,
Holy thoughts that star the night.

Spend all you have for loveliness,
Buy it and never count the cost.
For one white singing hour of peace
Count many a year of strife well lost,
And for a breath of ecstasy

Give all you have been or could be.

The main idea of the poem is to urge us

- to be cautious in life
- to avoid strife
- to despise the ugly part of life
- to enjoy life's treasures
- not to become involved

The beauty of nature is indicated in line

3 6 10 12 16

There is a simile (comparison) in line

2 4 8 10 16

The poet includes the spiritual in life with the words

- "climbing fire"
- "children's faces"
- "arms that hold"
- "holy thoughts"
- "year of strife"

The word barter means exchange by trade without money. In the poem the exchange is

- personal commitment for life's beauty
- a year of strife for ecstasy
- spirit's delight for peace
- children's faces for wonder
- music for a curve of gold

Management Decision Theory

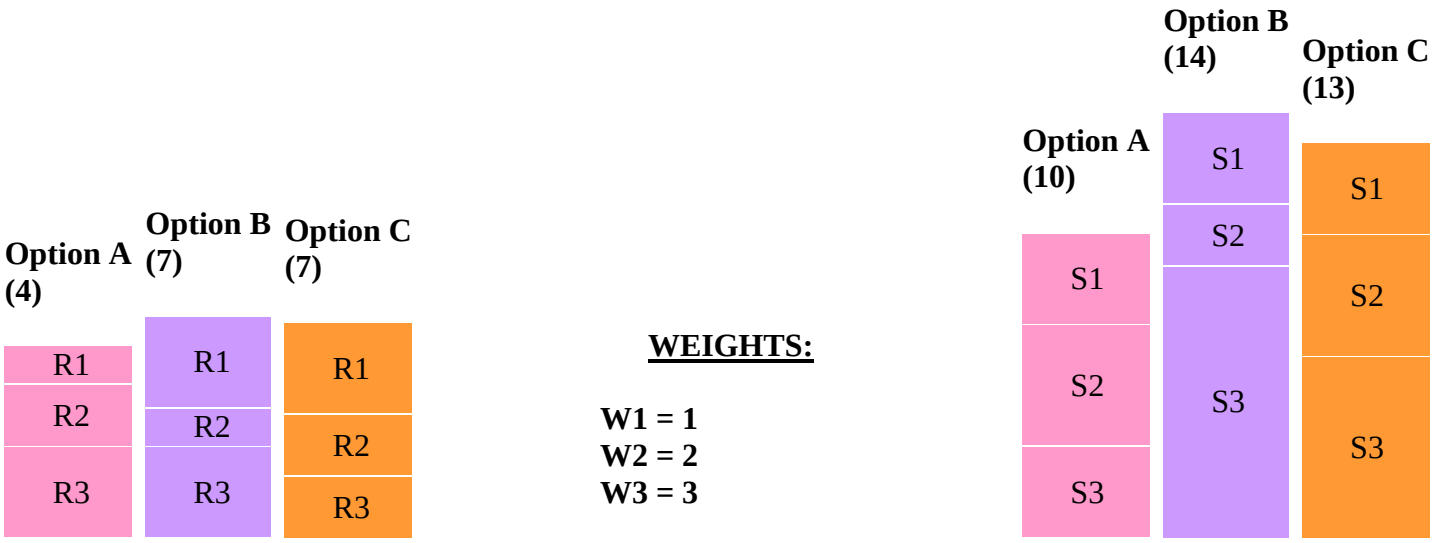
A company has identified criteria C1, C2, and C3 playing a role in the final decision, with a respective weight of 1, 2, and 3. Moreover, it has identified three prospective providers--A, B, and C--whose offer may constitute a good solution. The information is laid out in the 2-dimensional, L-shaped decision matrix below, and the scores for each solution are computed.

		ALTERNATIVES					
		Option A		**Option B**		**Option C**	
CRITERIA	**Weight**	Rating	Score[(1)]	Rating	Score	Rating	Score
Criterion C1	1	3	**3**	3	**3**	3	**3**
Criterion C2	2	2	**4**	1	**2**	2	**4**
Criterion C3	3	1	**3**	3	**9**	2	**6**
Total	6	4	**10**	7	**14**	7	**13**

The score for each solution is computed as

- rating + weight
- (rating + weight)^2
- rating x weight
- rating^2 x weight
- rating x weight^2

Histograms may permit a better interpretation of the data, where the data sources are the ***ratings*** and ***scores*** of evaluated solutions.



A valid generalization you can draw from the data in the histogram is:

- ¤ Solutions A and B are equivalent and outperform solution C.
- ¤ Solutions B and C are equivalent and outperform solution A.
- ¤ Solutions A and C are equivalent and outperform solution B.
- ¤ All the solutions are equivalent to one another.
- ¤ None of the above.

Another valid generalization you can draw from the data in the histogram is:

- ¤ Solution A is better than Solutions B and C on the criterion C3 but is weaker on C2.
- ¤ Solution B is better than Solution C on the criterion C3 but is weaker on C2.
- ¤ Solution B distributes its forces more evenly that do Solutions A and C.
- ¤ Solution C is better on criterion C3 that it is on criteria C1 and C2.

The “best-of-breed” solution is:

- ¤ Solution A
- ¤ Solution B
- ¤ Solution C
- ¤ No solution in the histogram qualifies as “best-of-breed”

The “suite” or “integrated solution” is:

- ¤ Solution A
- ¤ Solution B
- ¤ Solution C
- ¤ No solution in the histogram qualifies as the “suite” or “integrated solution”

Statistics

Two researchers were studying the relationship between amount of sleep each night and calories burned on an exercise bike for 42 men and women. They were interested if people who slept more had more energy to use during their exercise session. They obtained a correlation of .28, which has a two-tailed probability of .08. Alpha was .10.

1. Which is an example of a properly written research question?
   a. Is there a relationship between amount of sleep and energy expanded?*
   b. Does amount of sleep correlate with energy used?
   c. What is the cause of energy expanded?
   d. What is the value of rho?

2. What is the correct term for the variable amount of sleep?
   a. Dependent
   b. Independent *
   c. Predictor
   d. y

3. What is the correct statistical null hypothesis?
   a. There is no correlation between sleep and energy expanded
   b. Rho equals zero*
   c. R equals zero
   d. Rho equals r

4. What conclusions should you draw regarding the null hypothesis?
   a. Reject*
   b. Accept
   c. Cannot determine without more information

5. What conclusions should you draw regarding this study?
   a. The correlation was significant
   b. The correlation was not significant
   c. A small relationship exists*
   d. No relationship exists

Biology

One day you meet a student watching a wasp drag a paralyzed grasshopper down a small hole in the ground. When asked what he is doing he replies, "I'm watching that wasp store paralyzed grasshoppers in her nest to feed her offspring."

1. Which of the following is the best description of his reply?
    a. He is not a careful observer.
    b. He is stating a conclusion only partly derived from his observation.*
    c. He is stating a conclusion entirely drawn from his observation.
    d. He is making no assumptions.

2. Which of the following additional observations would add the most strength to the student's reply in Question 1?
    a. Observing the wasp digging a similar hole.
    b. Observing the wasp dragging more grasshoppers into the hole.
    c. Digging into the hole and observing wasp eggs on the paralyzed grasshopper*
    d. Observing adult wasps emerging from the hole a month later.

3. Both of you wait until the wasp leaves the area, then you dig into the hole and observe three paralyzed grasshoppers, each with a white egg on its side. The student states that this evidence supports his reply in Question 1. Which of the following assumptions is he making?
    a. The eggs are grasshopper eggs.
    b. The wasp laid the eggs.*
    c. The wasp dug the hole.
    d. The wasp will return with another grasshopper.

4. You take the white eggs to the biology laboratory. Ten days later immature wasps hatched from the eggs. The student states that this evidence supports his reply in Question 1. Which of the following assumptions is he making?
    a. The wasp dug the hole.
    b. The wasp stung the grasshoppers.
    c. The grasshoppers were dead.
    d. A paralyzed grasshopper cannot lay an egg.*

Student Assessment of Learning Gains (SALG) Template

From http://www.salgsite.org/instrument/preview/69109

Instructions to students:

Instructors value students' feedback and take it into account when improving their courses. Please be as precise as you can in your answers. Please choose "not applicable" for any activity you did not do. You may find one or more questions at the end of each section that invite an answer in your own words. Please comment candidly, bearing in mind that future students will benefit from your thoughtfulness. Remember that this is an anonymous survey; your instructor will never know what any individual student has written.

Your understanding of class content

1. As a result of your work in this class, what GAINS DID YOU MAKE in your UNDERSTANDING of each of the following?	no gains	a little gain	moderate gain	good gain	great gain	not applicable
1.1 The main concepts explored in this class	○	○	○	○	○	○
1.2 The relationships between the main concepts	○	○	○	○	○	○
1.3 The following concepts that have been explored in this class	no gains	a little gain	moderate gain	good gain	great gain	not applicable
1.3.1 (Concept 1) [Fill in]	○	○	○	○	○	○
1.3.2 (Concept 2) [Fill in]	○	○	○	○	○	○
1.4 How ideas from this class relate to ideas encountered in other classes within this subject area	○	○	○	○	○	○
1.5 Please comment on HOW YOUR UNDERSTANDING OF THE SUBJECT HAS CHANGED as a result of this class.						

Increases in your skills

2. As a result of your work in this class, what GAINS DID YOU MAKE in the following SKILLS?	no gains	a little gain	moderate gain	good gain	great gain	not applicable
2.1 Finding articles relevant to a particular problem in professional journals or elsewhere	○	○	○	○	○	○
2.2 Critically reading articles about issues raised in class	○	○	○	○	○	○
2.3 Identifying patterns in data	○	○	○	○	○	○
2.4 Recognizing a sound argument and appropriate use of evidence	○	○	○	○	○	○

2.5 Developing a logical argument						
2.6 Writing documents in discipline-appropriate style and format						
2.7 Please comment on what SKILLS you have gained as a result of this class.						

Class impact on your attitudes

3. As a result of your work in this class, what GAINS DID YOU MAKE in the following?	no gains	a little gain	moderate gain	good gain	great gain	not applicable
3.1 Enthusiasm for the subject						
3.2 Interest in taking or planning to take additional classes in this subject						
3.3 Confidence that you understand the material						
3.4 Your comfort level in working with complex ideas						
3.5 Your willingness to seek help from others (teacher, peers, TA) when working on academic problems						
3.6 Please comment on how this class has CHANGED YOUR ATTITUDES toward this subject.						

Integration of your learning

4. As a result of your work in this class, what GAINS DID YOU MAKE in INTEGRATING the following?	no gains	a little gain	moderate gain	good gain	great gain	not applicable
4.1 Connecting key class ideas with other knowledge						
4.2 Applying what I learned in this class in other situations						
4.3 Using systematic reasoning in my approach to problems						
4.4 Using a critical approach to information and arguments I encounter in daily life						
4.5 What will you CARRY WITH YOU into other classes or other aspects of your life?						

The Class Overall

5. HOW MUCH did the following aspects of the class HELP YOUR LEARNING?	no help	a little help	moderate help	much help	great help	not applicable
5.1 The instructional approach taken in this class						

5.2 How the class topics, activities, reading and assignments fit together						
5.3 The pace of the class						
5.4 Please comment on how the INSTRUCTIONAL APPROACH to this class helped your learning.						

Class Activities

6. HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?	no help	a little help	moderate help	much help	great help	not applicable
6.1 Attending lectures						
6.2 Participating in discussions during class						
6.3 Specific Class Activities	no help	a little help	moderate help	much help	great help	not applicable
6.3.1 Class Activity 1 [Fill in]						
6.3.2 Class Activity 2 [Fill in]						
6.3.3 Class Activity 3 [Fill in]						
6.4 Please comment on how the CLASS ACTIVITIES helped your learning.						

Assignments, graded activities and tests

7. HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?	no help	a little help	moderate help	much help	great help	not applicable
7.1 Graded assignments (overall) in this class						
7.2 Specific graded assignments	no help	a little help	moderate help	much help	great help	not applicable
7.2.1 Assignment 1 [Fill in]						
7.2.2 Assignment 2 [Fill in]						
7.3 The number and spacing of tests						
7.4 The fit between class content and tests						
7.5 The feedback on my work received after tests or assignments						
7.6 Please comment on how the GRADED ACTIVITIES AND TESTS helped your learning.						

Class Resources

8. HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?	no help	a little help	moderate help	much help	great help	not applicable
8.1 The textbook						
8.2 Other reading materials	no help	a little help	moderate help	much help	great help	not applicable
8.2.1 Reading material 1 [Fill in]						
8.2.2 Reading material 2 [Fill in]						
8.3 Online notes or presentations posted by instructor						

8.4 Please comment on how the RESOURCES in this class helped your learning.

The information you were given

9. HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?	no help	a little help	moderate help	much help	great help	not applicable
9.1 Explanation of how the class topics, activities, reading and assignments related to each other						
9.2 Explanation given by instructor of how to learn or study the materials						

9.3 Please comment on HOW the INFORMATION YOU RECEIVED about the class helped your learning.

Support for you as an individual learner

10. HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?	no help	a little help	moderate help	much help	great help	not applicable
10.1 Interacting with the instructor during class						
10.2 Interacting with the instructor during office hours						
10.3 Working with teaching assistants outside of class (e.g., recitation, office hours)						
10.4 Working with peers outside of class (e.g., study groups)						

10.5 Please comment on how the SUPPORT YOU RECEIVED FROM OTHERS helped your learning in this class.

Items developed by Linda B. Nilson

Stem: *How much has this course improved your skills/abilities in each of the following:*

Communication
Expressing myself in writing
Expressing myself orally

Content Mastery
Identifying the most important ideas in readings
Mastering factual material
Explaining key concepts/principles of the discipline
Drawing connections between different disciplines

Critical/Higher-Order Thinking
Giving fair consideration to new viewpoints
Drawing relationships, such as comparisons and contrasts, between different ideas
Applying knowledge to solve real-world or realistic problems
Thinking through arguments or problems
Evaluating ideas critically
Evaluating high-quality and low-quality work in the discipline
Critically examining my own opinions and values
Developing positions that I can support and defend with logic and evidence

Research Skills
Formulating hypotheses
Identifying trends in data
Explaining possible reasons for trends in data
Evaluating the quality of sources of information
Finding reliable sources of knowledge outside of the course material
Following sound laboratory procedures
Conducting original research

Quantitative Reasoning
Interpreting statistical data
Reasoning through a problem mathematically

Creativity
Exercising my creativity in the discipline
Developing an original product (a design, multimedia presentation, piece of art or equipment, etc.)

Social and International Skills
Working in cooperation with others
Understanding people who are very different from me
Assessing societal problems/needs
Drawing relationships between events in your own country and other countries

Functioning effectively in another culture
Acting in a leadership capacity

Computing
Using computer technology and resources

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