Workshop – Research Tools to Uncover the "Hidden Curriculum"

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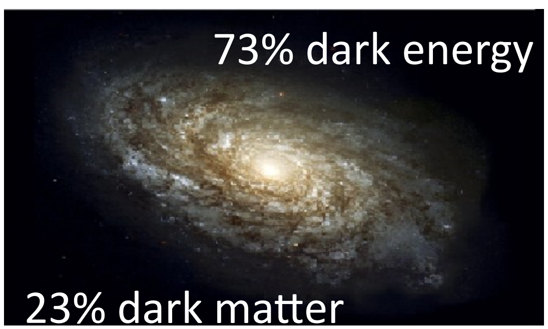
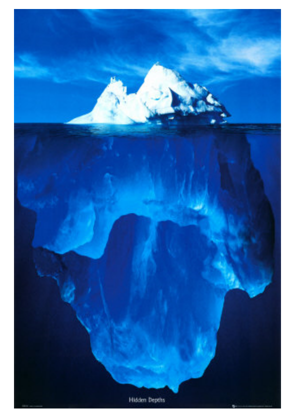




Charles Henderson
Western Michigan University
in absentia

Andy Mason
University of Minnesota
in absentia

What is the Hidden Curriculum?

- Goals of the faculty which are not articulated to the students
- Learning of the students that are not intended by the faculty
- Expectations of the other stakeholders in the learning outcomes

The hidden curriculum causes dissatisfaction and frustration for everyone

- **Students:** I work hard but can never satisfy my teacher.
- **Faculty:** Most of my students are not good enough for my class.
- **Engineering faculty:** Physics classes don't teach anything useful.
- **Upper level Physics faculty:** Students are not prepared.
- **Curriculum developers:** Faculty refuse to use pedagogy that works.

The "hidden curriculum" resides in (at least) 5 places

1. **What the instructor believes the student should and can learn.**
2. **What the instructor intends to teach.**
3. **What research says students need to learn.**
4. **What other "stakeholders" such as faculty teaching these students downstream (physics & non-physics) and employers expect.**
5. **What students actually learn.**

To find out about 1 & 2 requires probing the beliefs and values of the instructor.

Artifact based interviews is one way of doing this.

To find out about 5 requires assessment of the students' actions.

Analyzing student written work is one way of doing this.

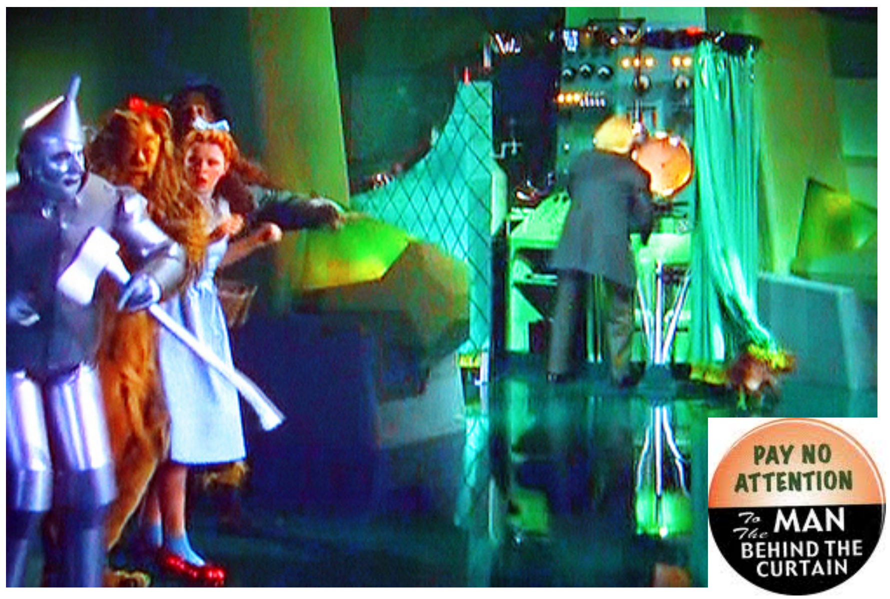
3 & 4 are well documented but could use some further study – not addressed here

This workshop gives a brief overview of tools to investigate

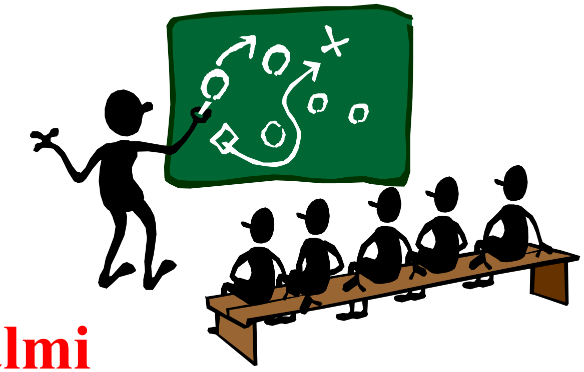
How do 1 & 2 align with 3?
How do 1 & 2 align with 5?
How does 3 align with 5?

Problem Solving: an excellent context for uncovering the "hidden curriculum"

- It is a typical assessment tool used by instructors for a course.
- True problem solving involves fundamental principles, conceptual knowledge, visualization, metacognition, logical organization, creativity, insight, and mathematical skills.



The Plan



Background Information –

1. **Uncovering Faculty Beliefs - Edit Yerushalmi**

   Illustrative activity – collecting your ideas on problem solving

2. **Analyzing student written problem solving – Jen Docktor**

   Illustrative activity – assessing student problem solving

3. **Alignment of faculty & research curriculum – Andy Mason**

   Illustrative activity – connecting your ideas on problem solving to the problem solving assessment.

Studying the Hidden Curriculum
- Faculty Beliefs

Edit Yerushalmi
Weizmann Institute for Science, Israel
Charles Henderson
Western Michigan University
Ken Heller, Pat Heller
University of Minnesota

Focus:
Physics faculty beliefs and values about the teaching and learning of problem solving

1 What students **should do** when problem solving (PS)?

2 How students **should learn** in the context of PS?

3 What do students **actually do** when PS?

4 How can they **help** students' learning in an optimal situation?

The answers to these
are part of the Hidden Curriculum

How shouldn't we study the hidden curriculum?

"Concerning the Interview", Mark Twain

Newly Published Mark Twain Essay, July 7, 2010 , PBS:

The Interview …is perhaps the poorest of all ways of getting at what is in a man. In the first place…you are afraid of the interviewer, and that is not an inspiration.

You close your shell; you put yourself on your guard; you try to be colorless… and talk all around a matter without saying anything: and when you see it in print, it makes you sick to see how well you succeeded.

How should we study the hidden curriculum?

Assumption: instructional decisions are the resolutions of conflicting beliefs ⇒

Needed: a data collection tool that elicits different beliefs in different contexts, and their resolution

The data collection tool should reflect decision making context

⇒ Artifacts comparison approach

Get instructors to uncover decision making by focusing on concrete artifacts that they routinely design and assess.

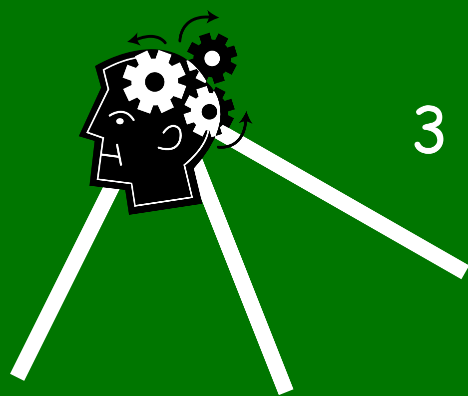
Ref: Henderson, Yerushalmi, Heller, Heller, Kuo, Phys. Rev. ST-PER, 2007

Interview design

1 baseline problem, 4 Problems, 5 Student Solutions, 3 Instructor Solutions, revolving around the baseline problem

1.5 h, 4 parts, video documentation

Parts 1-3:
3 classroom contexts



Instructor models PS

Grading

Students solve problems

During each of the 1st 3 parts: general and specific questions:

1) General: How / why do you use instructor solutions?
2) Specific: How are they similar/different to yours? Why?
3) What components that are important in the PS process are represented in the various solutions

Baseline problem

- Could reasonably be given in most calculus-based introductory physics courses (verified with physics faculty at several other institutions), indeed, was taken from a final exam at the University of Minnesota, designed and approved by a group of four physics instructors

Homework Problem

You are whirling a stone tied to the end of a string around in a vertical circle having a radius of 65 cm. You wish to whirl the stone fast enough so that when it is released at the point where the stone is moving directly upward it will rise to a maximum height of 23 meters above the lowest point in the circle. In order to do this, what force will you have to exert on the string when the stone passes through its lowest point one-quarter turn before release? Assume that by the time that you have gotten the stone going and it makes its final turn around the circle, you are holding the end of the string at a fixed position. Assume also that air resistance can be neglected. The stone weighs 18 N.

The correct answer is 1292 N

- Difficult for an introductory physics course, rich enough to allow for interesting variations. An average student has to use an exploratory decision making process as opposed to an algorithmic procedure. Required several important physics concepts

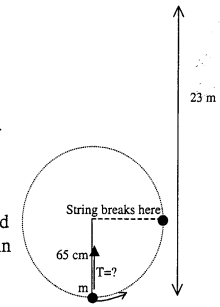
Problems

Differing features

1. Includes drawing
2. State the target quantity
3. Broken into sub problems
4. Includes motivation
5. requires qualitative analysis
6. Abstract/contextual
7. multiple-choice

Problem A

A 1.8 kg mass is attached to a frictionless pivot point and is moving in a circle at the end of a 65 cm string. The string breaks when the mass is moving directly upward and the mass rises to a maximum height of 23.0 m. What is the tension in the string one-quarter turn before the string breaks? Assume that air resistance can be neglected.



A) What velocity, v_1, must the stone have when released in order to rise to 23 meters above the lowest point in the circle?

B) What velocity, v_o, must the stone have when it is at its lowest point in order to have a velocity v_1 when released?

C) What force will you have to exert on the string at its lowest point in order for the stone to have a velocity v_o?

Problem B

You are whirling a stone tied to the end of a string around in a vertical circle having a radius of 65 cm. You wish to whirl the stone fast enough so that when it is released at the point where the stone is moving directly upward it will rise to a maximum height of 23 meters above the lowest point in the circle. In order to do this, what force will you have to exert on the string when the stone passes through its lowest point one-quarter turn before release? Assume that by the time that you have gotten the stone going and it makes its final turn around the circle, you are holding the end of the string at … neglected. The stone weighs 18 N …

A) 1292 N
B) 1258 N
C) 1248 N
D) 1210 N
E) None of the Above

Note: The c…

Problem C

You are working at a construction … standing on the top of the building … way up and then back down again, … you're not strong enough to throw … You tie the bag of nails to the end … You try this, and after a little while … a circle you notice that you no long… circle. You think that if you release… that the bag will go up to your co-worker. As you whirl the bag of nails around, however, you begin to worry that the string might break, so you stop and attempt to decide before continuing. According to the string manufacturer, the string is designed to hold up to 100 lbs. You know from experience that the string is most likely to break when the bag of nails is at its lowest point.

…roblem D

…ou are whirling a stone tied to the end of a string around in a vertical circle of radius R. You …ish to whirl the stone fast enough so that when it is released at the point where the stone is …oving directly upward it will rise to a maximum height, H, above the lowest point in the circle. …order to do this, what force will you have to exert on the string when the stone passes through …lowest point one-quarter turn before release? Assume that by the time that you have gotten …e stone going and it makes its final turn around the circle, you are holding the end of the string …a fixed position. Assume also that air resistance can be neglected.

…) For each point labeled in the diagram, circle the symbol(s) that describe how the speed of the stone is changing.

Point	Change in Speed
A	↑ ↓ = max min
B	↑ ↓ = max min
C	↑ ↓ = max min
D	↑ ↓ = max min
E	↑ ↓ = max min

Change of Speed Symbols

↑ Speed is increasing
↓ Speed is decreasing
= Speed is constant
max Speed is at a maximum
min Speed is at a minimum

B) At each point on the diagram, draw and label a vector representing the acceleration of the stone.

C) At each point, draw and label vectors to represent all of the forces acting on the stone.

Students' Solutions

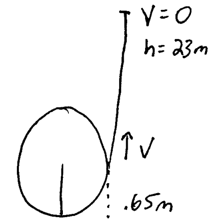
Student Solution E

$$v^2 = 2gh$$

$$F - mg = \frac{m2gh}{R}$$

$$F = 18 + \frac{2 \cdot 18 \cdot 23}{.65} = 1292\,N$$

Student Solution D



Energy conservation between top and release

$$\tfrac{1}{2}mv^2 = mg\Delta h$$

$$v^2 = 2gh$$

$$v = \sqrt{2(-9.8)23}$$

$$v = 21.2$$

uses h instead of h-R

makes sign error

changes sign

Between release and bottom $T \perp v$ so no work done

∴ Energy is conserved and velocity is the same

$$\Sigma \vec{F} = m\vec{a}$$

$$T - mg = \frac{mv^2}{R}$$

$$T = 18 + \frac{\frac{18}{9.8} \cdot 21.2^2}{.65}$$

$$= 1292\,N$$

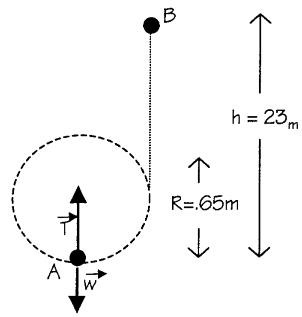
uses $v_{release}$ instead of v_{bottom}.

Student solution D
Explains his reasoning
Reveals mistakes

Student solution E
No Reasoning
Doesn't reveal mistakes

Hands on experience: instructor solutions
1st task, in groups of 3, 7 min

Instructor solution I



The ten

Conser

Mv

V_A^2

At point

$\vec{T} - \vec{w} = m\vec{a}$ b

$T - w = mv_A^2/R$

$T = 18_N + 2 \cdot 18_N \cdot 23_m / .65_m =$ 1292N

Instructor solution III

Approach:

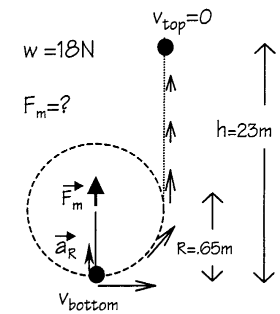
I need to find F_m, force exerted by me. I know the path, h (height at top) and v_t (velocity at top)

A) For a massless string $F_m = T_b$ (T_b-Tension at bottom)

B) I can relate T_b to v_b (velocity at bottom) using the radial component of $\sum \vec{F} = m\vec{a}$, and radial acceleration $a_R = v^2/R$, since stone is in circular path

C) I can relate v_b to v_t using either i) energy ii) Dynamics and kinematics

ii) Messy since forces/accelerations change through the circular path

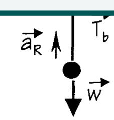


Instructors' solutions can represent aspects/components that are important in problem solving (e.g. things student needs to know or be able to do).

What aspects/components that you consider important are represented (or missing) in these instructor solutions?

$\sum F_R = ma_R$

$T_b - w = m v_b^2/R$



$F_m = T_b = w + 2\,w\,h/R$

$= 18 + 2\;18\;23/.65$

$=$ 1292N

=N m/m units O.K.

C) Relate v_b to v_t

Work = ΔKE

For constant force

$\vec{F} \cdot \vec{d} = KE_f - KE_i$

$F_y d_y = KE_{top} - KE_{bottom}$

Large compared to weight, but stone needs to travel up large distance

Check limits: $T_b \uparrow$ as R $\downarrow$, for smaller circle I'll need bigger force, reasonable

Hands on experience: Categorizing cards
2^{nd} task, in groups of 3, 7 min

Too detailed ⇒ Please put these components into categories of your choosing & please name these categories

	Components
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

	Components
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	

Categories	Components

	Components
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

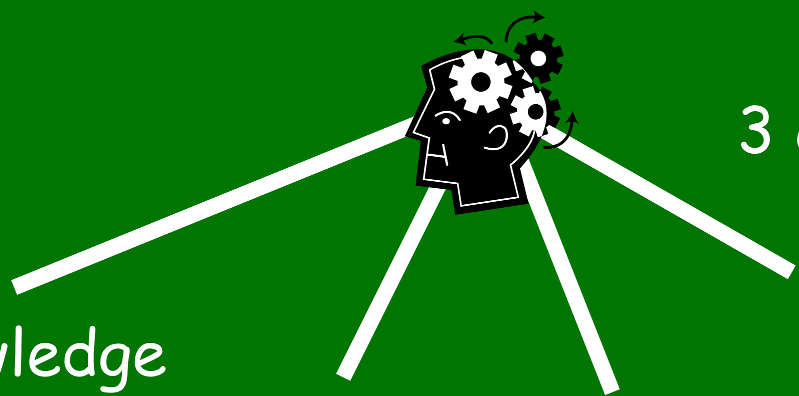
	Components
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	

Indeed, we did this

1 baseline problem, 4 Problems, 3 Instructor Solutions, 5 Student Solutions, revolving around the baseline problem

1.5 h, 4 parts, video documentation

Parts 1-3:
3 classroom contexts



Part 4: knowledge organization

What components that are important in the PS process are represented in the various solutions? Recorded on index cards by the interviewer

Interviewees categorize the cards and name each category.
Asked regarding the categories:

- How did your students perform on X?
- How would you help them to improve in X?

PS components recorded on index cards

- *translating English statements to physics equations*
- *Break the problem into steps*
- *Knowing conservation of energy*
- *Draw vector diagrams*
- *Substitutes to get answer*
- *Recognize when something is missing*
- *Comment on result*

Categorized cards (by interviewee)

translating English state... to ph... equa...

Break the problem into steps

OVERALL APPROACH

Knowing conservation of energy

UNDERSTAND PHYSICS

Draw vector diagrams

Substitutes to get answer

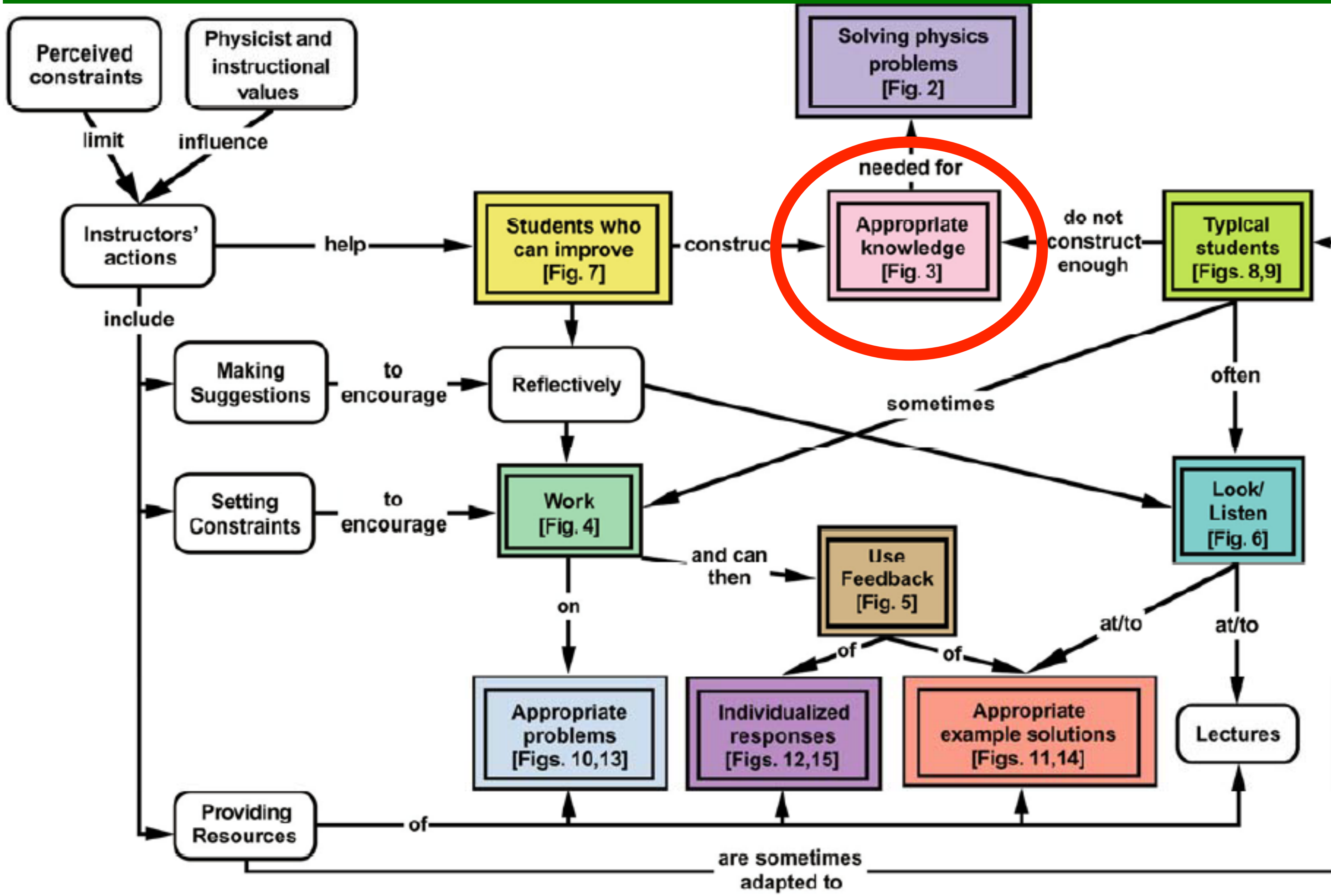
PROCEDURAL

Recognize when something is missing

MATURITY

Comment on result

Findings: Map of Instructor's Beliefs



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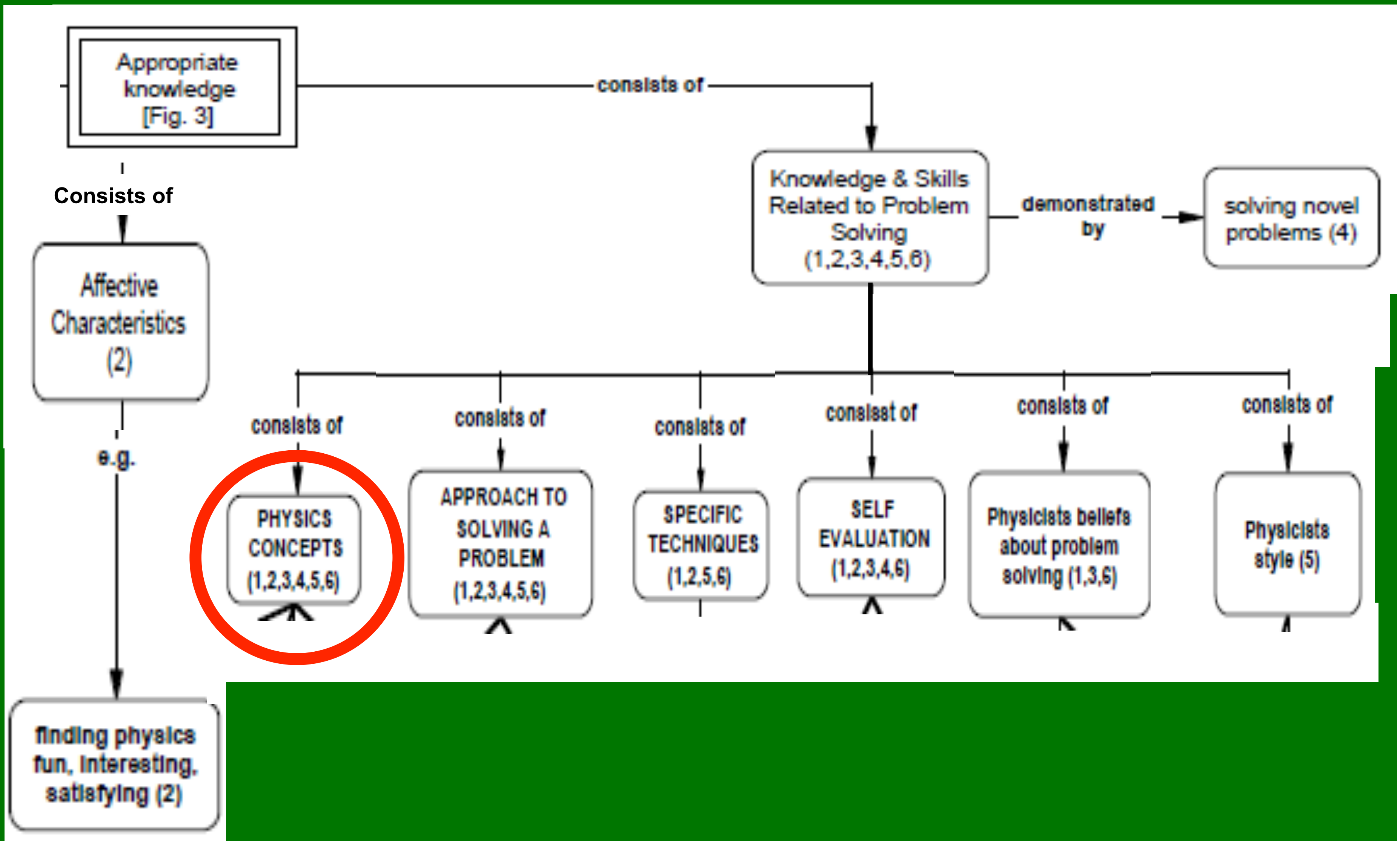

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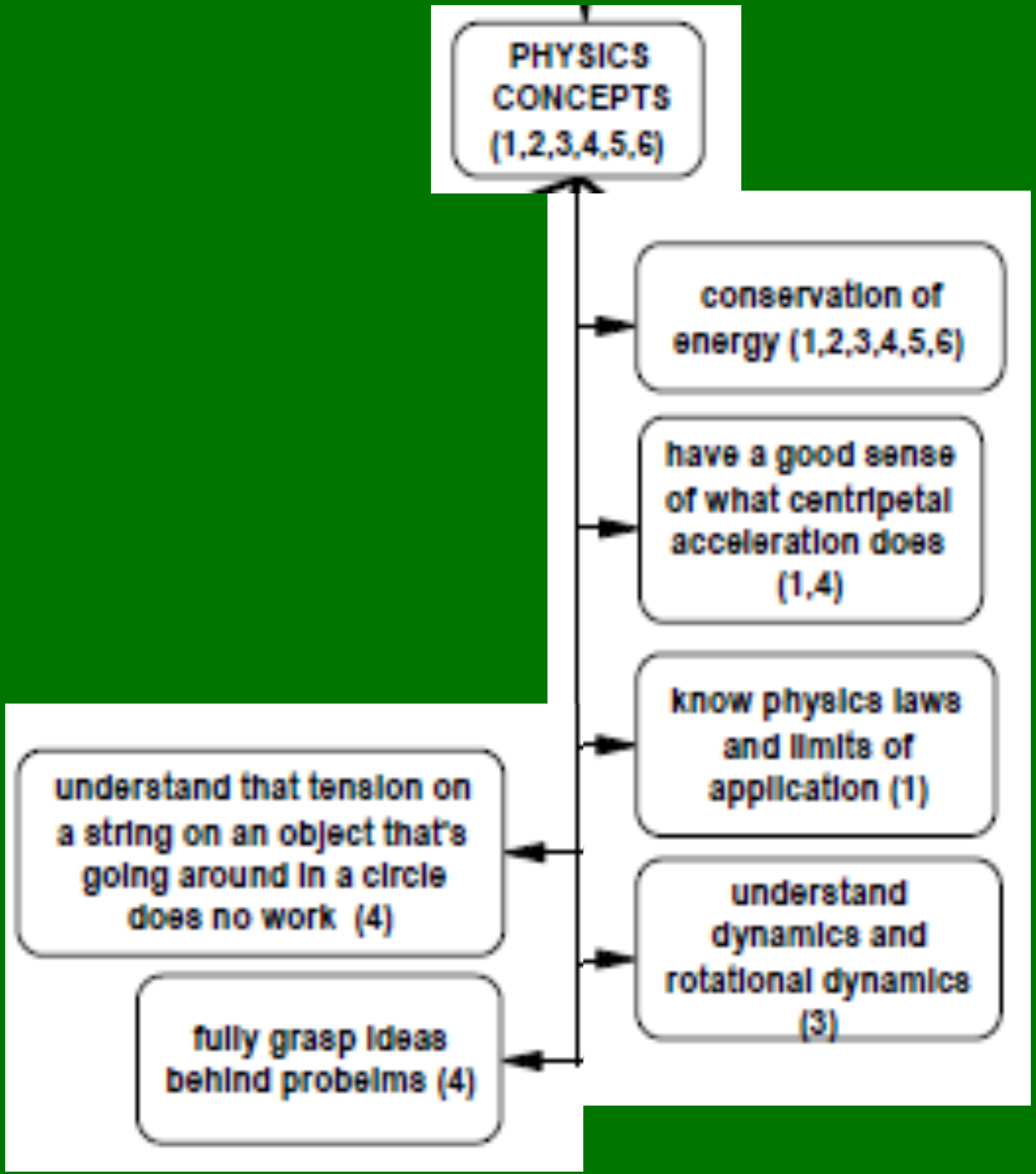

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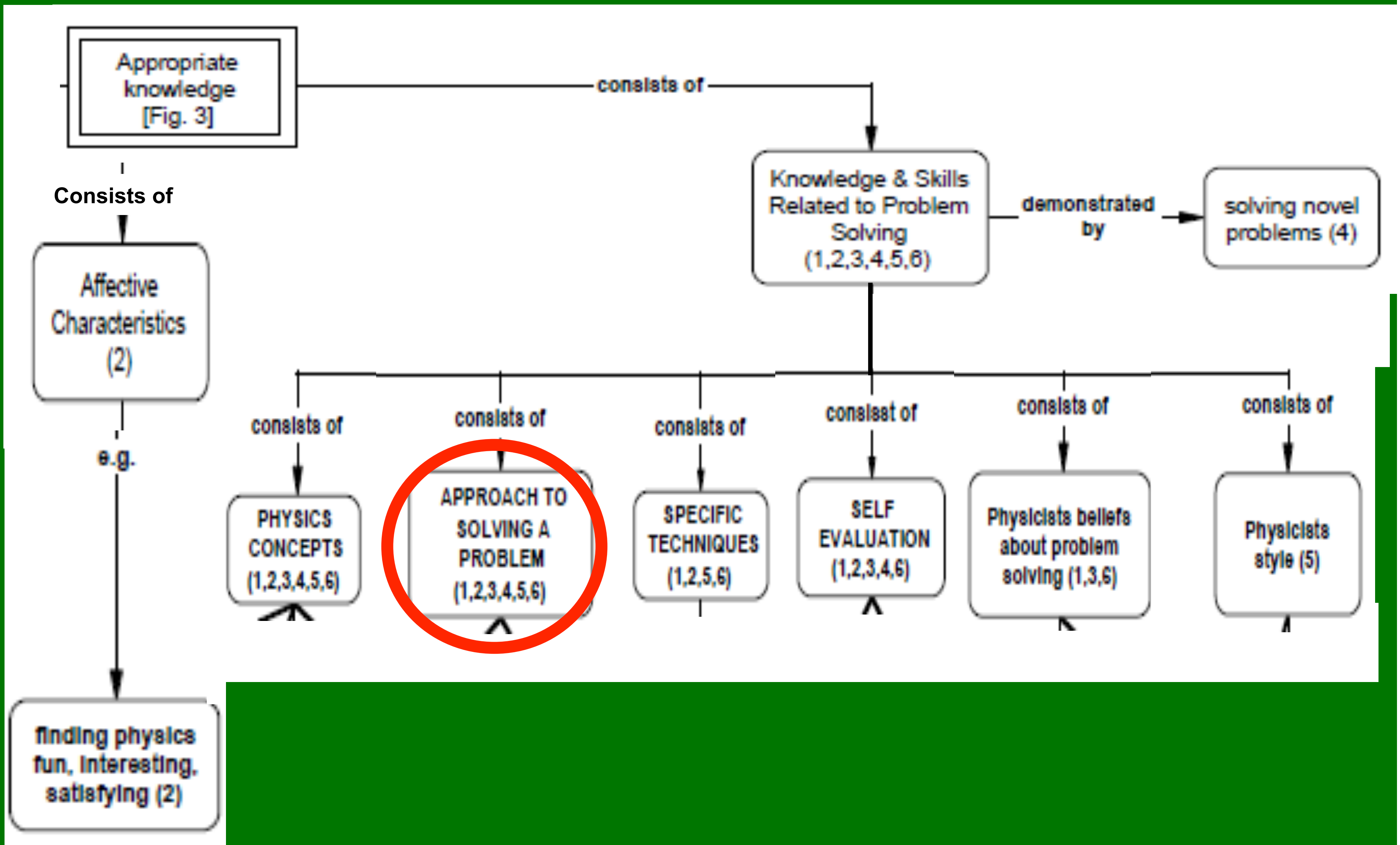

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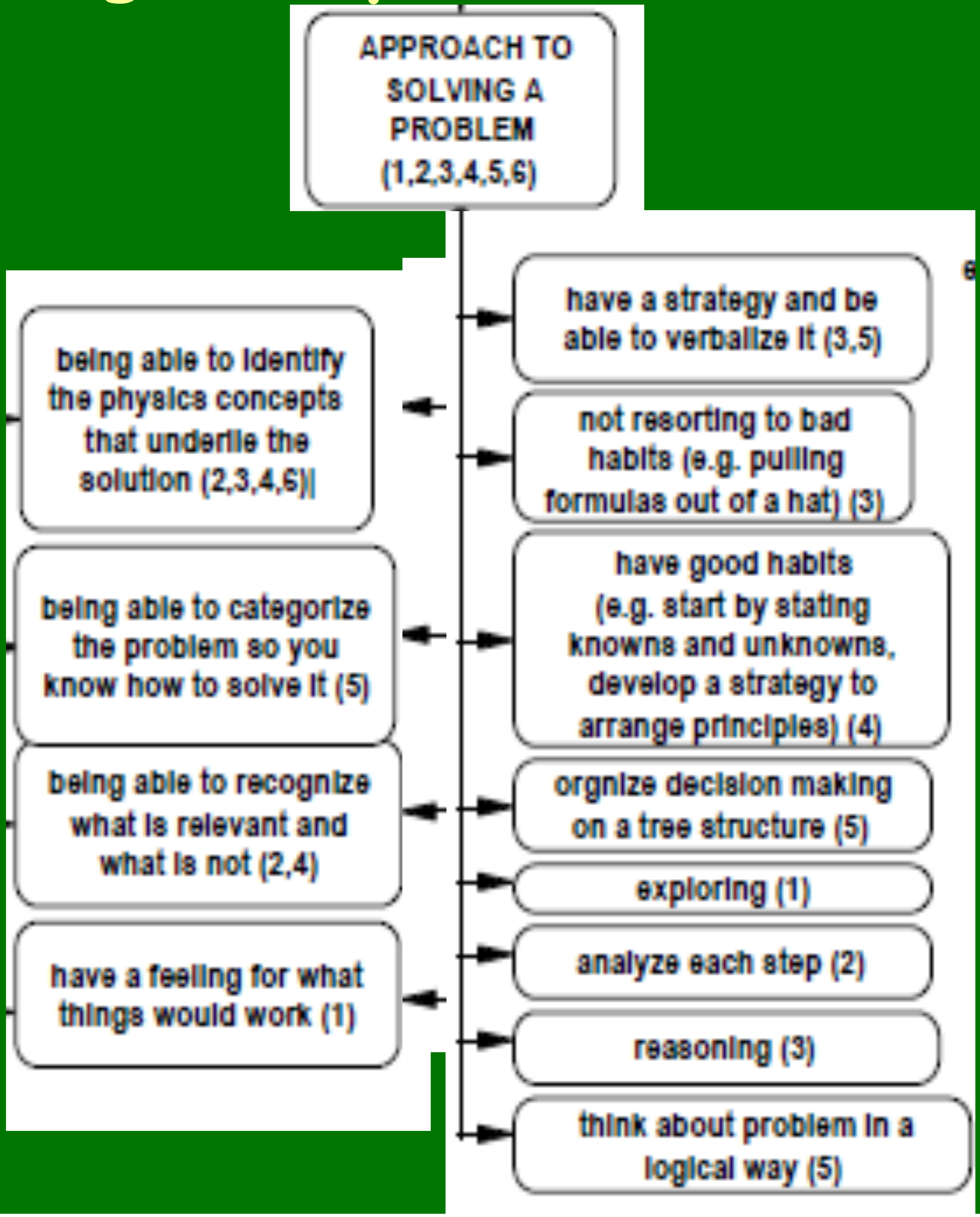

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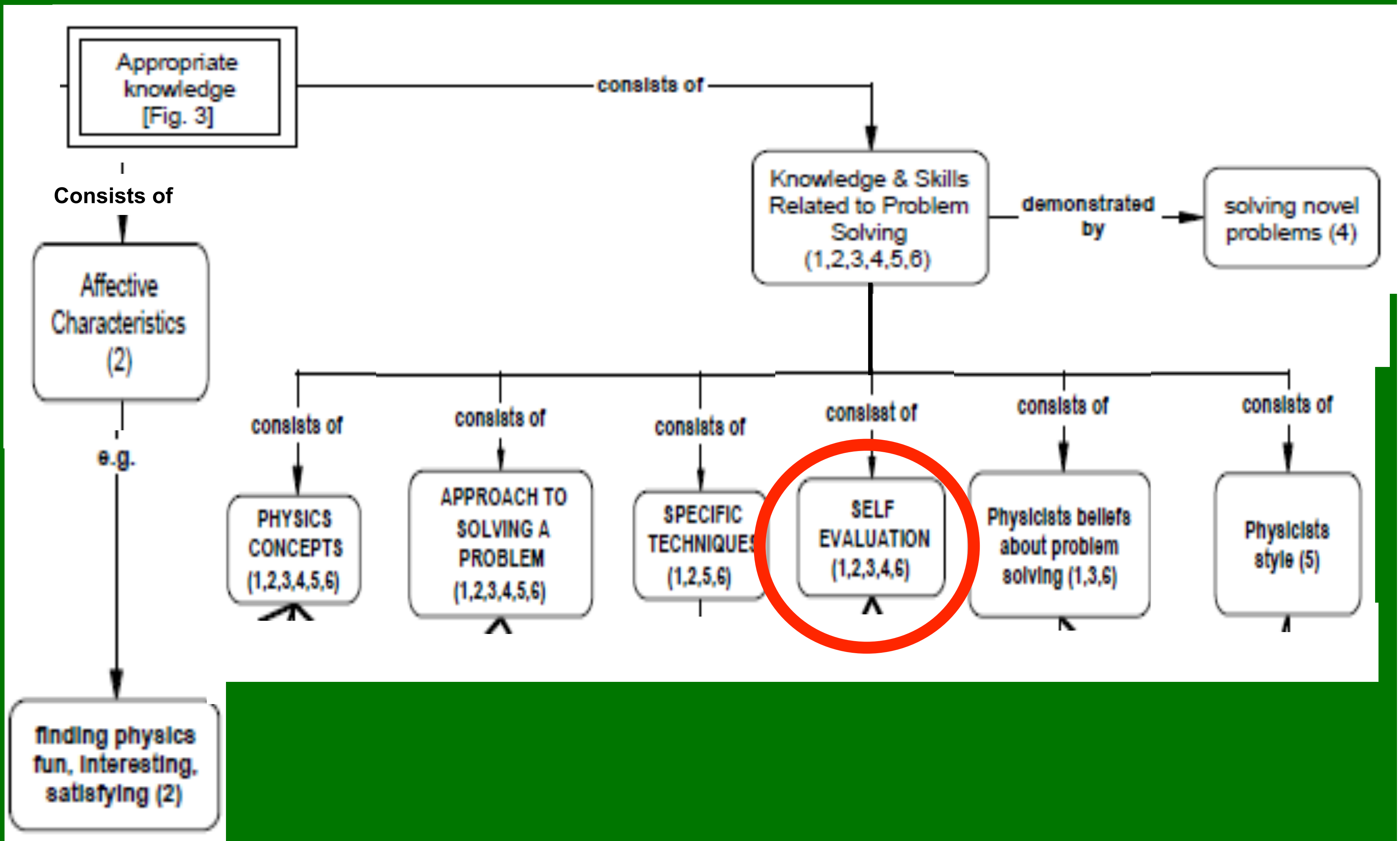

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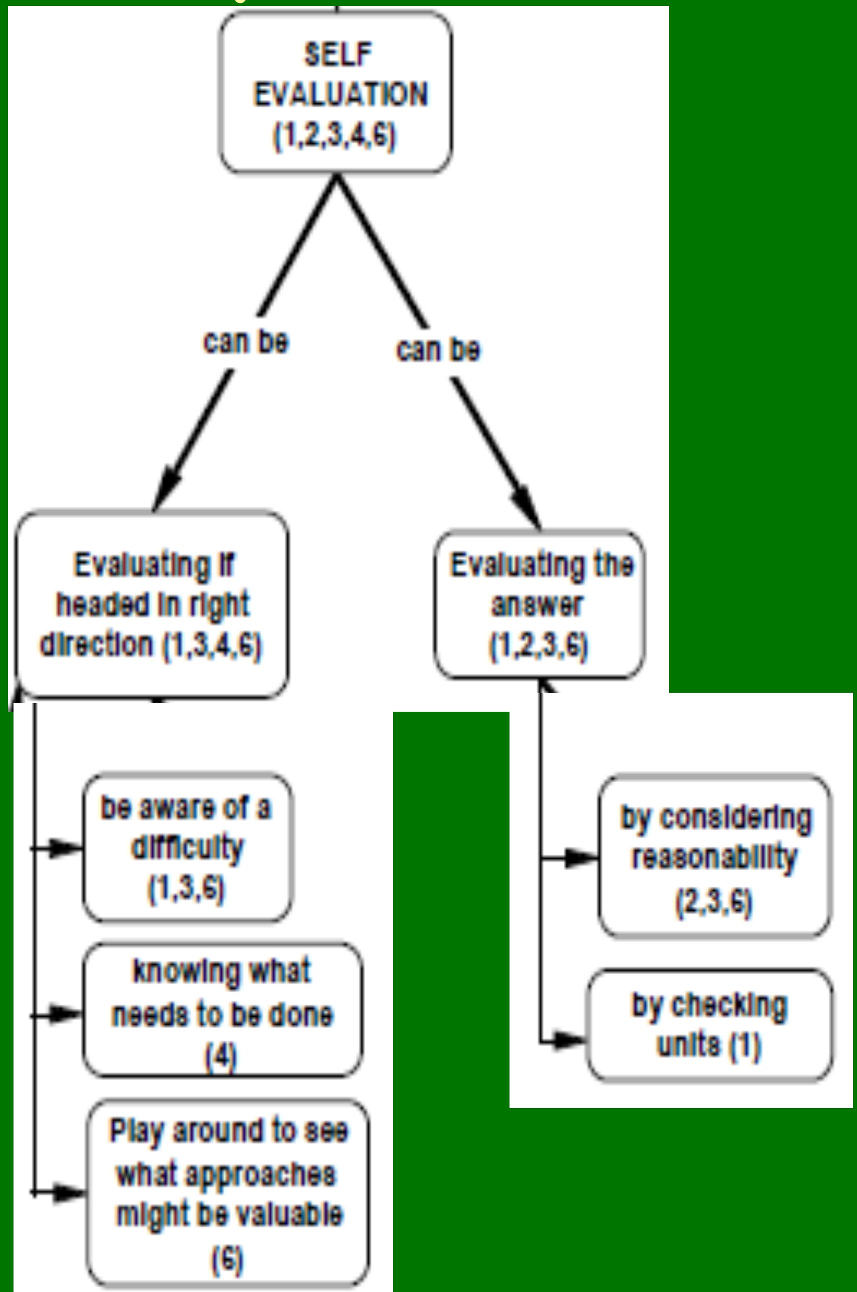

Reflection on the task

What where the advantages/disadvantages of the task as mean to get at your "hidden curriculum"?

-"Measures" for data collection "Artifacts comparison" interview approach

Guba & Lincoln "measures"	Interview features
Credibility ~ validity	Encouraging Introspection: comparison between artifacts differing in pedagogical features Identifying strong/weak beliefs: triangulation, 3 teaching contexts, General & specific Allowing natural language questions regarding interviewee's categories Making the interviewee comfortable baseline problem sent in advance
Conformability ~ objectivity	Artifacts reflect the research literature to trigger thoughts about the distribution of roles between instructor & student, desired and perceived students' reasoning. (i.e. Student solutions reflect expert vs, novice PS)
Dependability ~ reliability	Reproducibility through Pre defined questions

Assessing Student Problem Solving Using a Rubric

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Rubrics

- **Commonly used to measure complex skills**
  - **Defined by a set of categories**
- **Typically a table or grid where cells identify criteria met to attain a score**
- **Convert qualitative data → quantitative data**

Arter, J., & McTighe, J. (2001). *Scoring rubrics in the classroom*. Thousand Oaks, CA: Corwin Press, Inc.

Montgomery, K. (2002) Authentic tasks and rubrics: Going beyond traditional assessments in college teaching. *College Teaching*, *50*(1), 34-39

Rubric Category Descriptions

- **Useful Description**
  - organize information from the problem statement symbolically, visually, and/or in writing.
- **Physics Approach**
  - select appropriate physics concepts and principles
- **Specific Application of Physics**
  - apply physics approach to the specific conditions in problem
- **Mathematical Procedures**
  - follow appropriate & correct math rules/procedures
- **Logical Progression**
  - overall the solution progresses logically; it is coherent, focused toward a goal, and consistent (not necessarily linear)

Based on previous work at Minnesota by:

J. Blue (1997); T. Foster (2000); T. Thaden-Koch (2005);

P. Heller, R. Keith, S. Anderson (1992)

Research Basis of Rubric

Rubric categories were derived from research on experienced & inexperienced problem solvers:

Useful Description

- (Larkin, McDermott, Simon, & Simon 1980; Reif & J. Heller 1982)

Physics Approach

- (Chi et al. 1981; de Jong & Ferguson-Hessler; J. Heller & Reif 1984)

Specific Application of Physics

- (Larkin 1979; Schoenfeld & Hermann 1982; Eylon & Reif 1984)

Math Procedures

- (Polya, 1945; Reif, Larkin, & Brackett 1976)

Logical Progression

- (Chi 2006; Singh 2002; Reif & J. Heller 1982)

Also developed from applying the rubric to student and instructor solutions

Rubric Scores (in general)

5	4	3	2	1	0
Complete & appro-priate	Minor omission or errors	Parts missing and/or contain errors	Most missing and/or contain errors	All inappro-priate	No evidence of category

NOT APPLICABLE (NA):

NA - Problem	NA - Solver
Not necessary for this problem *(i.e. visualization or physics principles given)*	Not necessary for this solver *(i.e. able to solve without explicit statement)*

Problem solving rubric at a glance

← *SCORE*

CATEGORY: *(based on literature)*	5	4	3	2	1	0	NA (P)	NA (S)
Useful Description								
Physics Approach								
Specific Application								
Math Procedures								
Logical Progression								

Want

- ***Minimum*** ***number of categories that include relevant aspects of problem solving***
- ***Minimum*** ***number of scores that give enough information to improve instruction***

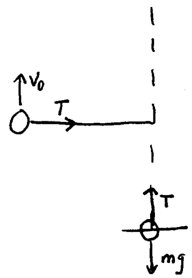
Problem-Solving Task

Homework Problem

You are whirling a stone tied to the end of a string around in a vertical circle having a radius of 65 cm. You wish to whirl the stone fast enough so that when it is released at the point where the stone is moving directly upward it will rise to a maximum height of 23 meters above the lowest point in the circle. In order to do this, what force will you have to exert on the string when the stone passes through its lowest point one-quarter turn before release? Assume that by the time that you have gotten the stone going and it makes its final turn around the circle, you are holding the end of the string at a fixed position. Assume also that air resistance can be neglected. The stone weighs 18 N.

The correct answer is 1292 N

Student Solution B



This is a centripetal force problem $\Rightarrow F = m\frac{v^2}{R}$

Free Fall:

$v_y = v_0 - gt$ (= 0 at max. height)

$gt = \frac{v_0}{g}$

$t = \frac{v_0}{g}$

$\Delta y = y_0 + v_0 t - \frac{1}{2} g t^2$

$\Delta y = y_0 + v_0\left(\frac{v_0}{g}\right) - \frac{1}{2} g \left(\frac{v_0}{g}\right)^2$

$\Delta y = y_0 + \frac{v_0^2}{g} - \frac{1}{2}\frac{v_0^2}{g}$

$\Delta y = \frac{(y_0 - 1/2)\, v_0^2}{g}$

uses Δy instead of y

makes math error

$\frac{\Delta y\, g}{(y_0 - \frac{1}{2})} = v_0^2$

$T = F = ma = \frac{m v_0^2}{R}$

$= \frac{mg\,\Delta y}{(y_0 - 1/2) R}$

$= \frac{18 \cdot 22.65}{(.65 - 1/2)(.65)} = 4182\,N$

Force Exerted by me

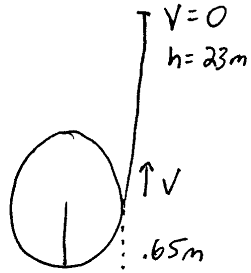
Does not sum Forces

uses $V_{release}$ instead of V_{bottom}

Description	2
Approach	3
Application	2
Math	3
Logical Progression	4

5-complete & appropriate
4-minor errors / omissions
3-parts incorrect
2-mostly incorrect
1-all incorrect
0-missing
NA(Problem)
NA(Solver)

Student Solution D



Energy conservation between top and release

$\frac{1}{2}mv^2 = mg\Delta h$

$v^2 = 2gh$

$V = \sqrt{2(-9.8)23}$

$V = 21.2$

uses h instead of h-R

makes sign error

changes sign

Between release and bottom $T \perp v$ so no work done

∴ Energy is conserved and velocity is the same

$\Sigma \vec{F} = m\vec{a}$

$T - mg = \frac{mv^2}{R}$

$T = 18 + \frac{\frac{18}{9.8} \cdot 21.2^2}{.65}$

$= 1292N$

uses $V_{release}$ instead of V_{bottom}.

Description	**?**
Approach	**?**
Application	**?**
Math	**?**
Logical Progression	**?**

5-complete & appropriate
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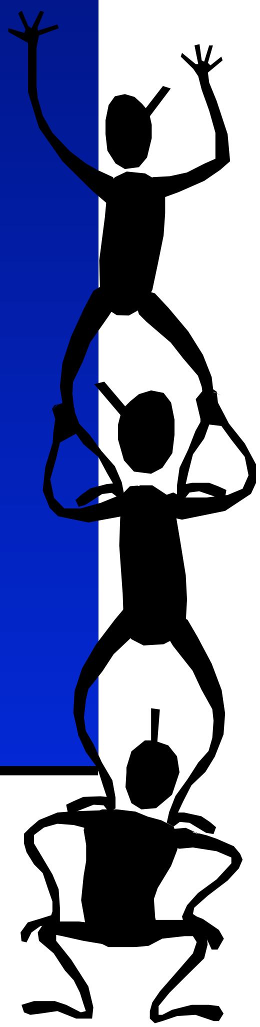
References



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Additional Slides

	5	4	3	2	1	0	NA(Problem)	NA(Solver)
USEFUL DESCRIPTION	The description is useful, appropriate, and complete.	The description is useful but contains minor omissions or errors.	Parts of the description are not useful, missing, and/or contain errors.	Most of the description is not useful, missing, and/or contains errors.	The entire description is not useful and/or contains errors.	The solution does not include a description and it is necessary for this problem /solver.	A description is not necessary for this problem. (i.e., it is given in the problem statement)	A description is not necessary for this solver.
PHYSICS APPROACH	The physics approach is appropriate and complete.	The physics approach contains minor omissions or errors.	Some concepts and principles of the physics approach are missing and/or inappropriate.	Most of the physics approach is missing and/or inappropriate.	All of the chosen concepts and principles are inappropriate.	The solution does not indicate an approach, and it is necessary for this problem/ solver.	An explicit physics approach is not necessary for this problem. (i.e., it is given in the problem)	An explicit physics approach is not necessary for this solver.
SPECIFIC APPLICATION OF PHYSICS	The specific application of physics is appropriate and complete.	The specific application of physics contains minor omissions or errors.	Parts of the specific application of physics are missing and/or contain errors.	Most of the specific application of physics is missing and/or contains errors.	The entire specific application is inappropriate and/or contains errors.	The solution does not indicate an application of physics and it is necessary.	Specific application of physics is not necessary for this problem.	Specific application of physics is not necessary for this solver.
MATHE-MATICAL PROCEDURES	The mathematical procedures are appropriate and complete.	Appropriate mathematical procedures are used with minor omissions or errors.	Parts of the mathematical procedures are missing and/or contain errors.	Most of the mathematical procedures are missing and/or contain errors.	All mathematical procedures are inappropriate and/or contain errors.	There is no evidence of mathematical procedures, and they are necessary.	Mathematical procedures are not necessary for this problem or are very simple.	Mathematical procedures are not necessary for this solver.
LOGICAL PROGRESSION	The entire problem solution is clear, focused, and logically connected.	The solution is clear and focused with minor inconsistencies	Parts of the solution are unclear, unfocused, and/or inconsistent.	Most of the solution parts are unclear, unfocused, and/or inconsistent.	The entire solution is unclear, unfocused, and/or inconsistent.	There is no evidence of logical progression, and it is necessary.	Logical progression is not necessary for this problem. (i.e., one-step)	Logical progression is not necessary for this solver.

Student Solution A

$$\frac{V^2}{R} = a = \frac{F}{m} \qquad \frac{2\pi R}{T} = V$$

$$a = \frac{\left(\frac{2\pi R}{T}\right)^2}{R} = \frac{4\pi^2 R}{T^2}$$

$$V = \sqrt{Ra}$$

$$y = y_0 + vt + \frac{at^2}{2}$$

$$= 0.65 + \sqrt{Ra}\,t + \frac{at^2}{2}$$

$$\not{V}^2 \to 0 \quad - V_0^2 = -2g\Delta y$$

$$V_0 = \sqrt{2g\Delta y} = \sqrt{Ra}$$

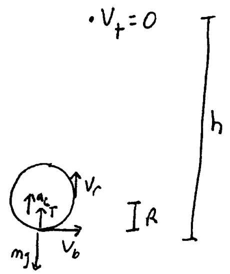
$$\frac{2g\Delta y}{R} = a = \frac{F}{m}$$

Uses $V_{release}$ instead of V_{bottom}

Does not sum forces

$$F = \frac{2mg\Delta y}{R} = \frac{2 \cdot 18 \cdot (23 - 0.65)}{0.65} = 1237.846\,N$$

Student Solution C



$V_t = 0$
$V_r = ?$
$V_b = ?$
$T = ?$
$mg = 18N$
$h = 23m$
$R = 0.65m$

Find velocity to reach height (free fall)

$$V^2 - V_0^2 = 2a(y - y_0)$$

~~$0 - V_0^2 = 2(-g)(h)$~~

$$0 - V_r^2 = 2(-g)(h - R)$$

$$V_r = \sqrt{2g(h-R)}$$

$$= \sqrt{2 \cdot 9.8\,m/s^2 \cdot (23 - 0.65)m} \qquad \sqrt{m/s^2 \cdot m} = m/s$$

$$= 20.9\,m/s$$

It can't be that $V_r = V_b$ but I don't know how to relate them. If $V_r = V_b$, then:

Find Force

Uses $V_{release}$ instead of V_{bottom}

$$\Sigma \bar{F} = m\bar{a}$$

$$T - mg = ma_c$$

$$N + \frac{N}{m/s^2} \cdot \frac{m^2/s^2}{m} = N$$

$$T = mg + \frac{mv_r^2}{R} = 18N + \frac{\frac{18N}{9.8\,m/s^2}(20.9\,m/s^2)^2}{0.65m}$$

Force exerted by me $= 1256N$

Looks large, but stone needs to go up far

$$V^2 = 2gh$$

$$F - mg = \frac{m\,2gh}{R}$$

$$F = 18 + \frac{2 \cdot 18 \cdot 23}{.65} = 1292\ N$$

Comparing the Research Based Hidden Curriculum to the Instructor Hidden Curriculum – Do They Match?

Andy Mason
University of Minnesota
in absentia

Categorized cards (by interviewee)

translating English stater physic equat

Break the problem into steps

OVERALL APPROACH

Knowing conservation of energy

UNDERSTAND PHYSICS

Draw vector diagrams

Substitutes to get answer

PROCEDURAL

Recognize when something is missing

MATURITY

Comment on result

Your Categories

Sample professor, matching

Category	Useful Description	Physics Approach	Specific Application	Math procedure	Logical Progression
Check					
Presentation					
Math					
More relationships needed					
Performing different steps					
Defining variables & coordinate syst					
Start solution looking for relationships that involve what you look for					
Realized different way to solve problem					
Read					

Sample professor, modeling matching

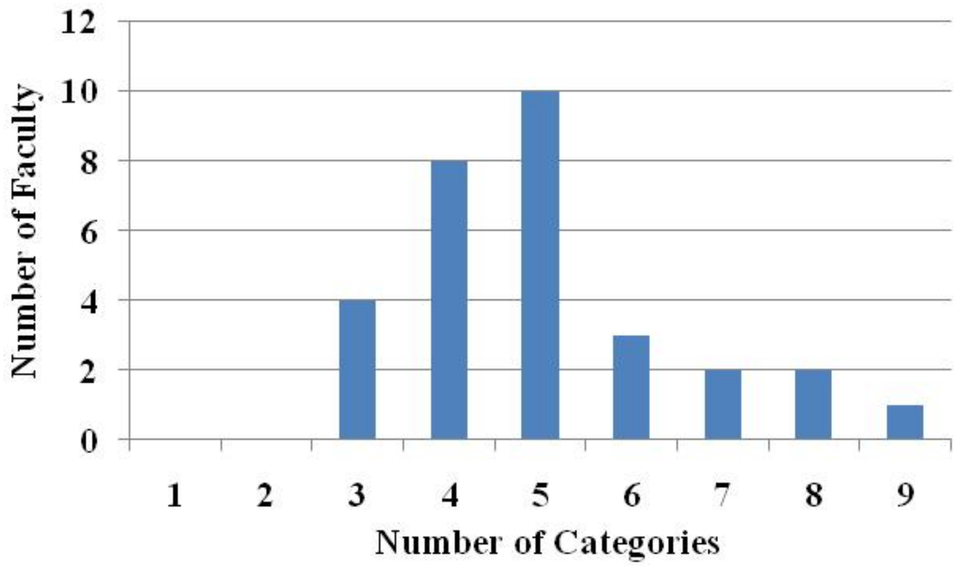
Category	Useful Description	Physics Approach	Specific Application	Math procedure	Logical Progression
Check				X	
Presentation					X
Math				X	
More relationships needed			X		
Performing different steps					X
Defining variables & coordinate syst	X				
Start solution looking for relationships that involve what you look for			X		
Realized different way to solve problem		X			X
Read	X				

Use your categories to match

Your Categories	Useful Description	Physics Approach	Specific Application	Math procedure	Logical Progression

How well did your categories which emerged from the "Instructor Solutions" artifact match to research based categories?

The extent to which they did indicates an overlap in two types of hidden curriculum

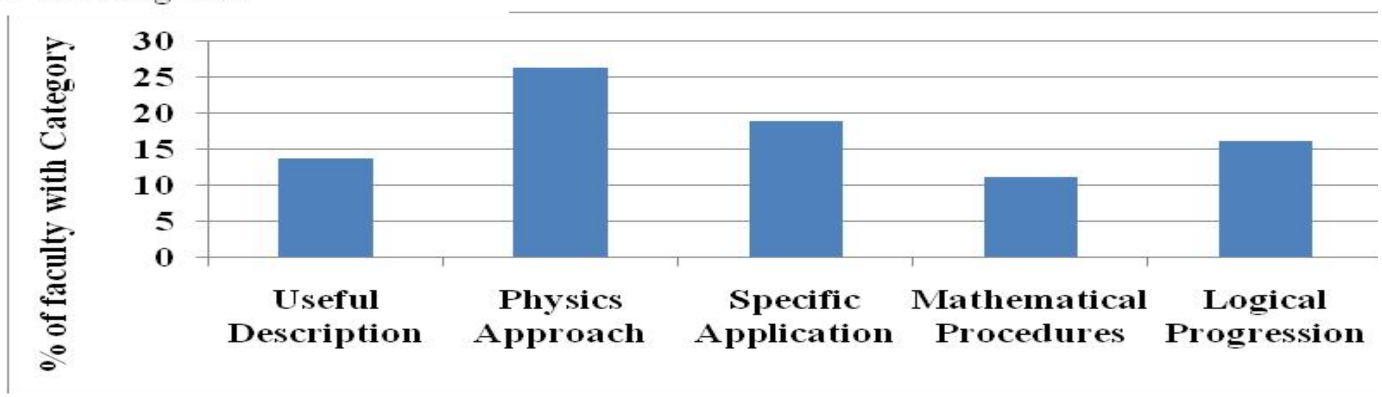


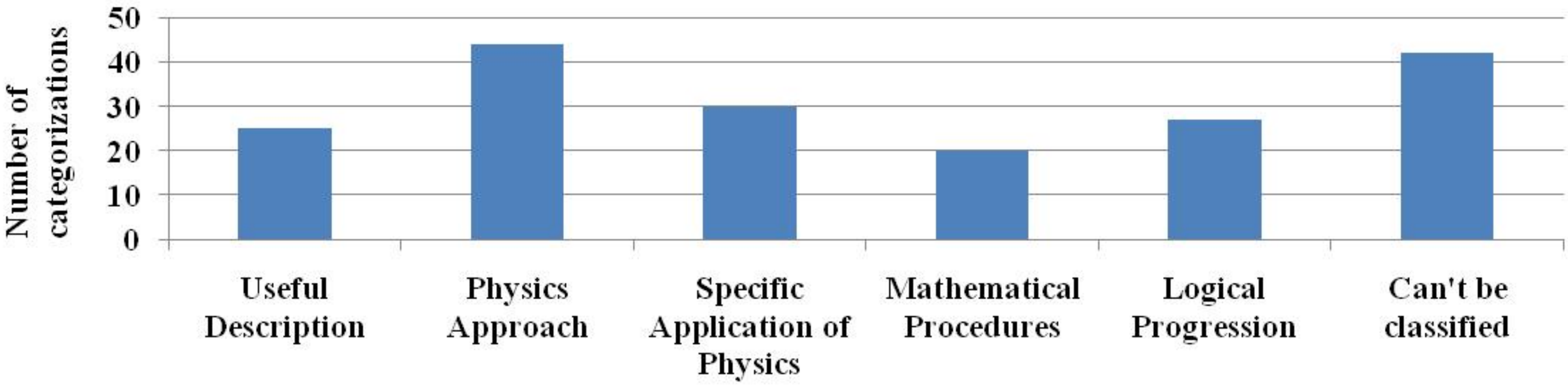
30 physics faculty

Equally divided between

- **Research university**
- **PU state university**
- **PU private college**
- **Community college**

90% Inter- rater reliability





How well did the overlap of the research based hidden curriculum and your hidden curriculum match with student performance represented by your rating of the student solution?

This was just a brief illustration of using interview tools for faculty and research validated rubrics to assess student performance to expose the various aspects of the hidden curriculum.

The extent to which all of the various hidden curriculums are aligned and exposed makes the learning and teaching experience more effective and less frustrating.

Thank you