

促进 深度学习 的有效策略和具体方法

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我们的共识

- 我会采用4-T方法：
 - * Task (学习活动)
 - * Team (小组协作)
 - * Thinking (思考)
 - * Talking (发言)



请配合

- 请包涵我的普通话和香港用语

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深度学习
有效策略和具体方法
何淑冰博士

教育部高教司吴岩2019.4.29讲话

国家级一流课程申报条件



突出学生中心，注重能力培养，
有效提升课程的高阶性、创新性、挑战度

- 目标融合创新：立德树人+专业人才培养
- 内容融合创新：基本内容+学科发展前沿+“四新”
- 技术融合创新：教育教学方法+现代技术
- 模式融合创新：流程重组+结构再造



中华人民共和国教育部
Ministry of Education of the People's Republic of China

新工科EECS圈



您在工作坊前应填写了
《促进学生深度学习：思索-困惑-探索》工作纸
请在小组中分享您的答案



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您满意您的学生的学习深度吗？
什么因素影响他们学习的深度？



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「涵盖内容」是理解的最大敌人 🐼

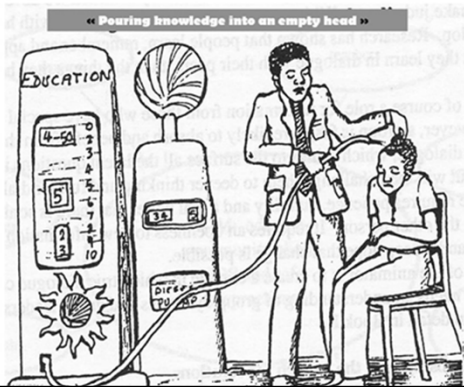


We've got to do fewer things in school. The greatest enemy of understanding is coverage... You've got to take enough time to get kids deeply involved in something so they can think about it in lots of different ways and apply it.

— Howard Gardner —

AZ QUOTES

为了「涵盖内容」要满堂灌



Effective teachers
don't
'cover' curriculum,
they
u n c o v e r
it

Ann Parker
Kannapolis City Schools

不图
「涵盖内容」



u n c o v e r

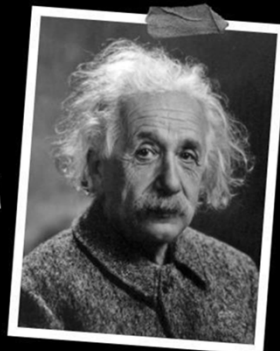
帮助学生

- ◆发现 ...
- ◆找出 ...
- ◆解开...
- ◆弄清楚 ...

Uncover ... 发现

发现什么?
如何发现?

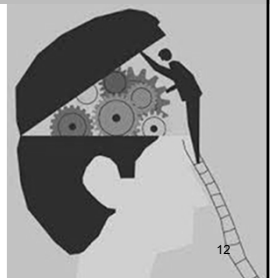
"Education is not
the learning of
facts, but the
training of the mind
to think."
-Albert Einstein



培养学生的认知思维

Uncover cognitive thinking

发现
认知思维



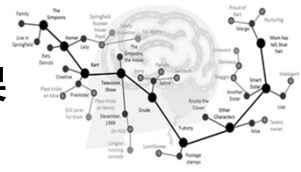


你认为大脑是如何学习和储存知识的呢？



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个性化知识框架



- 大脑将积累的信息、概念、经验 ... 等等，透过思想活动建构出自己所理解的知识框架图式 (Schema 从数 schemata)
- 人在其一生中不断建立、重建图式中的连接，使其变化和成长，这就是学习

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满堂灌教学法是基於错误概念

- 大脑是一个容器
- 老师可以把知识按原样“加”进学生的脑袋里
- 学生的大脑容器越装越满，知识就多了！



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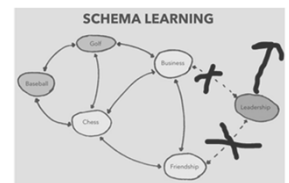
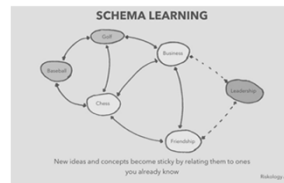
当代认知心理学理论

深度学习
(deep learning)

- 将新信息整合，融入到现有图式中
- 成为重建的知识一部分

浅度学习
(surface learning)

- 信息不能植根于图式，不能被用于建立知识
- 孤立的信息很快被遗忘



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请细读後面两段谈联系知识点的文字，并在小组中讨论

- 1) 他们的视觉、思想焦点有分别吗？怎样不同？
- 2) 他们和这个工作坊有关联系知识的概念有异同吗？

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历史是一门社会科学，具有综合性特点。内容涉及政治、经济、文化、科技、社会生活诸领域，与现实生活及初中开设的人文和自然学科知识相联系。因此，教学中联系现实生活、渗透相关学科知识是必要的。加强这种横向联系，有利于学生更为全面深入地了解和读懂历史，克服历史与现实、理论与实际相脱离的弊端，使历史课更加贴近现实，贴近生活，贴近学生。

.....
(来源：9/2006 《安徽教育》月刊)

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豆瓣 **douban** 首页 浏览发现 话题广场 游戏

知识点，联系成线 <https://www.douban.com/note/587607984/>

Peter_Kuma 2016-10-19 19:25:55

不知不觉看了有3个月的书了，看的各种各样的书，有美食、生活、科普、儿童、哲学、小说、励志和一些名著。

今天读了一本关于谈判的书，在书中看到了博弈论的概念和锚定效应的介绍，突然眼前一亮豁然开朗的感觉，发现之前了解的知识可以串联在一起了，连起来了之后就是一条叫做谈判的线，我还想深入地了解这方面的知识，进入了这个世界之后，发现现实充满了可以充分应用这些知识的案例，就感觉整个世界都不一样了，开始从新的角度看世界。我也发现了以前的我是多么的渺小了，现在也很渺小，但是也发现了各种不一样的自己，不一样的可能性。

阅读真的很有趣啊，思考真的很有意思啊，脑袋本来就是一个应该多工作的天赐之物，不要将它荒废了，它会带给你不一样的力量!!!

我们应该学会看世界，不是让世界塑造我们。

来自 豆瓣App


联系知识：两种视角和焦点，

以老师教学为中心	以学生学习为中心
老师整理知识点间的联系，作为新知识内容的部分讲授给学生	学生把新信息自行与自己大脑里已有的概念框架整合，重建构成自己新的知识图式
焦点主要放在外在的事实，概念	焦点同时放在外在的事实，概念和学生的已有知识


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帮助学生建立新旧知识的联系

- 1) 激活 背景知识



- 2) 建立新旧知识的联系



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第一步：激活背景知识





WAKE UP YOUR BRAIN

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第二步：把新知识联系到.....

- 旧知识、概念
- 过往相关经验
- 现实生活
- 相关学科
- 专业实况
-



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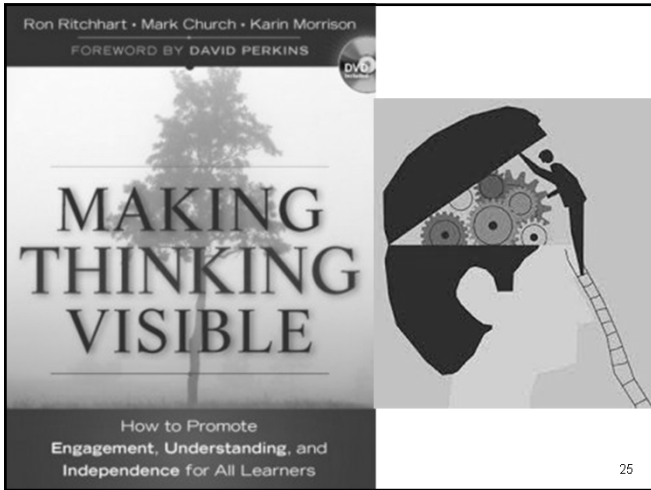
培养学生的认知思维(一)

Uncover relational cognition

发现联系认知



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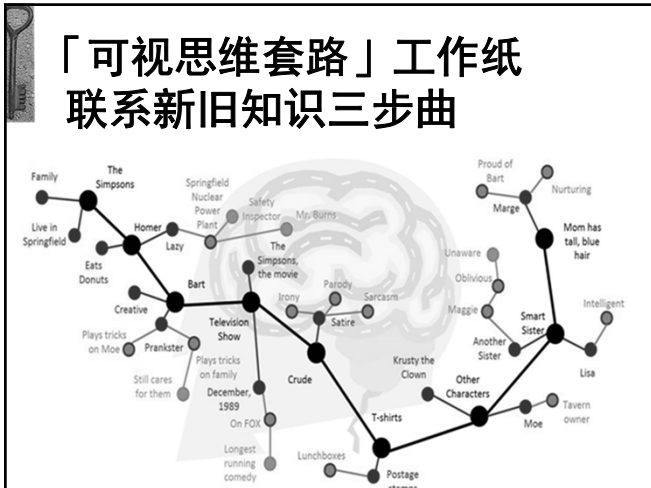
http://www.visiblethinkingpz.org/VisibleThinking_html_files/03_ThinkingRoutines/03a_ThinkingRoutines.html

VISIBLE THINKING

Visible Thinking in Action
Getting Started
Thinking Routines
Introduction
Core Routines
Understanding Routines
Fairness Routines
Truth Routines
Creativity Routines
Thinking Ideals

Thinking Routines

Routines exist in all classrooms; they are the job of learning and working together thought of as any procedure, process, or manage and facilitate the accomplishment of learning, and to establish rules for classroom have routines that structure the way students learning routines can be simple structures



「可视思维套路」工作纸 联系新旧知识三步曲

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第一式: 启动联系思维 (开始新课题时用)

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Think - Puzzle - Explore

- 思索** 你对这个课题了解多少?
(激活背景知识)
- 困惑** 关于这个课题你有什么困惑?
(激发兴趣)
- 探索** 您计划如何对这些困惑进行探索?
(为自主学习奠定基础)

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这个学习活动对您有帮助吗？



您在工作坊前应填写了
《促进学生深度学习：思索-困惑-探索》工作纸
请在小组中分享您的答案



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例一：教师培训班



THINK / PUZZLE / EXPLORE

Think about what you may have read as part of the pre-reading activity for this workshop as well as what you already know about the SBAC Assessment. Take a few post-it notes and generate responses to the prompts below. Place them accordingly on the large chart.

1. What do you already **think/know** about the SBAC assessment that do you want to discuss with your colleagues?
2. What **questions/puzzles** do you have about how the implementation of this assessment or how it will impact teaching/learning in your classroom?
3. How would you like to further **explore** the questions/puzzles we have around the SBAC assessment or performance tasks?

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例二：“可持续旅游”



思索

• 你对“可持续旅游”了解多少？

困惑

• 你对“可持续旅游”有什么困惑？

探索

• 您将如何探索 and 了解有关“可持续旅游”的概念？

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Table 1: Sustainable Transportation

Think	Puzzle	Explore
<ul style="list-style-type: none"> -increase the standard living -improve public health -Mexico city is one of the world's top polluted cities -Traffic still is a problem in Mexico City -cars can make traffic bad 	<ul style="list-style-type: none"> -What are countries doing to "stop" or improve air quality? -How to make bikes safer? -How to incorporate into poorer cities? -Can horse-drawn carriages help with pollution problems? -What ever happened to walking? -cost of program? -Get electric car chargers in cities? 	<ul style="list-style-type: none"> -National Geographic Documentaries on youtube -Primary Sources: someone who lived in a polluted area -Research bike/bus transportation -Research ITDP -Ask anyone who has ever been to Mexico City?

Table 2: Sustainable Design

Think	Puzzle	Explore
<ul style="list-style-type: none"> -3D printer: melts plastic and builds up an object layer by layer -Efficient because there are less transportation costs and faster production. -It's already being used today -Cuts down on prototyping, waste, and transportation emissions. -Coming to domestic markets -The world + the technologies are developing quickly. 	<ul style="list-style-type: none"> -Can it handle making things out of more than one material? -What do the biggest limitations go? -Could we make them safer? -Could they provide brand new arms and legs? -What are the factors of production? -Is it costly or cheap? -What are the disadvantages and advantages of the manufacturing? -What raw materials can be harvested? -Is it only limited to plastic? -Why is it not well-known around the world? 	<ul style="list-style-type: none"> -Look into articles and videos and uses it to see how it works. -Further information can come from the inventor & the 3-D printer. -If plastic is used to print out 3-D objects, what happens if dangerous objects can be made from it? easily too.

Table 3: Sustainable Textiles


Think	Puzzle	Explore
<ul style="list-style-type: none"> -There are 4 factors -Textiles/fabrics can be harmful to the overall environment? -Add chemistry affect? <u>textile workers health</u> -Natural methods = better for your body (ex: wool) -Harmful additives are added to fabrics and <u>are harmful to our skin</u> -PFC's harm animals but wool is naturally sustainable -Harmful chemicals in clothes harm the environment/our health -Chemicals harm thyroid gland -Harmful chemicals used on clothes, shower or hospital-use clothes 	<ul style="list-style-type: none"> -What positive effects is the <u>use of chemicals</u> have on the clothes longevity? -What things go into <u>textile</u> making clothes? -How source are the chemicals? -Have the chemicals ever killed anyone? -Does the price of the chemicals harm the economy? -Positive vs negative health risks -Self-cleaning fabrics? -Benefits vs. hurting? (PFC) -Better resources? -Not deteriorating (washing) -How are health concerns of performance clothes affecting humans? -Why keep making such harmful textiles? -What is the difference b/w polyester & nylon? -I wonder what the health costs amount to for women's clothes 	<ul style="list-style-type: none"> -textiles -raw materials -landfill -Cancer (textile worker, etc.) -textile production -fabric sustainability -textile workers -cost into different sources -wishes to ask: Anyone in the working company - the guardian.com Keywords: textiles, raw materials, term chemical used in clothing <u>textile industry</u> -ask people who have chemical in clothing and those who don't (ex history channel) -discovery channel -additives

例三：小学课题-海盗与海岛

Pirates and Islands

THINK, PUZZLE, EXPLORE


Think	Puzzle	Explore
<ul style="list-style-type: none"> steal treasure unkind have cannons they fight climb rigging use telescopes talk funny have ships look for buried treasure 	<ul style="list-style-type: none"> where they come from what they eat what they drink what they do why they live on a boat why they fight are they still alive how they steal treasure 	<ul style="list-style-type: none"> books maps TV or movies diaries online - Google ipad, computer, phone museum letters



第二式： 深化联系思维

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Connect - Extend - Challenge



联系 新信息和概念与你已知的有什么联系？
(把新知识与背景知识联系起来)

延伸 新概念使你的思维扩展到那些新方向？
(鼓励拓宽思维)

挑战 新信息和概念使你想到了什么挑战或困惑？
(提示对困惑和困难作评估)

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例一：统计学

Connect You can show probability in a fraction or percentage. Probability is the likelihood or chance of something happening.

Extend Reverse chances, eg probability of NOT rolling a 5. There is a mathematical way to describe chance and it requires thinking harder. Can multiply to get total # outcomes for rolling 2 dice (6-6=36). Probabilities should influence decisions. OR means add the probabilities - the chances go up. Can use a visual ("area") model. (1,2) and (2,1) are two different outcomes. After 11/2/12

Challenge Does P(1)-P(6) statistics relate? When rolling two dice, how does probability change? How does probability influence decisions and vice versa? Can you do probability with something besides dice? Are they different? Why does dice color matter? Prob with 3 dice?

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例二：探讨社会问题(例:安乐死)

Watch and make notes

‘CONNECT - EXTEND - CHALLENGE’

How are the ideas and information connected to what you already know?

What new ideas did you get that extend your thinking in new directions?

What is still challenging or confusing for you?

关于安乐死视频
<http://www.youtube.com/watch?v=UiPFeluy3rA>

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例三：小学课题 - Poetry

Connect What do you already know about Poetry? (Activate your schema and share your background knowledge.) I knew that poetry could have rhymes, rhyme, big empty space, no order at all, and you don't have to have a title.

Extend What are you learning about Poetry? Synthesize your new learning and share what it means to you. I learned that poems tell personal and articulation, they can be riddles, they tell stories. For example, the poem I read was a poem and a riddle.

Challenge What do you still wondering about Poetry? Share concepts that you are still thinking about that continue to challenge you. How does poetry affect our life? poetry change our lives?

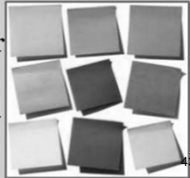
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例四：用于教师培训班

Your Picture of an Effective Classroom

Connect/Extend/Challenge

- **Connect:** What connections did you see or hear between your description of an effective classroom and the brief description of the 5Ds?
- **Extend:** What extended your thinking?
- **Challenge:** What challenged your thinking?



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第三式： 总结联系思维

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I used to think ... but now I think



我以前认为

(反思以前对主题的看法)

但现在我认为

(巩固新的学习和理解)

我的想法改变了，因为 ...

(思考思维改变的原因：
帮助学生发展元认知)

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用来总结一个课题 (e.g. 社会科学)



I Used To Think...

Now I Think...

With a partner on a notecard...

Write down I used to think and answer what you used to think about Social Studies and ELAR Integration

Write down Now I think and answer what you now think about Social Studies and ELAR Integration

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HARVARD GRADUATE SCHOOL OF EDUCATION

Harvard Education Press

Browse New Releases

Twenty leading educators reflect on the work of school reform

I used to think... | And now I think...



Edited by Richard F. Elmore

JEAN ANYON | ERNESTO J. CORTÉS JR. | RUDY CREW | LARRY CUBAN | HOWARD GARDNER | BEVERLY L. HALL | THOMAS HENRICH | JEFFREY B. HENIG | FREDERICK M. HESS | DEBORAH JEWELL-SHERMAN | BRAD JUFF | DENNIS LITTEY | DEBORAH MEER | RON MILLER | SONJA NIETO | CHARLES M. PAYNE | LARRY ROSENTOCK | MARK SIMON | MARSHALL S. SMITH

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「可视思维套路」 工作纸的用处

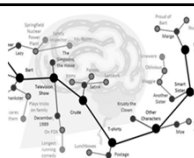


- 向学生展示联系思维的方法
Making thinking VISIBLE
- 帮助学生在不同的学习阶段运用适合的联系思维，
达至对知识的深层理解
- 经常使用帮助学生养成积极思考的习惯



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培养联系认知思维



Uncover relational cognition

可以在你的课堂用这些工作纸让学生耍「思维套路」吗？



培养学生的认知思维(二)

Uncover metacognition

发现元认知



解题需要：知识+元认知能力

成功的问题解决者掌握知识同时演示良好的元认知意识，例如：

- 小心的理解问题中事实之间的关系
- 将复杂的问题分解成简单的步骤
- 检查自己的推理, 不作出盲目猜测
- 常常停下来自我提问, 理清思路
- ...

Metacognition



方法(一)：老师示范“大声思考”

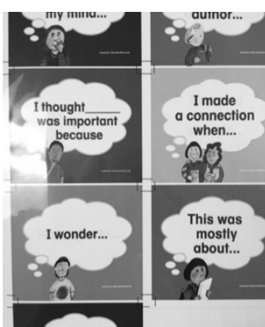


在教学时，不单解释课程知识，同时说出自己怎样思考，演示专业的思考范式。

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方法(二)：学生进行“大声思考”

- 鼓励学生在做功课或温习时“大声思考”
 - 帮助内化理解
- 大声思考解决问题二人组
 - 组员说出自己怎样思考，更要相互提问
 - 互相监控思维
- 大声思考进展性评价
 - 评估解决问题的能力/弱点



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方法(三)：“猜猜这步为什么”

老师

学生

逐步演示解决问题

猜测为什么要采取这些步骤
提出替代路线来解决



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培养元认知思维

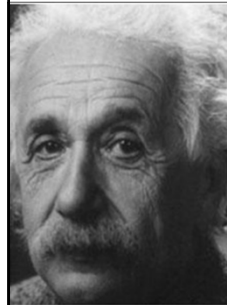


Uncover metacognition

这些“Think-about-thinking”的方法可以在您的课堂用吗？



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True knowledge comes with deep understanding of a topic and its inner workings.

— Albert Einstein —

AZ QUOTES

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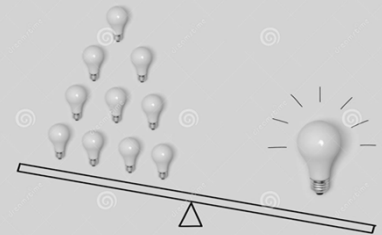
Uncover ... 发现



帮助学生深度理解(一)

Uncover big ideas in the curriculum

发现大概念



What is a Big Idea?

Grant Wiggins

Jun 10, 2010

return to [Big Ideas Home](#)

http://www.authenticeducation.org/ae_bigideas/

Big idea 是关键的概念，像一个透镜有效地看到零散的、看似无意义的、混乱不清的知识点之间的连接，有助于达到深层理解

Meanings

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例一：微积分

- 学生经常只记住不同积分方法的公式

$$\int \frac{dx}{\sqrt{a^2-x^2}}, \int \frac{dx}{\sqrt{x^2-a^2}}, \int \frac{dx}{\sqrt{x^2+a^2}}, \\ \sqrt{a^2-x^2} dx, \sqrt{a^2+x^2} dx, \\ \sqrt{x^2-a^2} dx \text{ How to Memorise Integration Formulae}$$

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Home » Programs » Faculty and Departments » Curriculum & Department Guidelines & Recommendations » Innovative Teaching Exchange » Engaging Students via In-Class Worksheets

Engaging Students via In-Class Worksheets

用工作纸帮助学生专注微积分基本概念

by Cindy Wyels, California State University Channel Islands

Wyels, C. (published date unknown) Engaging Students via In-Class Worksheets. Retrieved January 23, 2017, from <http://www.maa.org/programs/faculty-and-departments/curriculum-department-guidelines-recommendations/innovative-teaching-exchange/in-class-worksheets>

微积分的大概念

- 工作纸帮助他们看到所有数值积分公式都是
 - 将积分的平面区域划分成合适的形状
 - 找这些形状总面积
- 形状可以是矩形、梯形和用抛物线段代替矩形顶部形成的图形 (rectangles, trapezoids, and figures formed by replacing the top of a rectangle with a parabolic segment)

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例二：历史科 常用教学法：涵盖大量历史内容

WHAT THE PROFESSOR WANTS US ALL TO KNOW

ANCIENT AND MEDIEVAL HISTORY, 40 TO 1500 <ul style="list-style-type: none"> ■ The legend of Boadicea (below) ■ The destruction of Lindisfarne ■ The kingdom of Alfred ■ The Domesday Book ■ Richard the Lionheart and the Crusades ■ The legend of Robin Hood ■ Cathedrals and 	<ul style="list-style-type: none"> ■ The killing of Wat Tyler ■ Chaucer: English and European writer ■ Henry V and France ■ The Battle of Bosworth ■ The divorce of Henry VIII (below) ■ Making an English bible ■ The Armada ■ The Three Kingdoms, England, Scotland 	<ul style="list-style-type: none"> ■ Shakespeare and the Globe ■ The trial of Charles I ■ Witchcraft, magic and science ■ The Siege of Drogheda ■ The Great Fire of London ■ 1688, European politics and the ambitions of Louis XIV ■ The Boston Tea Party ■ The Battle of Britain 	<ul style="list-style-type: none"> ■ its suppression ■ The power of steam ■ The repeal of the Corn Laws ■ The Indian Mutiny ■ The changing role of Parliament ■ Votes for women ■ The Battle of the Somme ■ The Munich Conference ■ The Battle of Britain ■ Creation
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HISTORY TIMELINE

3400 3300 3200 3100 3000 2900 2800 2700 2600 2500 2400 2300 2200 2100 2000 1900 1800 1700 1600 1500 1400 1300 1200 1100 1000 900 800 700 600 500 400 300 200 100 0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 1945

MESOPOTAMIA, ANCIENT EGYPT, INDUS VALLEY, ANCIENT GREECE, ROMAN EMPIRE, THE MAYA, ROMANESQUE, ANGLI-SAXONS, VIKINGS, KINGDOM OF BENIN, AZTECS, TUDORS, WORLD WAR II 1918-45

历史大概念： 历史是对过去重要事情的解释

History is the interpretation of the significance that the past has for us.

— Johan Huizinga —

AZ QUOTES

Johan Huizinga (Dutch pronunciation: [ˈjoːɦɑn ˈɦayzɪŋxɑ]; 7 December 1872 – 1 February 1945) was a Dutch historian and one of the founders of modern cultural history.

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帮助学生发现历史概念

National Academy of Sciences (2017). *Effective Teaching: Examples in History, Mathematics, and Science*, Chapter 7.

- 学生们创造他们认为过去最重要的东西的时间胶囊
- 学生阐明他们对什么是历史意义的基本假设
- 老师把所有假设写成巨幅海报称为“确定历史意义的规则”，並以此作为全年的课堂讨论的聚焦
- 最初学生严格跟循“规则”来评价史料，後来发现规则是他们订的，他们也可以改，理解了为什么有不同意见的历史学家和历史的“解释性”。



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帮助学生深入学习大概念

大概念不应该作为事实或定义来教授

- 1) 明确识别大概念，重点帮助学生加深理解他们
- 2) 设计需要学生应用这些概念的学习任务
- 3) 在整个课程中重温和强化对大概念的理解

Schrock, J. and Benko, S. (2015). *Using Fundamental Concepts and Essential Questions to Promote Critical Thinking*. Retrieved from <http://www.facultyfocus.com/author/juleschrockdphdandstevbenkophd/>

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科学大概念例子

- 物质的化学特性和物理特性可以用它的原子、离子和分子的结构和排列以及这些粒子之间的力来解释。
- 化学反应速率是由分子碰撞的细节决定的。
- 内稳态是生物体通过保持动态平衡而保持稳定和存活的能力。
- 热量不断从较暖的物体移动到较冷的物体，直到所有物体处于相同的温度
- 能量不能被创造或毁灭。它只能从一种形式转换为另一种形式。能量的转换会导致状态或运动的改变。
- 每一个作用力都有相等的反作用力。
- 地球由漂浮在称为软流圈的液体层上的板块构成。这些板块的运动是许多地质事件的起因。

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人文学科大概念例子

- 历史是对过去对我们的重要意义的事的解释
- 文明需要地域，政治，经济，宗教和社会结构才能生存和繁荣。艺术家选择代表主题的方式来传达他们的想法
- 什么是公平？
- 什么使艺术伟大？

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以下网页有不同课程大概念例子

NYU STEINHARDT New York University Steinhardt
<http://steinhardt.nyu.edu/teachlearn/science/resources/ideas>

Big Ideas & Guiding Questions
<https://thebigideas.wikispaces.com/>

GO-LAB Go-Lab Project (Global Online Science Labs for Inquiry Learning at School)
<http://www.golabz.eu/big-ideas>

WhatItMeansForArt acstratten's website
<https://whatitmeansforart.wordpress.com/2014/08/27/big-idea-2/>

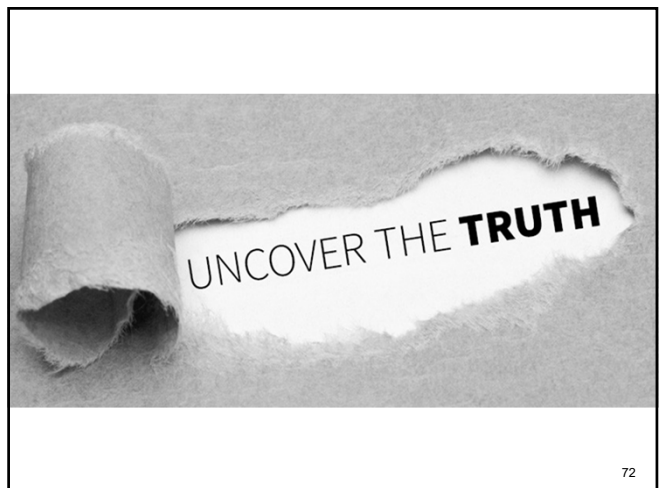
70

a) 您教的学科有那些大概念？

b) 设计有效并有趣的方法引导您的学生探索它



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对或错?



电池存电
Batteries
store

Electricity

73

对或错?

SPIDERS are insects.



蜘蛛是昆虫

74

对或错?

价值决定价格
VALUE JUDGMENT



75

对或错?

ARE YOU READY YET SIR?

I THINK I'M GOING TO NEED A BIT MORE TIME...



葡萄酒是越陈越好

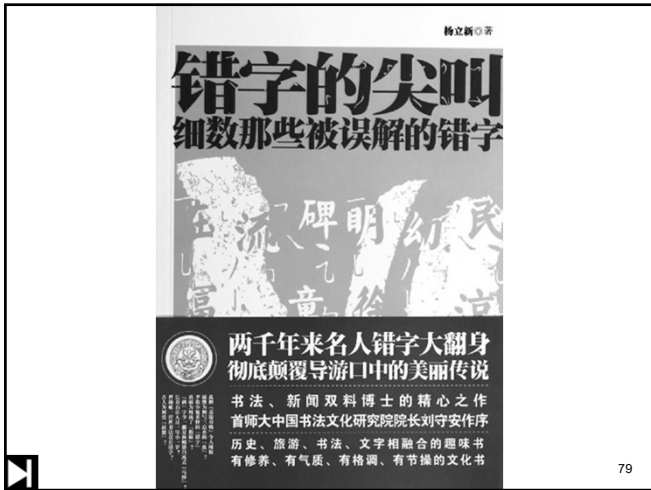


对或错?

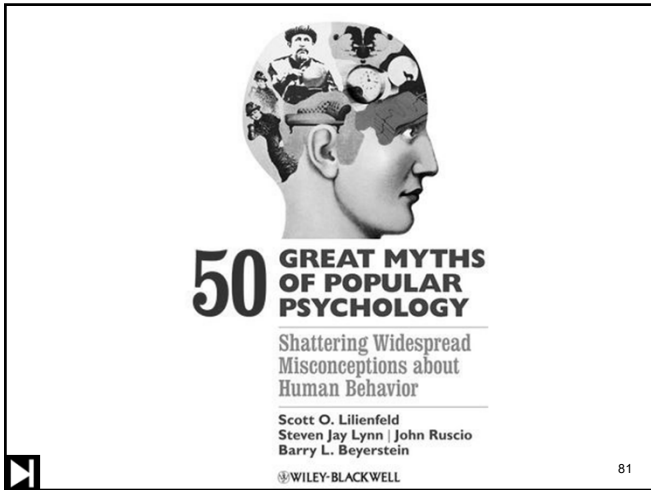


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- ### Misconceptions
- 1) Marketing is Advertising
 - 2) Marketing is spin, buzz and sizzle
 - 3) Marketing is selling
 - 4) Marketing is unethical and wasteful
 - 5) only marketers do Marketing
 - 6) Marketing is a cost center and costly
 - 7) the goal of Marketing is to maximize customer satisfaction
 - 8) the goal of Marketing is to maximize sales

错误背景概念 (Misconceptions)

- 从小到大由日常生活经验而形成
- 常有不科学的误解

根深蒂固!!!
顽强难改!!!



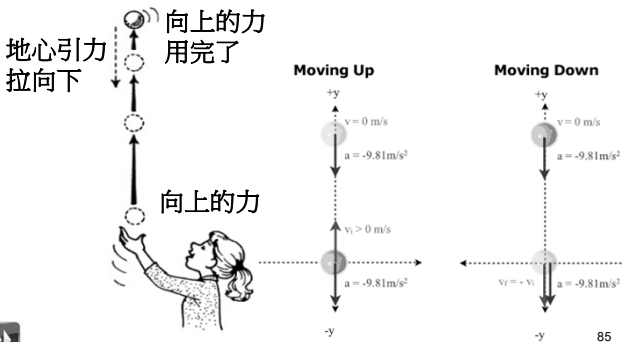
83

错误背景概念对学习的影响

- 学生不会轻易放弃错误观念
- 干扰或扭曲对新知识的理解



错误背景概念扭曲了对力学的理解



帮助学生深度理解(二)

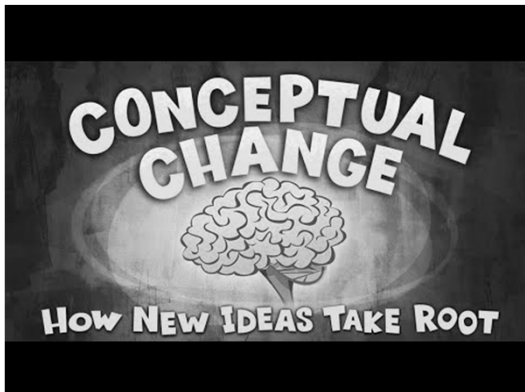
Uncover misconception

发现
错误背景概念

INCORRECT



深度学习：改变错误背景概念



概念改变教学法 Conceptual Change Teaching

1. 揭露学生的错误观念
2. 安排就错误作讨论，迫使学生无法回避，正视并处理他们的误解
3. 帮助学生重建并内化正确的新概念

Unfreezing Moving Refreezing

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教师识别学生的错误观念




- 常见错误概念汇编
- 聆听学生
 - 课网、课外的讨论
 - 大声思考解决问题二人组
 - 大声思考进展性评价
- 阅读学生的写作
 - 作业
 - 课堂短写, e.g.
 - 最混淆的内容
 - 最明白的内容
 - 与XX课题的关系
 - 仍待解答的疑问



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**WE NEED X-RAY VISION GLASSES
FOR STUDENT MISCONCEPTIONS**




小组讨论

有什么方法可以帮助学生发现自己的错误背景概念?

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方法(一): 错误概念检查

1. 老师提出关于主题的一个常见的误解
2. 学生们表明同意或不同意这一观点并解释为什么
3. 可安排学生互相质疑



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方法(二): Predict Observe Explain
预测 ⇨ 观察 ⇨ 解释

1. 实验或示范前
 - 学生**预测**其结果, 并说明基于什么背景知识作出预测
2. 实验或示范进行时
 - 学生**观察**结果
3. 实验或示范后
 - 学生讨论并**解释**预测和结果之间的分歧
 - **纠正**并背景知识, 实现更深入的了解

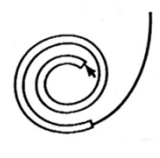
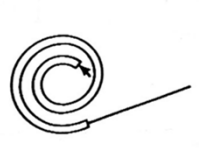
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POE: 迫使学生正视他们的误解

CONFRONTING STUDENTS' MISCONCEPTIONS

Problem: Movement of a ball exiting a curved metal tube

Two Possible Answers

Curved Path	Straight Path
	
College Student Answers 51%	47%

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方法(三): 及时的教学



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及时针对错误概念的教学

课前

- 老师预备**课前**学习材料
- 学生在截止时间前完成**课前**学习和数条**热身**问题
- 老师在上**课前**阅读学生的**答案**, 了解学生的**错误**概念或**困难**

课时

- 老师根据学生**答案****调整**教学活动, 让学生讨论反映**误解**的**答案**
及时针对学生的**错误**概念和**困难**



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设计好的热身问题



- 配合课程学习目标
- 开放式的
- 测试对下一课的重点概念的理解/误解
- 包括最有趣, 或最混淆的理念
- 相对简单, 不要花太多时间(大约30分钟)
- 大约三至四条问题

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热身问题例(一): Macromolecules



- Starch (e.g. bread, pasta) is a glucose polymer that we eat for energy, but cellulose an almost identical glucose polymer, is indigestible. Why do you think that ONE of these almost identical molecules can be digested, while the other can't?
- Butter and oil are both fats. Why is butter a solid at room temperature, but corn oil is liquid?

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热身问题例(二): Scientific Method, Evolution



- What is the difference between a theory and belief?
- *(Optional): I will not share these answers with the class*
Do you feel that there is an 'either/ or' choice between your religious beliefs and evolutionary theory – i.e. that you must reject the idea of evolution because of your religious beliefs, or that you can't believe in God if you accept the evidence for evolution? Is it possible to have both a belief in God and an acceptance of the evidence supporting evolution?

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热身问题例(三): Cloning / GenEthics



- Dolly the sheep is a genetic twin, or clone, of a sheep that was born 6 years earlier than Dolly. Does Dolly have parents? If so, who were her generic parents? Is Dolly a "virgin birth"?
- What is the flaw in thinking that if we were ever do clone a person, like Einstein, we would end up with another brilliant physicist?
- Can you think of a way that a person's generic information might be used to discriminate against them for employment or insurance coverage? Give an example.
- Can you think of any movies that center around cloning? Is so, what is the 'take-home message' of that movie?

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Predict what you think the shape of the distribution of desired weight for students in this class looks like. Explain why you think it will look that way.

预期正确答案: weight would be either bimodal, because male and female classmates differ in weight, or that it would be normally distributed

一个答案揭示了意想不到的误解

"I think the shape of the distribution would be skewed to the left because people want to weigh less, ...". This reviewed an error in interpreting the statistical concept of skewness with the height of the curve rather than a long tail in the horizontal direction, i.e. they reverse the x and y axes in their understanding of the term skewness.

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热身问题例子

B ■ C ■ E ■ S ■



http://jittl.physics.iupui.edu/jitt/sampler/biology/bio_archive/bio_wu.html

Biology WarmUps by Kathy Marrs



Warm Ups:

Warm Up 1: Scientific Method, Evolution
Warm Up 2: Cells and Organelles
Warm Up 3: Macromolecules
Warm Up 4: DNA / Mutation
Warm Up 5: Mitosis / Chemotherapy
Warm Up 6: Meiosis / Nondisjunction
Warm Up 7: Human Embryonic Stem (hES) Cells
Warm Up 8: Mendelian Genetics
Warm Up 9: Human Genetics
Warm Up 10: Cloning/ GenEthics
Warm Up 11: Three Domains of Life
Warm Up 12: Student Study Skills in N100
Warm Up 13: Photosynthesis / Respiration
Warm Up 14: Human Population Growth / AgBiotech

http://jittl.physics.iupui.edu/jitt/sampler/chemistry/warmups/chem_wu.html

Chemistry WarmUps by Bob Blake


Dimensional Analysis
States of Matter
Chemical Reactions
Atomic Structure
Stoichiometry
Stoichiometry II
Solution Chemistry
Chemical Reactivity
Acid and Heavy Metal
Thermochemistry
Thermochemistry II
Nuclear Chemistry
Light Waves
Electronic Structure
Periodic Properties
Periodic Trends
Periodic Trends II
Exam III
Molecular Shapes
Molecular Shapes II



See All Warm Ups on One Page

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http://jittdl.physics.iupui.edu/sign_on/



Just-in-Time Teaching Digital Library

Greetings! To learn about JITDDL please click About JITDDL.

HOME

Welcome to JiTTDL, the digital library for Just-in-Time Teaching pedagogical resources.

The Library collection has materials from biology, chemistry, geoscience, mathematics and physics. These represent the startup collection, provided by the JITT pioneers. If you are an active JITT practitioner, please share your materials. For a submissions kit please email gnovak@iupui.edu or request the submissions kit in the comments box of the [questionbook](#).

Guest visitors are welcome on the wiki and the collections sites. Hosting service is available only to registered users who sign up for the hosting service.

WIKI

COLLECTIONS

HOSTING

JITT People

The development of the JITDDL library is supported by an NSE grant. JITDDL is a member of the NSDL community.


This site is intended to serve as the virtual community center for the faculty who participate in the use and development of the [JITT pedagogy](#).

To request an account on the JITDDL hosting server please send your name and affiliation to gnovak@iupui.edu.

For a quick overview of JITT materials and activities please visit the [JITT Sampler](#).

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http://jittdl.physics.iupui.edu/jit/DL/dsp_resourceList.php?resClass=QuestionSet



Just-in-Time Teaching Digital Library

collections

Resource List

Page 1 of 357

Description	Topic	Resource Type / SubType	Date Entered	Record Number	View
No topic		QuestionSet /	2000-00-00	1451	View
Physics (PRA)	0423 : Mass and Momentum Transfer	QuestionSet /	2007-01-13	530	View
Physics (PRA)	Condensing	QuestionSet /	2007-01-13	530	View
Physics (PRA)	0423 : Phase Changes: Liquid-Gas	QuestionSet /	2007-01-13	37	View
Physics (PRA)	1-D Kinematic	QuestionSet /	2007-01-12	147	View
Physics (PRA)	0300 : MOTION IN ONE DIMENSION	QuestionSet /	2007-01-12	147	View
Physics (PRA)	Action and Reaction	QuestionSet /	2007-01-12	611	View
Physics (PRA)	0423 : Action and Reaction	QuestionSet /	2007-01-13	611	View
Physics (PRA)	Air Conditioner	QuestionSet /	2007-01-13	611	View
Physics (PRA)	0423 : ENGINES AND REFRIGERATORS	QuestionSet /	2006-12-28	1471	View

JUST-IN-TIME TEACHING

Learning technologies should be designed to increase, and not to reduce, the amount of personal contact between students and faculty on intellectual issues.

(Study Group on the Conditions of Excellence in American Higher Education, 1994)

JIT resources span the spectrum from web and classroom items to books and articles on effective teaching and assessment of learning. Here is a sampling.

I. A Sampling of Web Materials

- WarmUps**
Warmups are the core of the JITT method, providing the feedback loop between in-class and out-of-class involvement. The examples provided here will encourage you to create your own warmups that reflect your personality and your style and take into account the strengths and weaknesses of your students.
[BIOLOGY](#) (by Kathy Marrs) [CHEMISTRY](#) (by Bob Blake) [ETHICS](#) (by Kai Thune)
- "GoodFor" Essays**
The essays that we now call "GoodFors" were originally developed for introductory physics in response to students comments about "the lack of usefulness of this old stuff." It has been picked by by other disciplines. They are there to be shared. To prepare these is a time consuming task. "GoodFors" should not be a high priority item in a JITT course.
[BIOLOGY](#) (by Kathy Marrs) [CHEMISTRY](#) (by Bob Blake)
- JITT Mathematics Resources*** by Jeff Watt. Included are warmups, puzzles and GoodFors.
- JITT Physics Resources*** by Gregor Novak and Andy Gavrin. Included are warmups, puzzles and GoodFors.

*Please note: Some of the resources are actual web page that were presented to the students and include a navigation bar with links to other course resources. Some of those links are not operable.

[Psychology Resources](#) by Jim Benedict

<https://serc.carleton.edu/introgeo/justintime/examples.html>

Starting Point

Teaching Entry Level Geoscience

Example JiTT WarmUp Exercises

Results 1 - 10 of 16 matches

Earth System Topics

- Atmosphere [2 matches](#)
- Biosphere [10 matches](#)
- Climate [2 matches](#)
- Evolution [4 matches](#)
- Geography [1 match](#)
- Human Dimensions [2 matches](#)
- Hydrology [3 matches](#)
- Oceans [2 matches](#)
- Solar System and Astronomy [1 match](#)
- Solid Earth [4 matches](#)
- Time/Earth History [1 match](#)

JITT - Dam Removal - A Good Idea or Not? part of Examples
1) What are some of the biological effects of dam removal (good and bad)? 2) What are some of the more pressing/compelling reasons to remove a dam? Explain. 3) The Stanley and Doyle (2003) article states that, ...



JITT - Ethics of Fossil Collecting part of Examples
1) What do you think it means for a fossil resource to be "abused"? 2) What's the issue with fossil hunting on federal land (such as National Parks)? Explain what your interpretation of the conflict ...

JITT - The Big 5 Extinctions and Then Some part of Examples
1) What are the three leading ideas for the cause of the Permian mass extinction? What is the evidence for and against each? 2) Why are tropical forest species going extinct the quickest? 3) What are the ...


JITT - The Future of Africa's Health with Technology part of Examples
What are the benefits and opportunities handheld technology can offer the health sector in Africa? Answer

促进学生深度学习教学设计练习

- 请按您教的学科分组
- 在您的学科小组中
 - 商定一个大概念/重要概念
合作设计有效并有趣的方法
引导您的学生探索它
 - 商定一个常见的错误背景概念
合作设计有效的方法帮助学生
 - 发现自己的错误背景概念
 - 正视自己的错误背景概念, 并
 - 纠正这些错误背景概念





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工作坊后请填写以:
《促进学生深度学习:联系-延伸-挑战》工作纸
《促进学生深度学习:我的想法》工作纸

我鼓励您跟您的朋友分享答案



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感谢您的参与!