LEARNING ~~PRACTICES~~

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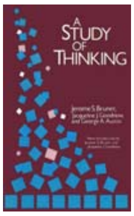
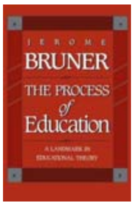
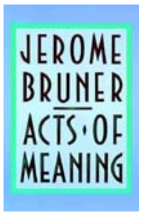
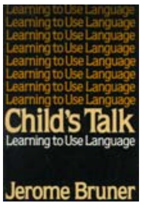




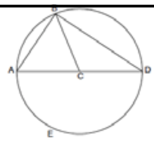
"any subject may be taught to anybody at any age in some form" (In: The Process of Education, p. 12)

Jerome Bruner (1915-2016)



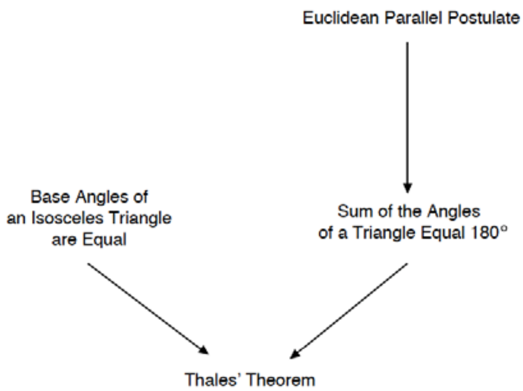


Did you read Eric Livingston's paper on Mathematics as an inspectable domain of practice?

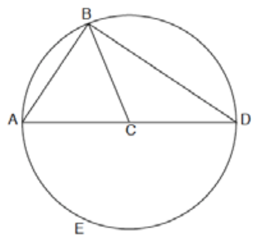


Thales' Theorem: An angle inscribed in a semicircle is a right angle.

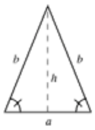
Statements	Reasons
1. ∠ABD is inscribed in a semicircle ABDC	1. Given
2. $\overline{CB}$ may be produced as a radius of circle ABDE	2. Construction postulate
3. $\overline{CA} = \overline{CB} = \overline{CD}$	3. All the line segments are radii of the same circle
4. ΔCAB is an isosceles triangle	4. By 3 and definition
5. ∠CAB = ∠CBA	5. Previous theorem: base angles of an isosceles triangle are equal
6. ΔCBD is an isosceles triangle	6. By 3 and definition
7. ∠CDB = ∠CBD	7. Base angles of an isosceles triangle are equal
8. 2∠CBA + 2∠CBD = 180°	8. 5, 7 and previous theorem: the sum of all the angles of a triangle equals 180°
9. ∠CBA + ∠CBD = 90°	9. Postulates of equality



ΔCAB is an isosceles triangle



Thales' Theorem: An angle inscribed in a semicircle is a right angle.



An isosceles triangle is a triangle with (at least) two equal sides. In the figure above, the two equal sides have length b and the remaining side has length a. This property is equivalent to two angles of the triangle being equal. An isosceles triangle therefore has both two equal sides and two equal angles. The name derives from the Greek *iso* (same) and *skelos* (leg).

A triangle with all sides equal is called an equilateral triangle, and a triangle with no sides equal is called a scalene triangle. An equilateral triangle is therefore a special case of an isosceles triangle having not just two, *but all three* sides and angles equal. Another special case of an isosceles triangle is the isosceles right triangle.

The height of the isosceles triangle illustrated above can be found from the Pythagorean theorem as

$$h = \sqrt{b^2 - \tfrac{1}{4}a^2}\,. \quad (1)$$

The area is therefore given by

$$A = \tfrac{1}{2}\,a\,h \quad (2)$$
$$= \tfrac{1}{2}\,a\sqrt{b^2 - \tfrac{1}{4}a^2} \quad (3)$$
$$= \tfrac{1}{2}\,a^2\sqrt{\frac{b^2}{a^2} - \frac{1}{4}}\,. \quad (4)$$

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The inradius of an isosceles triangle is given by

$$r = \frac{a\left(\sqrt{a^2 + 4h^2} - a\right)}{4h}. \quad (5)$$

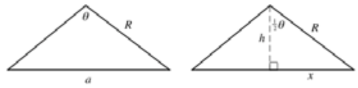
The mean of y is given by

$$\langle y \rangle = \int_{-a/2}^{a/2}\int_0^{(1-|x|/(a/2))h} y\,dy\,dx \quad (6)$$
$$= \tfrac{1}{6}\,a\,h^2, \quad (7)$$

so the geometric centroid is

$$\bar{y} = \frac{\langle y \rangle}{A} \quad (8)$$
$$= \tfrac{1}{3}\,h, \quad (9)$$

or 2/3 the way from its vertex (Gearhart and Schulz 1990).



Considering the angle at the apex of the triangle and writing R instead of b, there is a surprisingly simple relationship between the area and vertex angle θ. As shown in the above diagram, simple trigonometry gives

$$h = R\cos\left(\tfrac{1}{2}\theta\right) \quad (10)$$
$$x = R\sin\left(\tfrac{1}{2}\theta\right), \quad (11)$$

so the area is

$$A = \tfrac{1}{2}\,a\,h \quad (12)$$
$$= x\,h \quad (13)$$
$$= R^2\cos\left(\tfrac{1}{2}\theta\right)\sin\left(\tfrac{1}{2}\theta\right) \quad (14)$$
$$= \tfrac{1}{2}R^2\sin\theta. \quad (15)$$

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Solution　　Keep Practicing

Show Steps

$\int\int_0 2y\,dy\,dx = \frac{2}{3}$ (Decimal: 0.66667...)

Steps

$\int\int_0 2y\,dy\,dx$

$\int_0 2y\,dy = (|x|-1)^2$ — Show Steps

$= \int (|x|-1)^2 dx$

$\int (|x|-1)^2 dx = \frac{2}{3}$ — Show Steps

$= \frac{2}{3}$

click here to test your integrals skills »

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Not only know, but also understand

- Doing something correctly is not, by itself, evidence of understanding. It might have been an accident or done by rote. To understand is to have done it in the right way, often reflected in being able to explain why a particular skill, approach, or body of knowledge is or is not appropriate in a particular situation. (Wiggins and McTighe, 2005, p. 39).
- Knowledge and skill, then, are necessary elements of understanding, but not sufficient in themselves. Understanding requires more: the ability to thoughtfully and actively "do" the work with discernment, as well as the ability to self-assess, justify, and critique such "doings." (Wiggins and McTighe, 2005, p. 41).
- Understanding is an ongoing ,intersubjectively-based achievement, to be constantly monitored, checked, re-ascribed and updated (I am indebted with Prof. Rod Watson for this wonderful and insightful comment).

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"Do you understand?"

- When one asks: "Do you understand?", whether I understand every single point that could be made regarding a topic is not the question that is being asked. (Liberman, 2013, pp. 158)
- Rather, what is meant is something more like, "For the practical matters that appear to be central to our communication, and given the limits on our time and the need to use our energies in the most efficacious way, do you understand well enough for us to continue?" (Liberman, 2013, pp. 158-159)

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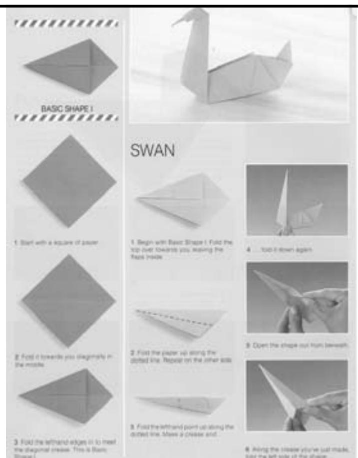

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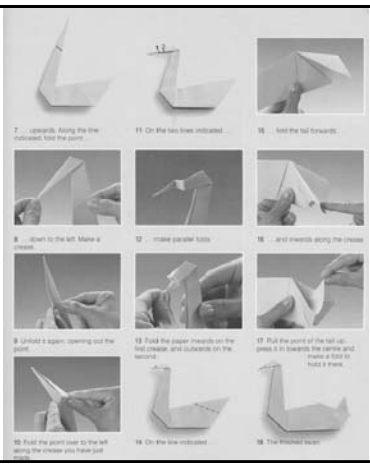

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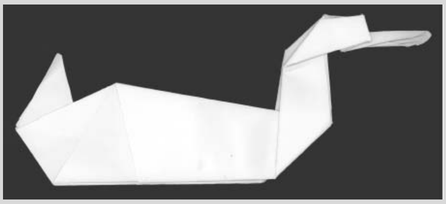
FIRST ATTEMPT



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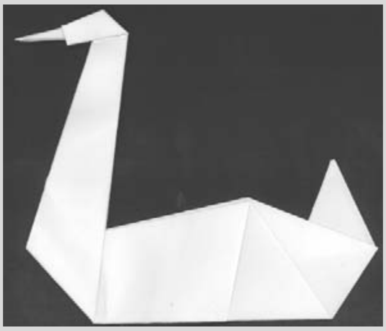
SECOND ATTEMPT



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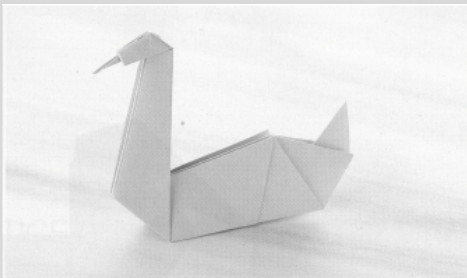
THE ANTICIPATED RESULT



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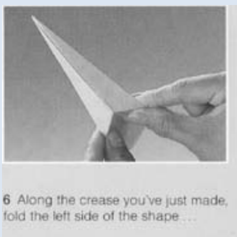

- The transformation of the paper-in-hand to look like an illustration, even for the most basic folds, can be problematic. Until I actually folded my paper, I could not see how folding a piece of paper in the manner described in Figure 6 would produce the resulting shape. (Livingston, p. 251)

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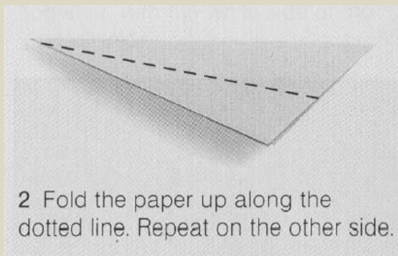
Why is this illustration problematic?



Understanding depends on the local accomplishment of the activity

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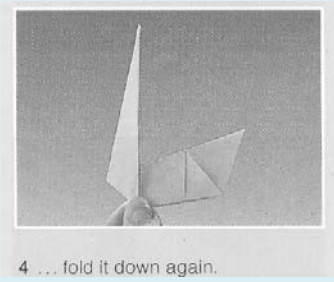
What do "fold", "it" and "down" mean?



Actions that transform the previous illustration into the present one. See the use of "again"

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What is learning?

- Learning is a *process*, not a product! (Ambrose et al. 2010, p. 3)
- Learning is not something done *to* students, but rather something students themselves do. (Ambrose et al. 2010, p. 3)
- The process cannot be teacher-centered, but not student-centered either! There must be a *balance* between both approaches.

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Let's take a look at mudane reports…

7:20 Raymond got up from his chair. He went directly out of the kitchen and into the bathroom.

Coming from the bathroom, he returned to the kitchen. His mother asked pleasantly, "Did you wash your teeth?" Mr Birch looked at him and laughed saying, "My gosh, son, you have tooth powder all over your cheeks." Then both parents laughed heartily.

Raymond turned instantly and went straight to the bathroom. He smiled as though he were not upset by his parents' comments.

He stayed in the bathroom just a few seconds.

He came back rubbing his face with his hands. The tooth powder was no longer visible.

Herbert F. Wright and Roger Barker (1951). One boy's day: a specimen record of behavior. New York: Harper

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Where can we find 'learning'?

- Learning cannot be found in abstract characterizations of activities, but (only) in the self-organizing structures of concerted practical action produced by a person in the course of carrying out his/her task. (when people act, you can see actions forming a 'self-organizing' structure).
- Origami constructions — actual paper-in-hand constructions — and the naturally accountable proofs of ordinary mathematical practice are taken to be the fundamental phenomena, for which origami instructions are analogous to the written proofs of mathematical exposition. (Livingston, 2000, p. 21)

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Let's take a look at game plays…

Retrieved from Liberman (2013, p. 90)

"Should we read all the rules? I guess we should go through this … There is a lot!"

"The rules just continue on and on."

"Do we have to read the entire thing?"

"Let's just see what we have to do to start the game."

[After some minutes of listening to the rules], "Are there any other *important* rules?"

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Liberman (2013, p. 85)

- Sometimes players understand the rules senselessly. It may be that "understanding", located here as a real-world phenomena, is something other than what philosophers know about "understanding"
- But in these documented cases, the players nod knowingly as they listen to nonsensical syllables, smile to each other, laugh embarrassedly, and stare at the board together senselessly in hopes that the game will suddenly materialize before them in a single gestalt.
- And sometimes it does, but more commonly as they are staring at the board in frustration one player will say, "Let's just play and see"
- See what? See what the rules mean, in the only place they can have meaning – in the context of game play. It is here that a game-with-rules begins. At this point, players begin to offer accounts that turn the nonsense syllables into rules.
- These candidate formulations of the rules are heard, assessed, and reflexively applied in the game. They become the game.

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"A science is nothing more than, nothing less than, the activities of its practitioners".

"the discoveries of a discovering science are discoveries concerning practices"

Edmund Husserl (1907)

Eric Livingston (2000)

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The "how's" of teaching. Are our "how's" effective?

- First, think of your 'desired results'
- Then, you can outline the content, the methods and the activities
- Do not rely on the textbook only!

Backward Design! (Wiggins and McTighe, 2005)

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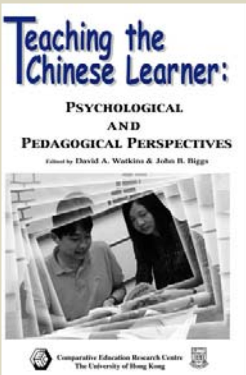
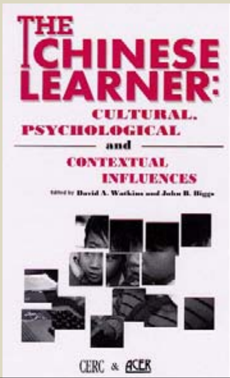
Two good recommendations!





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Neglected aspects of teaching-learning

- Students' practices (give them the same amount of content, in the same order, at the same time; evaluate them through indirect methods)
- Students' interests and needs (give them content without knowing what they wish/need to learn)

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Three big mistakes!

- "To hope for the best"
- "Throw some content and activities against the wall and hope some of it sticks" (Wiggins and MacTighe, 2015, p. 15)
- Students will learn only what I'm teaching

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Then… What to do?

- you must know what your goals (desired outcomes) are
- Learning comes (becomes observable) through actions, so you must know how to prepare activities
- Transparency of purpose

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Learning strategies/practices (Dunlosky, 2013)

Table 1 Effectiveness of Techniques Reviewed

Technique	Extent and Conditions of Effectiveness
Practice testing	Very effective under a wide array of situations
Distributed practice	Very effective under a wide array of situations
Interleaved practice	Promising for math and concept learning, but needs more research
Elaborative interrogation	Promising, but needs more research
Self-explanation	Promising, but needs more research
Rereading	Distributed rereading can be helpful, but time could be better spent using another strategy
Highlighting and underlining	Not particularly helpful, but can be used as a first step toward further study
Summarization	Helpful only with training on how to summarize
Keyword mnemonic	Somewhat helpful for learning languages, but benefits are short-lived
Imagery for text	Benefits limited to imagery-friendly text, and needs more research

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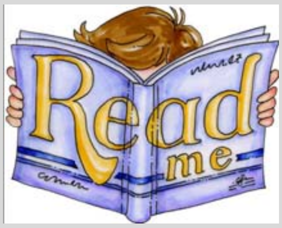

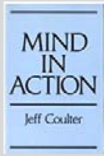

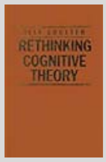

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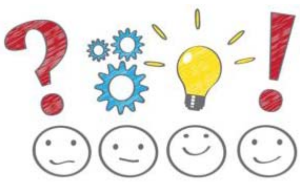
Thank you!

Questions?



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