

Technical Advances Initiating Didactic Reflection in Teacher Education

◦ Workshop ◦



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ICTMT Athens ◦ June 2023

1. AuthOMath : idea and objectives

– information I and activity I –

2. Digital Math Task Design

– information II and activity II

3. AuthOMath's DiCo : discussion

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Authoring Online Material with Multimodal, Dynamic and Interactive Applets and Automated Feedback for Learning Math



AuthOMath

University of Education Heidelberg : Guido Pinkernell
University of Cantabria Santander : Jose Manuel Diego Mantecon
University of Edinburgh : Chris Sangwin
Johann-Kepler-Universität Linz : Zsolt Lavica
Geogebra GmbH (associated)



AuthOMath

AuTo

- a moodle based authoring tool for randomized interactive and dynamic multimodal mathematical tasks with automatic adaptive feedback

which basically means to

extend STACK to facilitate the implementation of GeoGebra applets into task and feedback

DiCo

- a didactical concept for designing online based interactive learning material for use in mathematics teacher education



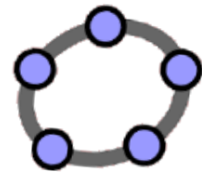
AuthOMath

AuTo

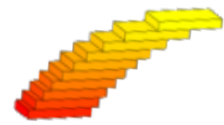
- a moodle base for randomized multimodal material with automatic feedback which basically extend STACK the implementation of GeoGebra as task and feedback

Idea combining strengths and communities of GeoGebra and STACK

- interactivity
- dynamization
- multimodality



- adaptive feedback
- randomization



concept
online based
learning material
mathematics teacher



activity I

aim
work
give feedback

- gain insight into the type of digital math tasks AuthOMath is about
by trying a collection of tasks from AuthOMath
- explore the field of possible criteria that need to be considered for “good digital math task design (in AuthOMath)”
and share your thoughts

activity I

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by trying a collection of tasks from AuthOMath
- explore the field of possible criteria that need to be considered for “good digital math task design (in AuthOMath)”
and share your thoughts here:

stack.authomath.org
> login : ictmt2023-XX
> passwd: same
> dashboard
> ICTMT



flinga.fi/s/FA5YLTZ

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2. Digital Math Task Design

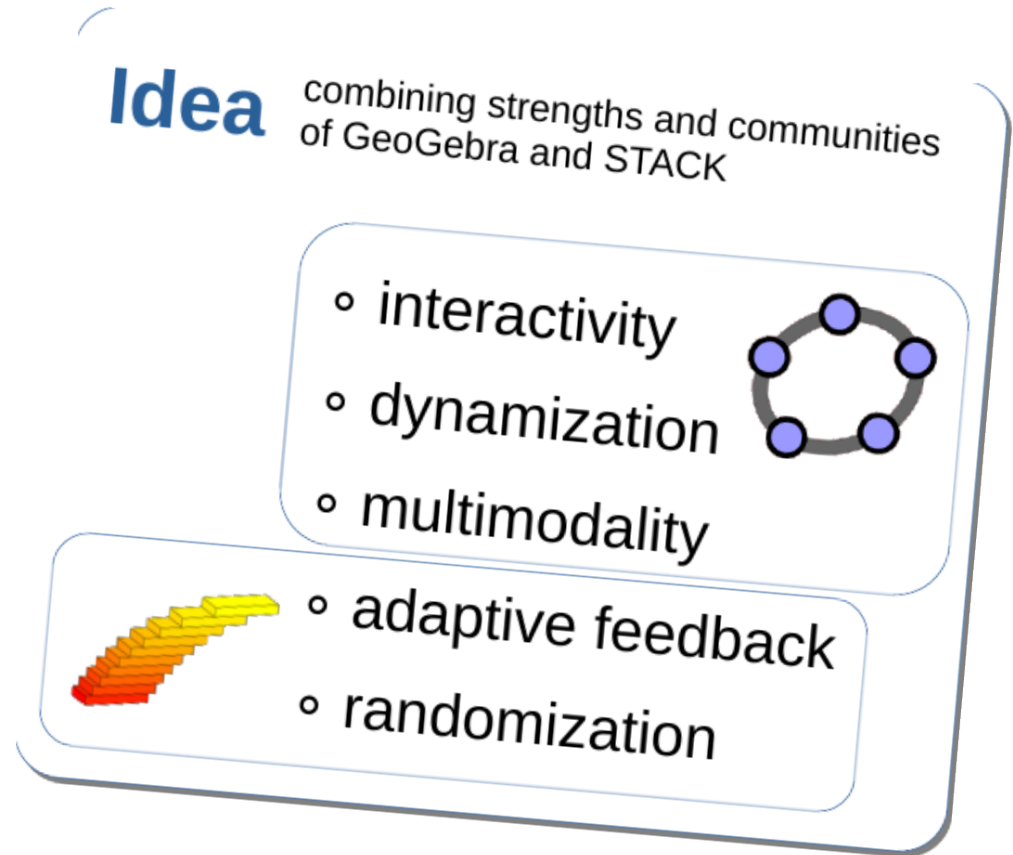
– information II and activity II

3. AuthOMath's DiCo : discussion

digital math task design

...in teacher education:

technical advances
resulting from combining
GeoGebra and STACK
initiate
didactic reflection



digital math task design

...in teacher education:

technical advances
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initiate
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“You want to use
GeoGebra and STACK
for creating
multimodal and interactive
math tasks
with adaptive feedback.

What is it
that you need to think about
before you do the programming
(if this is you...)”

digital math task design

...in teacher education

1. how to address the learning object
2. how to address learners
3. how to use media

“You want to use
GeoGebra and STACK
for creating
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What is it
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digital math task design

1. how to address the learning object

2. how to address learners

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- mathematical analysis:

“do research on how to address the object of learning such that it supports mastery and understanding”

focus on:

- relevant definitions and terminology
- mathematically valid explanatory models (aka basic ideas, “Grundvorstellungen”)
- specific representations, strategies, and applications

digital math task design

1. how to address the learning object
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The *WiGORA* framework

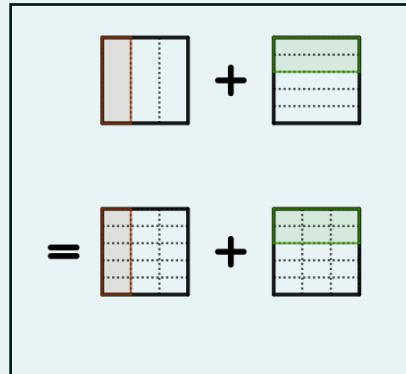
Declarative Knowledge	ability to recall rules, definitions and characteristic properties
Explanatory Models	ability to recall explanatory models that make sense of a mathematical concept
Operational Flexibility	ability to apply, adapt and modify mathematical procedures for situational needs
Representational Flexibility	ability to switch within and between representational forms
Knowledge Application	ability to identify a concept or procedure as suitable for a given problem

digital math task design

1. how to address the learning object
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This picture explains how two fractions are added.

Translate into maths:



+

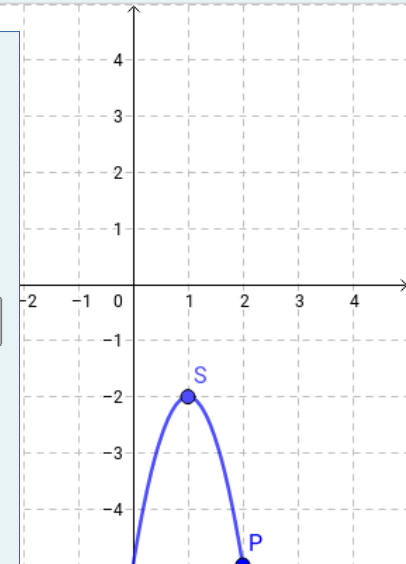
= +

=

Give a quadratic expression which has exactly the two roots -3 und -1 .

$$f(x) = \text{input box containing } (x-3)*(x-1)$$

Move the points S und P, such that the graph fits with $f(x) = -3 \cdot (x + 1)^2 - 2$.



"Multiply the difference of 2 and x with 4 and you get 8."

Translate into an equation:

$$\text{input box containing } 2-x*4 = 8$$

digital math task design

1. how to address the learning object
- 2. how to address learners**
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- didactic perspective:

“do research on how learners actually do access the object of learning (correctly or wrongly)”

focus on

- as novices or experts in the topic, as low or high achievers in general
- individual conceptions, misconceptions, systematic errors
- range of possible solving strategies

digital math task design

1. how to address the learning object
2. **how to address learners**
3. how to use media

Give a quadratic expression
which has exactly the two roots -3 und -1 .

$$f(x) = (x-3)*(x-1)$$

NEARLY correct, but not quite!

You seem to know what to do.
Just check your answer again...

digital math task design

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"Multiply the difference of 2 and x with 4 and you get 8."

Translate into an equation:

$$2-x*4 = 8$$

Well, yes and no.

You have translated all the words correctly into algebra.

But you should think of

"the difference of 2 and x " as a whole that needs to be multiplied with 4.

digital math task design

1. how to address the learning object
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Solve:

$$2 \cdot (q + 1) = 4$$

Copy the equation below,
then note each next step beneath:

$$\begin{aligned} 2 \cdot (q+1) &= 4 \\ 2 \cdot q + 2 &= 4 \\ 2q &= 2 \\ q &= 1 \end{aligned}$$

$$L = \{ \boxed{1} \}$$

$$2 \cdot (q + 1) = 4$$

$$\Leftrightarrow 2 \cdot q + 2 = 4$$

\Leftrightarrow Good. Your solution is correct.

And the transformations are fine.

\Leftrightarrow

But that took long!

There is a faster solution - compare:

$$2 \cdot (q + 1) = 4$$

$$2 \cdot q + 2 = 4$$

...

$$2 \cdot (q + 1) = 4$$

$$q + 1 = 2$$

...

One is your strategy,
the other is faster.

digital math task design

1. how to address the learning object
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- media perspective:

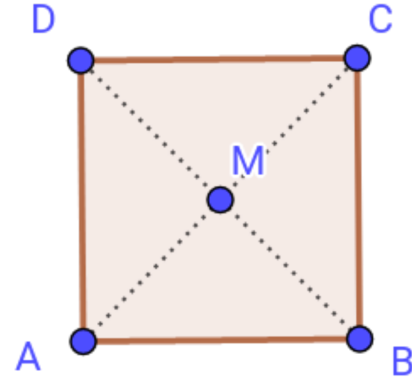
“now decide on the use and structure of textual and pictorial elements of task and feedback area”

focus on

- how to use language
- how to use static, dynamic, interactive elements
- how to structure task and feedback

digital math task design

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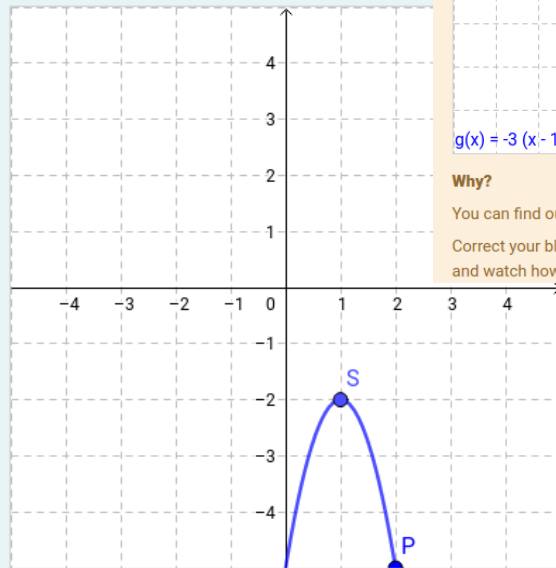
This is not a square.

Move points
to explore the range of appearances,
and then decide
what this quadrangle really is.

digital math task design

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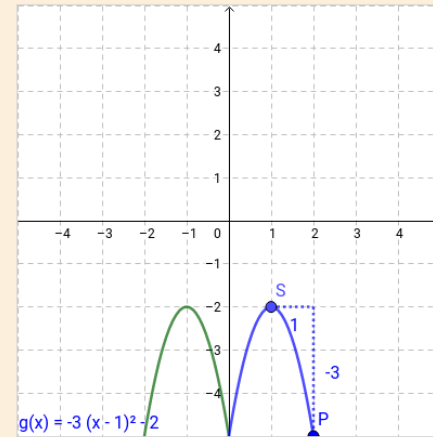
Move the points S and P, such that the graph fits with $f(x) = -3 \cdot (x + 1)^2 - 2$.



Check

Wrong, too bad!

The green graph would be correct.



Why?

You can find out yourself.

Correct your blue graph and watch how the expression changes

Try to find answers to the following questions:

1. Where in the expression can you see the coordinates of the vertex?
2. Where in the expression can you see a value for the opening of the parabola?

Do you have an idea already?

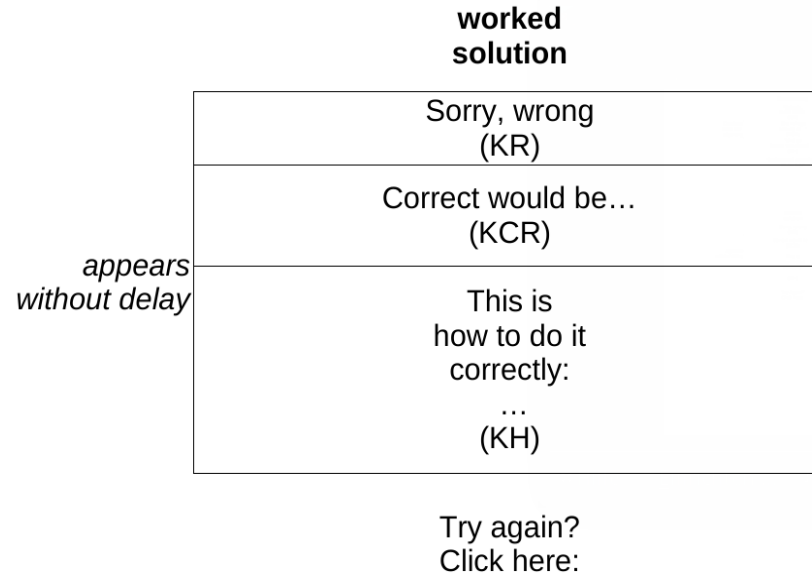
Then try the task again.

Or wait 30 seconds after which a full solution will appear:

Musterlösung

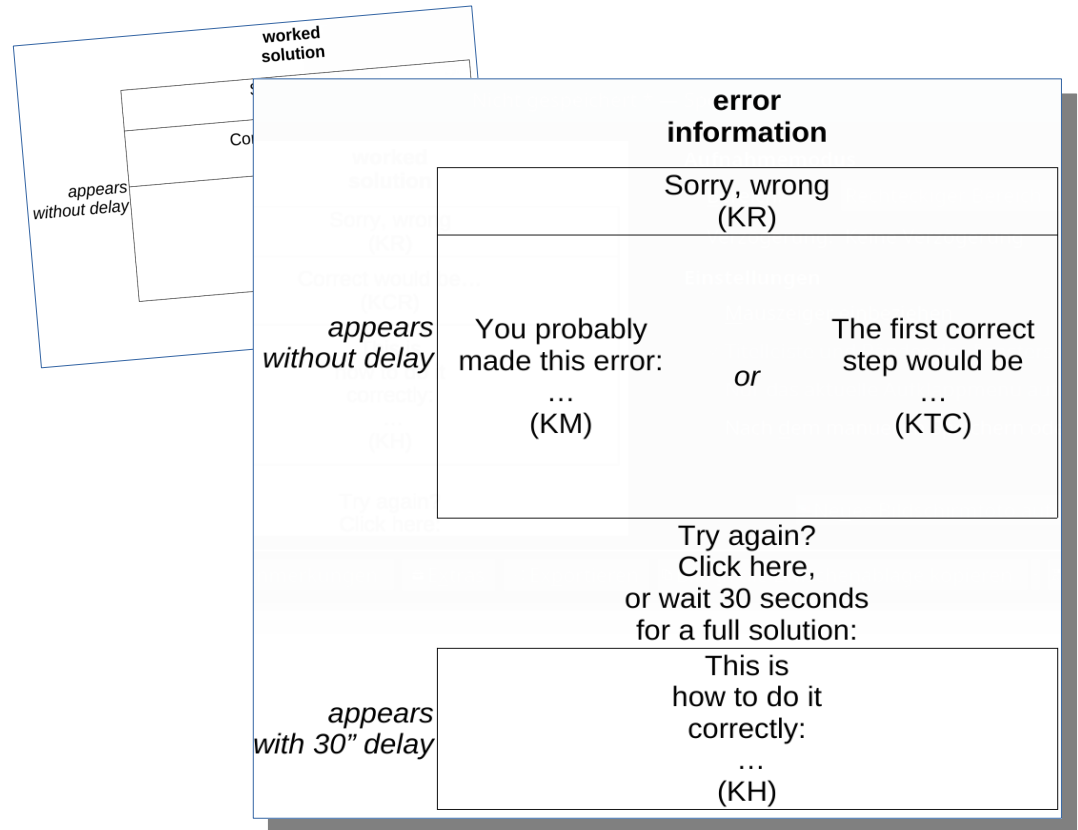
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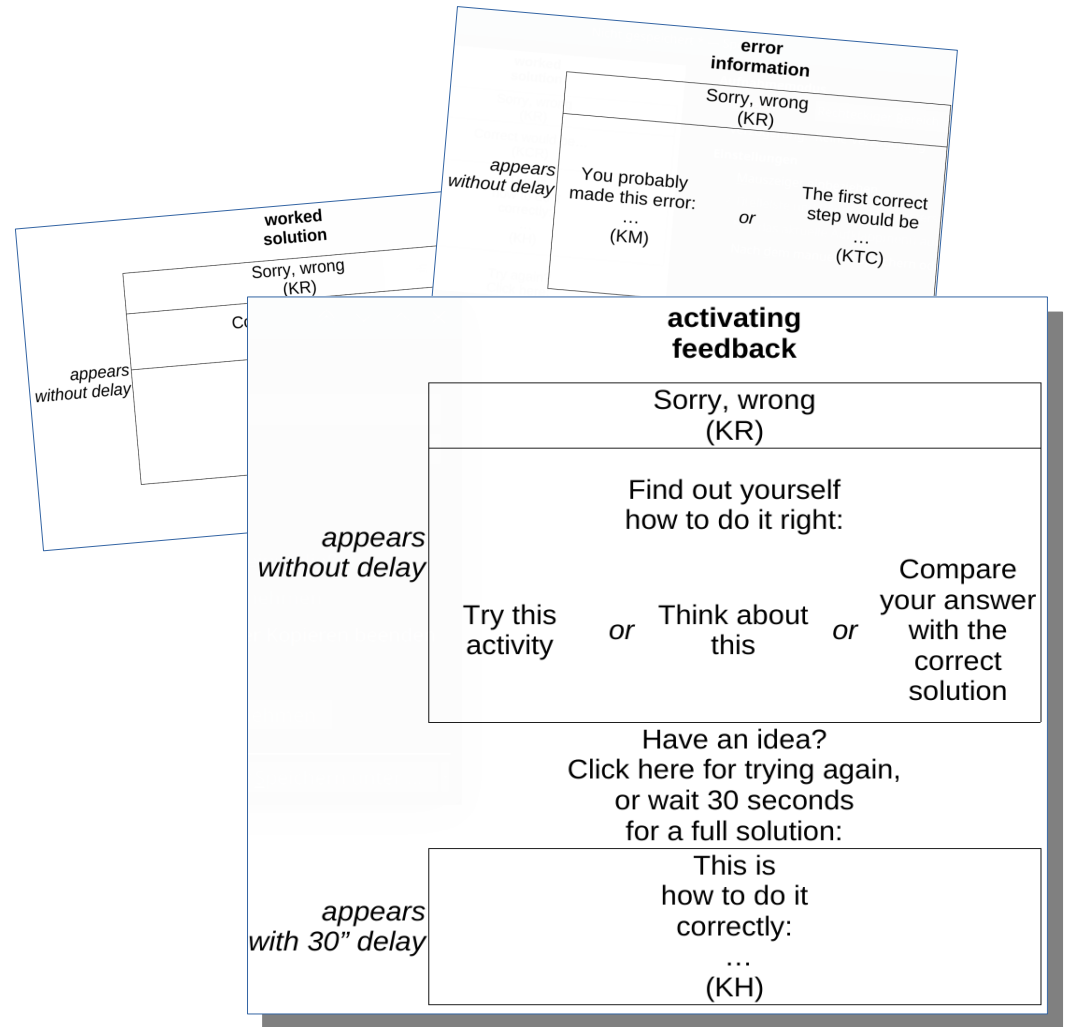
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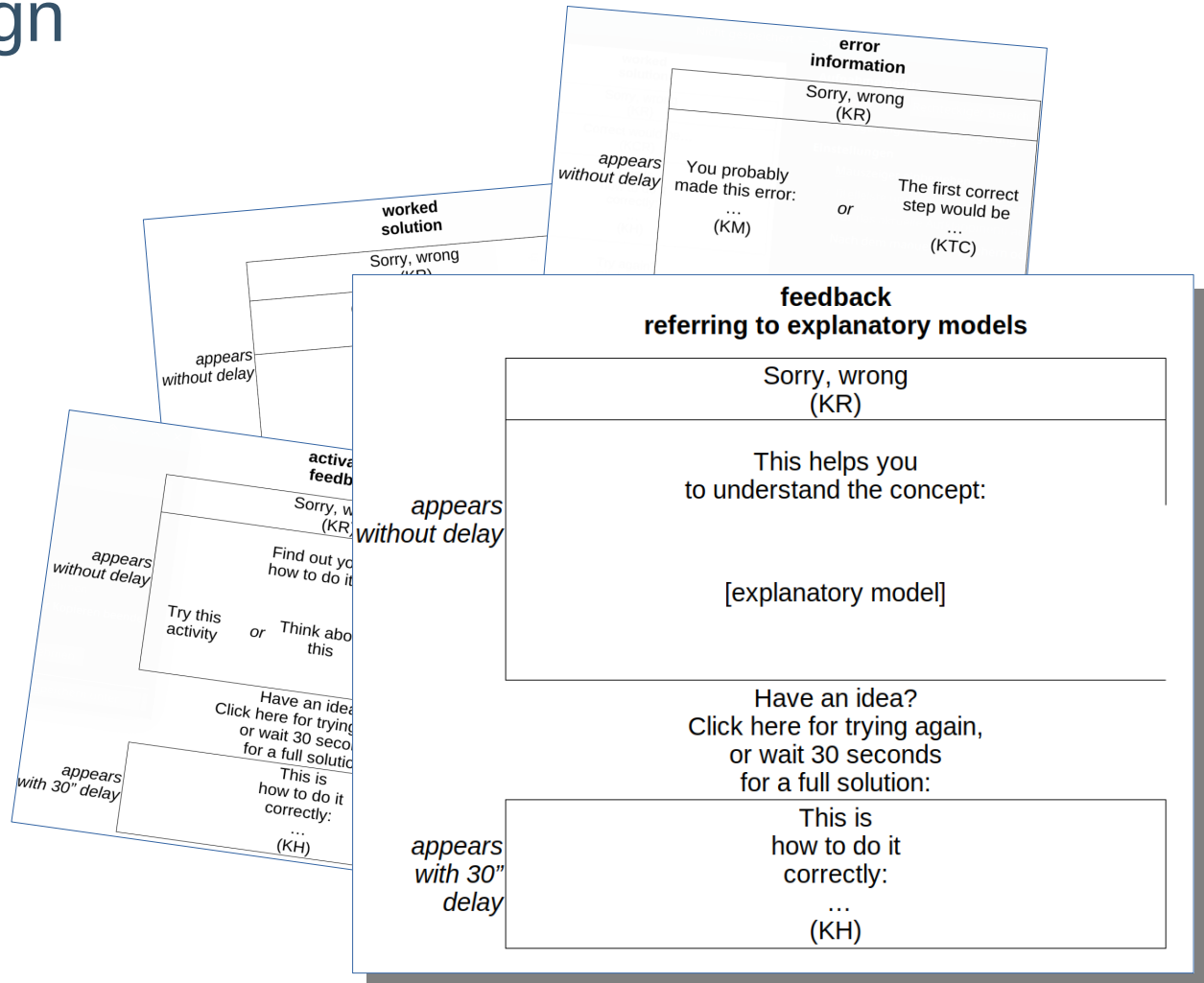
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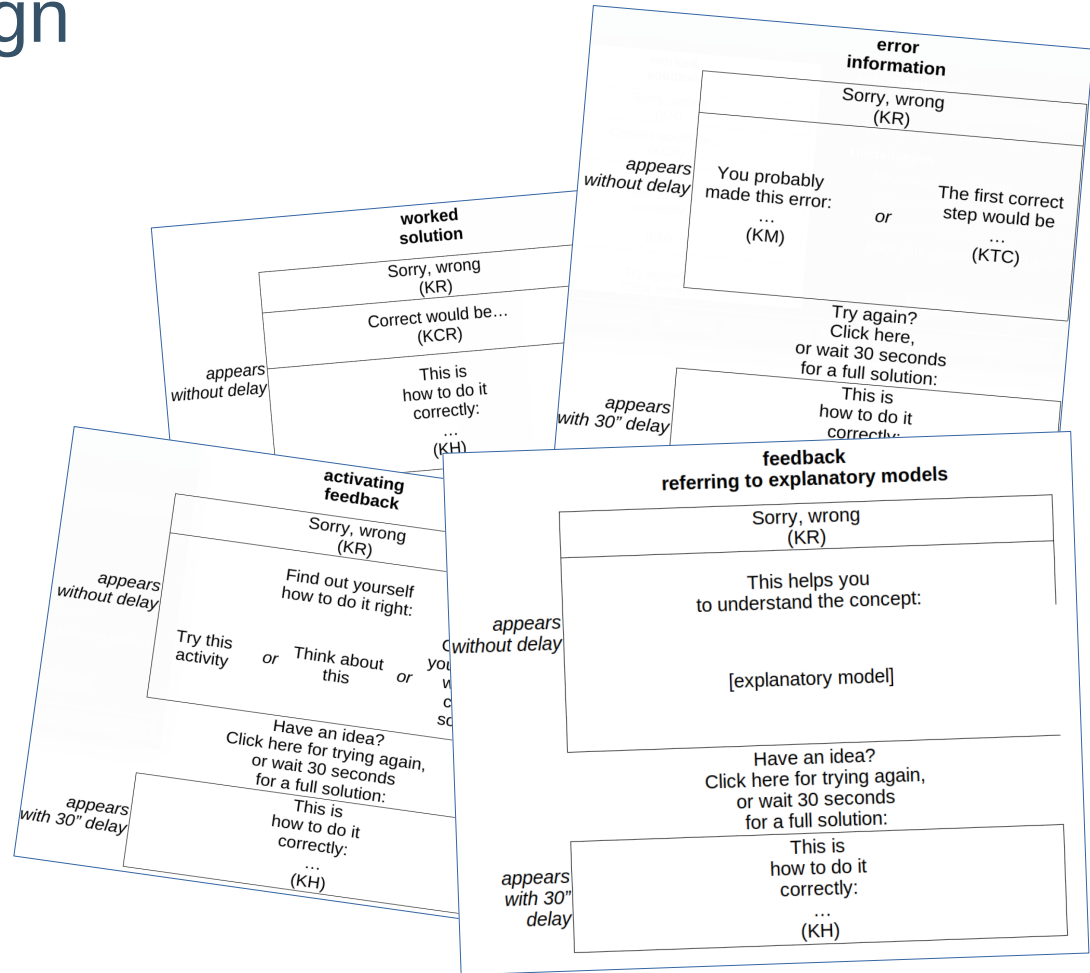
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digital math task design

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activity II

aim
work
present

- see whether the three given aspects of digital math task design help with designing AuthOMath tasks

by actually designing an AuthOMath task

choose from these topics

- 1 fractions, roots, potencies
- 2 expressions and equations
- 3 functions
- 4 measuring lengths, areas, volumes
- 5 geometric objects and concepts
- 6 data and probability

and go to your topic here:



https://docs.google.com/document/d/1gqJSegvvRWC_fYlGyg6owiZqVBFWtPt8/edit?usp=sharing&ouid=105668954735657769599&rtpof=true&sd=true

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