

# Hands-on session

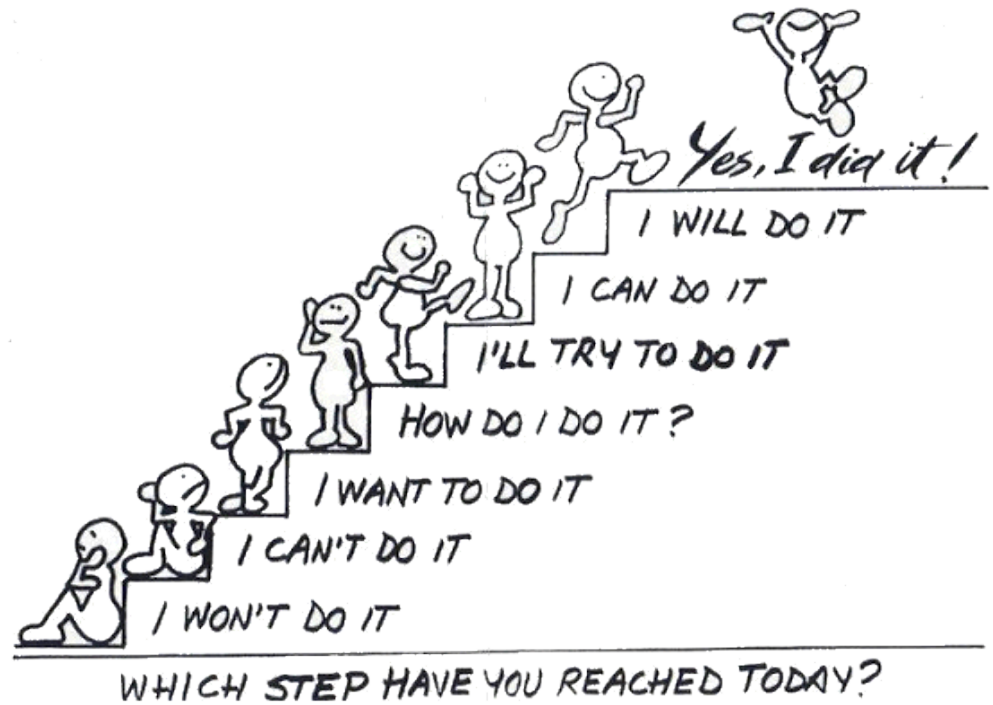
**Method for constructing test questions of a new  
innovative item format**

# Agenda

- Introduction
  - Who are we
  - What keeps us busy
  - What do we mean when talking about adaptive questions
- Example of question conversion into adaptive question
- Step by step conversion
  - Work out your own example

# Introduction

- Who we are
  - Celine Goedee (assessment specialist)
  - Meta Keijzer-de Ruijter (digital assessment specialist)
- Our research project
  - Improving quality of digital tests using adaptive questions
- Innovative question type – adaptive question
  - Question workflow that evaluates the student's response on the fly
  - Using a combination of different standard question types, like
    - Multiple choice / multiple selection
    - Numeric / formula
    - Matching
    - List / fill in the blanks
    - essay



# Scenario's for ADAPTIVE TESTING

Summative testing  
Formative testing

# Workflow Scenario's

## Summative

- Challenging Main/sub questions
- Underpinning Main/sub questions

## Formative

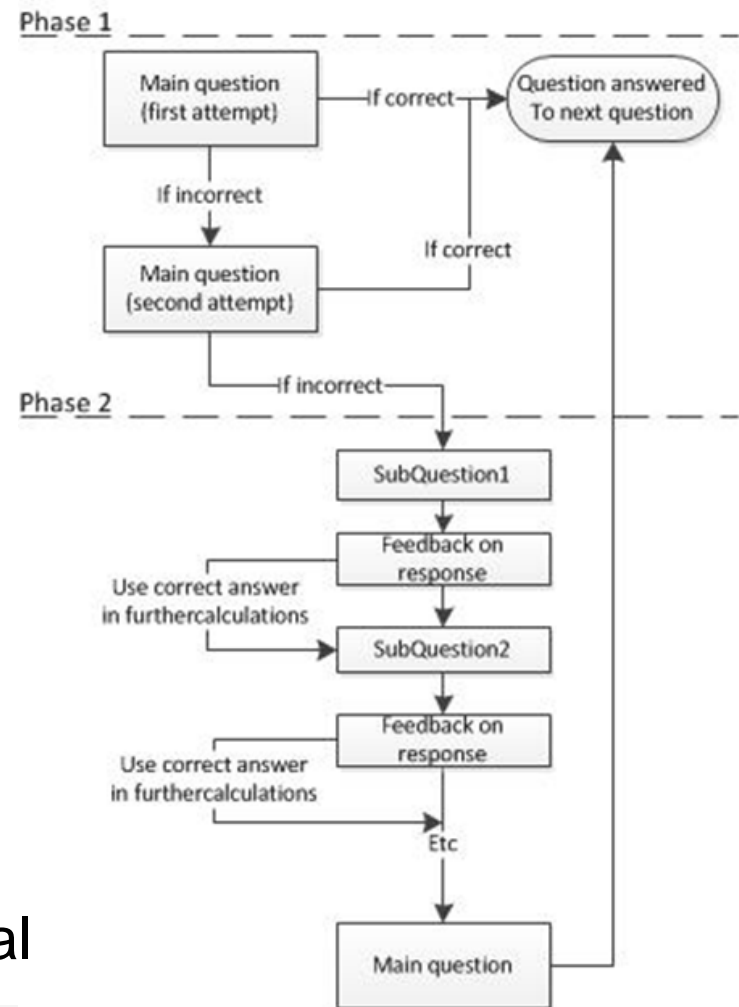
- With a little help Main/sub questions
- Step-by-Step Sequential questions

# Scenario's for summative testing

## Challenging

### Main/sub questions

- Talented students figure out how to solve the problem, without predefined steps
- Alternate route (Phase 2) checks knowledge and skills through a set of additional questions
- Adaptive QD-type
- Multiple attempts
- Randomization is essential

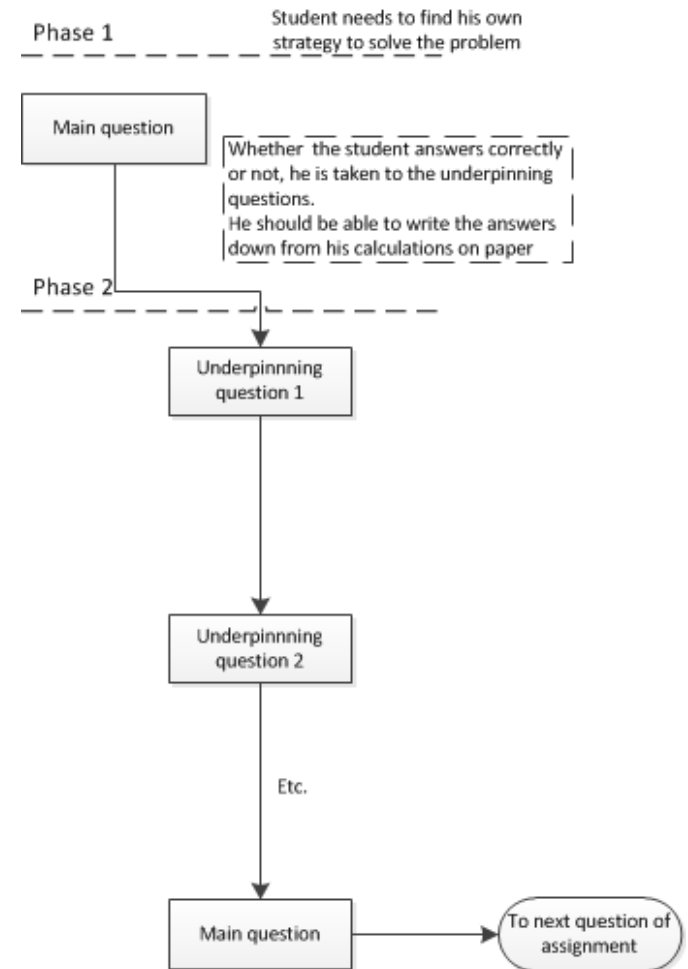


# Scenario's for summative testing

## Underpinning

### Main/underpinning questions

- Not providing a strategy
- Phase 2 should corroborate knowledge and skills through a set of additional questions
- Adaptive QD-type
- Multiple attempts only on main question
- Randomization is essential



# Advantage and disadvantage

## Advantages

- Be able to challenge the good performing students by not providing students with the steps to solve the problem.
- Help students when needed.
- Be able to check what parts are understood and what parts went wrong.

## Disadvantages

- Limited possibility for self correction along the path of solving a problem.
- Student anxiety when getting immediate feedback



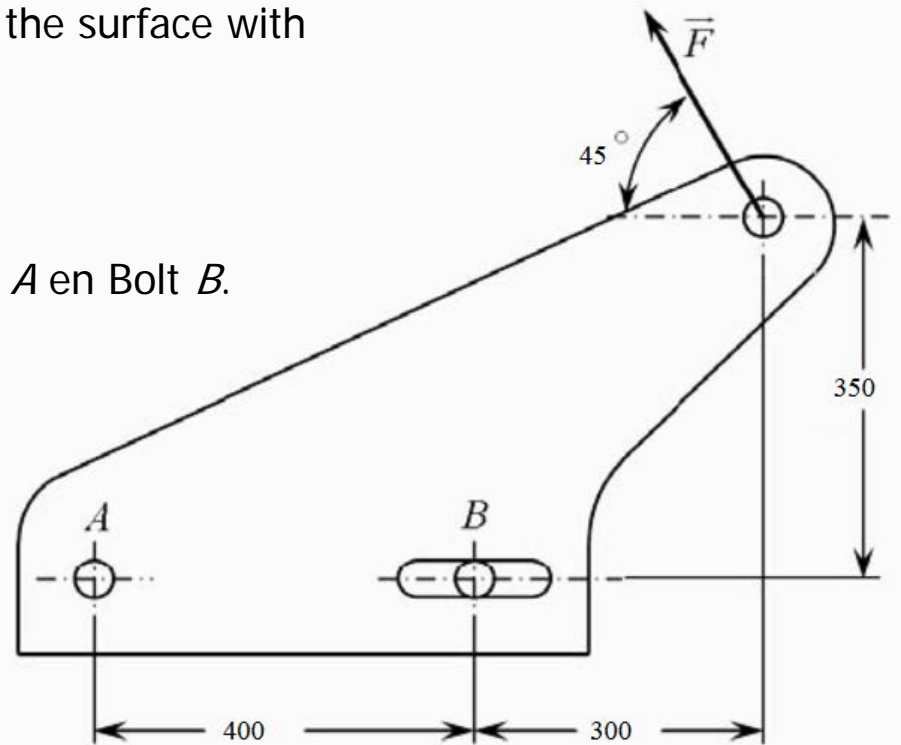
# Main/sub example on paper

A force  $F = 1000$  N works at a given angle of  $45^\circ$  on a support block of a pneumatic cylinder.

The support block is attached to the surface with bolts  $A$  en  $B$ .

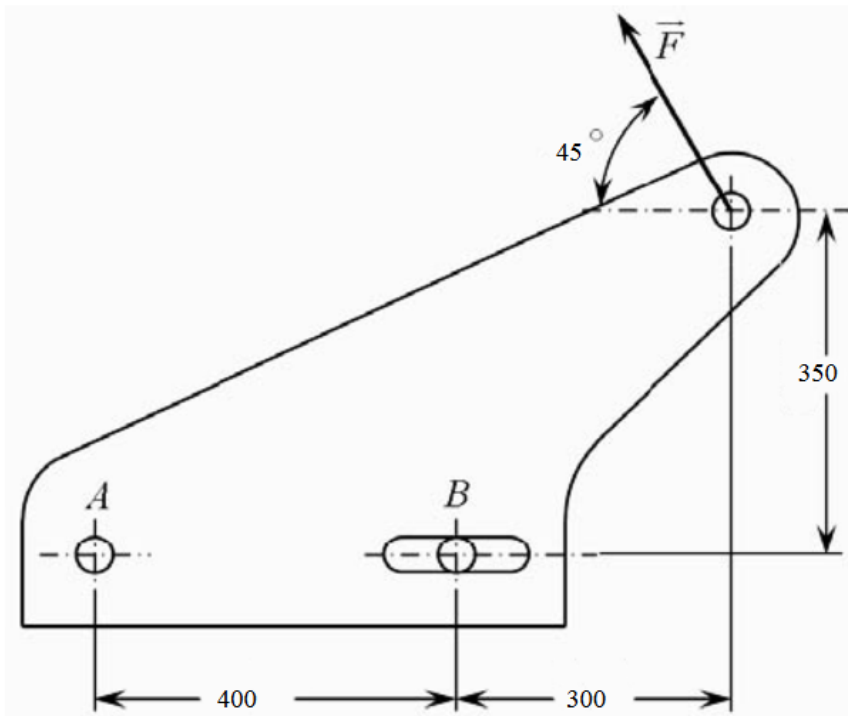
Bolt  $B$  is situated in a notch.

Calculate the forces on both bolt  $A$  en Bolt  $B$ .



# Main / Sub example step 1

## Question:



A force  $F = 1000$  N works at a given angle  $45^\circ$  on a support block of a pneumatic cylinder. The support block is attached to the surface with bolts A en B. Bolt B is situated in a notch.

Calculate the forces on both bolt A and B.

The force on bolt A is  [Num] N. (Round to one decimal)

The force on bolt B is  [Num] N. (Round to one decimal)

Fill out both answer fields and click the 'verify'-button. In this case, you get 2 attempts to give the right answer

I Give Up

Attempt 1 of 2

Verify

CENTRE FOR

# Main / Sub example step 2

Your answer(s) were incorrect.

It should be clear that the following two equations of equilibrium apply.

$$\sum \vec{F} = 0$$

The amount of 'help' is defined by the instructor

$$\sum M = 0$$

Subquestion A

Which of the following two equations enables you to successfully calculate the forces in A en B?

- $\sum M_A = 0$
- $\sum M_B = 0$

A correct answer adds 10% to your score

Click 'verify' to continue to the next subquestion.

Attempt 1 of 1

Verify

# Main / Sub example step 3

Correct response:  $\sum M_A = 0$

After clicking the 'verify'-button you immediately receive feedback. So you can continue to the next subquestion using the correct answer.

Subquestion B

Now calculate the force in  $B$ .

The force on bolt  $B$  is  [Num] N. (Round to one decimal)

Click verify to continue

Enter your response.  
A correct answer adds 30% to your score.

Attempt 1 of 1

Verify

# Main / Sub example step 4



Now calculate the force in *B*.

The force on bolt *B* is  [Num]

Correct response: 1209.3±0.1 N. (Round to one decimal)

Subquestion C is in fact one of the main questions. If you answer it correctly, this ends the sequence of subquestions.

Subquestion C

Use this response in further calculations

Knowing the force in *B*, you can now calculate the force in bolt *A* using the equilibrium  $\sum \vec{F} = 0$ .

The force on bolt *A* is  [Num] N. (Round to one decimal)

Verify and continue

A correct answer adds 30% to your score.

Attempt 1 of 1

Verify

# Main / Sub example step 5



Knowing the force in  $B$ , you can now calculate the force in bolt  $A$  using the equilibrium  $\sum \vec{F} = 0$ .

The force on bolt  $A$  is  [Num] N. (Round to one decimal)

The answer was incorrect. The system will now help you answer the second main question. That is way you do not receive the correct answer just yet.

Subquestion D

Your calculation of the force on the bolt in  $A$  was not correct.

First calculate the  $x$  and  $y$  components of vector  $\vec{F}$ . Be aware to use minus signs in case of a negative  $x$ - and/or  $y$ -direction.

$F_x =$   [Num] N. (Exact or rounded.)

$F_y =$   [Num] N. (Exact or rounded.)

Each correct answer adds 5% to your score

Verify and continue

Attempt 1 of 1

Verify

Optional: as a last step repeat main question

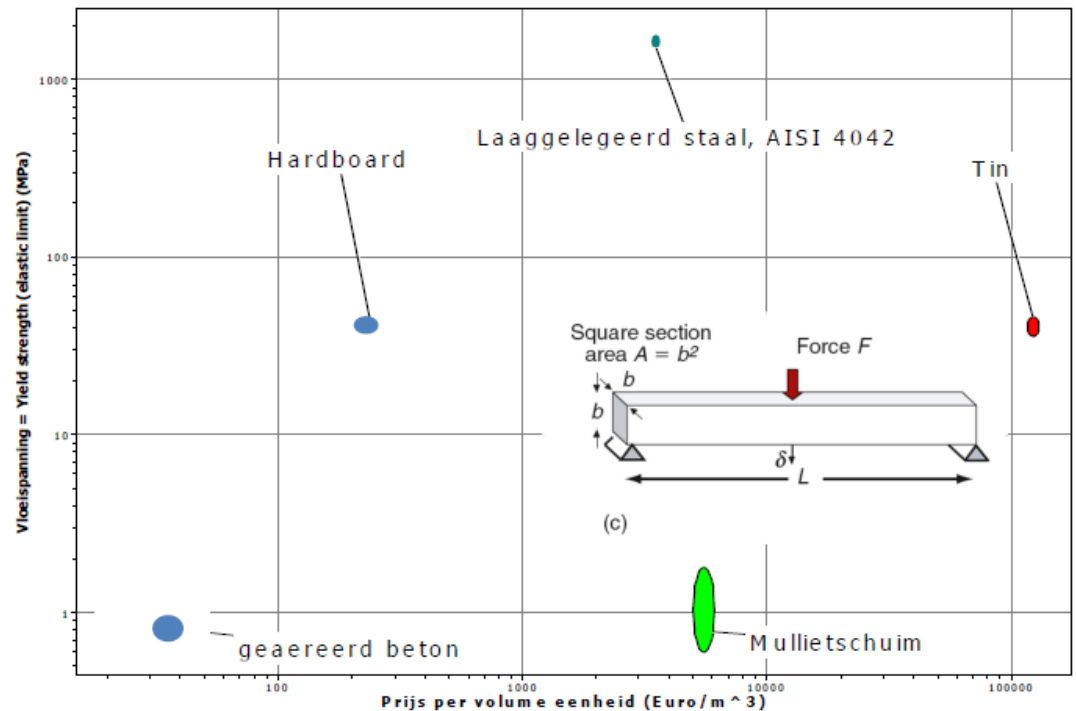
## Example 2: On paper

A beam with a square cross section is tested for bending, as shown in the image.

From the Ashby graph select the material that can provide the cheapest beam for this load, without reaching the elastic limit of the beam for this given length.

No additional constraints are set (weight, ductility, etc. for the material).

- a) Aerated concrete
- b) Hardboard
- c) Low alloy steel  
AISI 4042
- d) Mulliet foam
- e) Pewter (Tin)

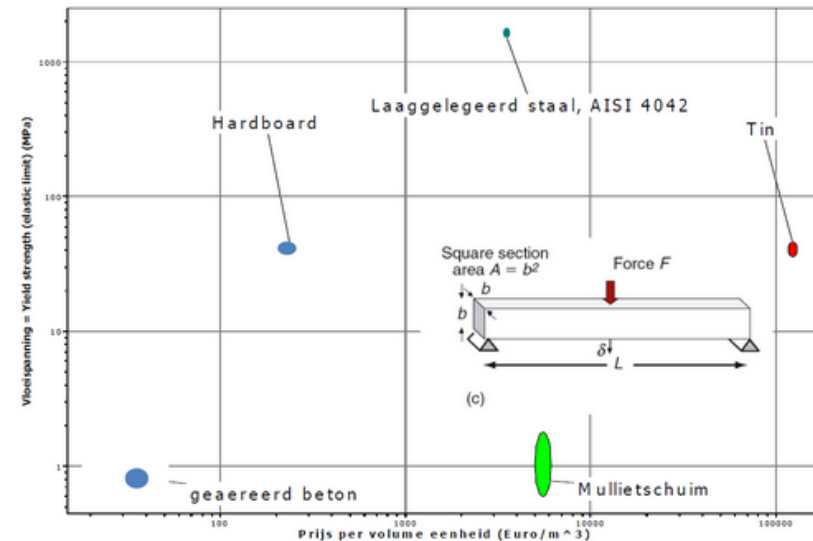


# Underpinning example

A beam with a square cross section is tested for bending, as shown in the image to the right. In the Ashby-graph the yield stress is plotted against the cost per unit volume for a number of materials.

From the Ashby-graph select the material that can provide the cheapest beam for this load, without reaching the elastic limit of the beam for this given length.

No additional constraints are set (weight, ductility, etc.) for the material.



Select the correct material.

- Pewter (Tin)
- Aered concrete
- Hardboard
- Low Alloy Steel, AISI 4042
- Mulliet foam

Attempt 1 of 1

Verify



# Underpinning example (step 2)

In order to determine the correct material you should have taken the following steps. Underpin your choice by answering the following questions.

Which is the correct material index?

$M = \frac{\sigma_y^{1/2}}{C_m \rho}$    $M = \frac{\sigma_y}{C_m \rho}$    $M = \frac{\sigma_y^{2/3}}{C_m \rho}$

What is the slope?

Number

In what direction should the slope be shifted in order to maximise the material index?

- To the left and up  
 To the right and up

Attempt 1 of 1

Verify

# Assignment 1

- Groups
  - Form groups of 2/3 persons
  - Make sure at least one person has his/her exam available
- Select **one** paper-and-pencil question to transform to a digital adaptive question. A couple of points to help you select:
  - If you want to automatically proceed with previous given (wrong) calculations
  - If you don't want to give away the steps
  - If it better fits your learning objective
- Look at the learning objective of the question.
  - Which level of the taxonomy is tested with the paper-and-pencil question? (write your answer on the flip-chart)
  - Which level of the taxonomy do you ideally want to test? Think about the constructive alignment between your education and learning objective (write your answer on the flip-chart).

# Assignment 2

- What are important elements of the question? Please write the answers on the questions below on the flip chart.
  - Is the focus on process/strategy or final answer?
  - Which factors determine the difficulty (e.g. image, round numbers versus decimal digits, story versus abstract question)
  - What are common mistakes of students?
  - What factors discriminate between good and bad performing students?
  - Are there different strategies possible? If yes, do you want to measure one specific strategy or the choice of the strategy?
  - Determine which mistakes (do not) weigh heavily.

## (p)review

- One member of the group stays with his/her own flip chart.
- The other member(s) of the group can look at the other flip charts and ask questions.

# Assignment 3

- Choose a scenario (challenging or underpinning)
- Formulate a main question
- Formulate sub questions

## Question types available

- Multiple Choice / Multiple Selection
- Pull down menu / Fill in the Blanks (text match)
- Numeric / Numeric with Units
- Mathematical formula
  - Equation (e.g.  $y = 3x + 1$ )
  - Formula (e.g.  $x^2 + 2x - 5$ ) with or without simplification
  - Chemical equation

# Assignment 4 (plenary)

- Learning objective
  - Level
  - Focus
  - Difficulty factors
  - Discriminating factors
  - Different strategies
  - Weight mistakes
- 
- What is the added value of the chosen scenario?

# Evaluation of this session

- Feedback on this session
- Usability of this method

# How to contact us

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