Workshop:
Exploring innovative digital assessment questions

Converting paper based questions into digital questions

1 February 2017

TU Delft

4TU. CENTRE FOR ENGINEERING EDUCATION

TU Delft

Agenda

- Introduction
- General introduction of scenario questions
- Two Examples of question conversion into scenario question
- Step by step conversion
  - Work on your own example

Introduction

- Who we are
  - Celine Goedee (O&S assessment specialist)
  - Meta Keijzer-de Ruijter (ICT digital assessment specialist - MapleTA)

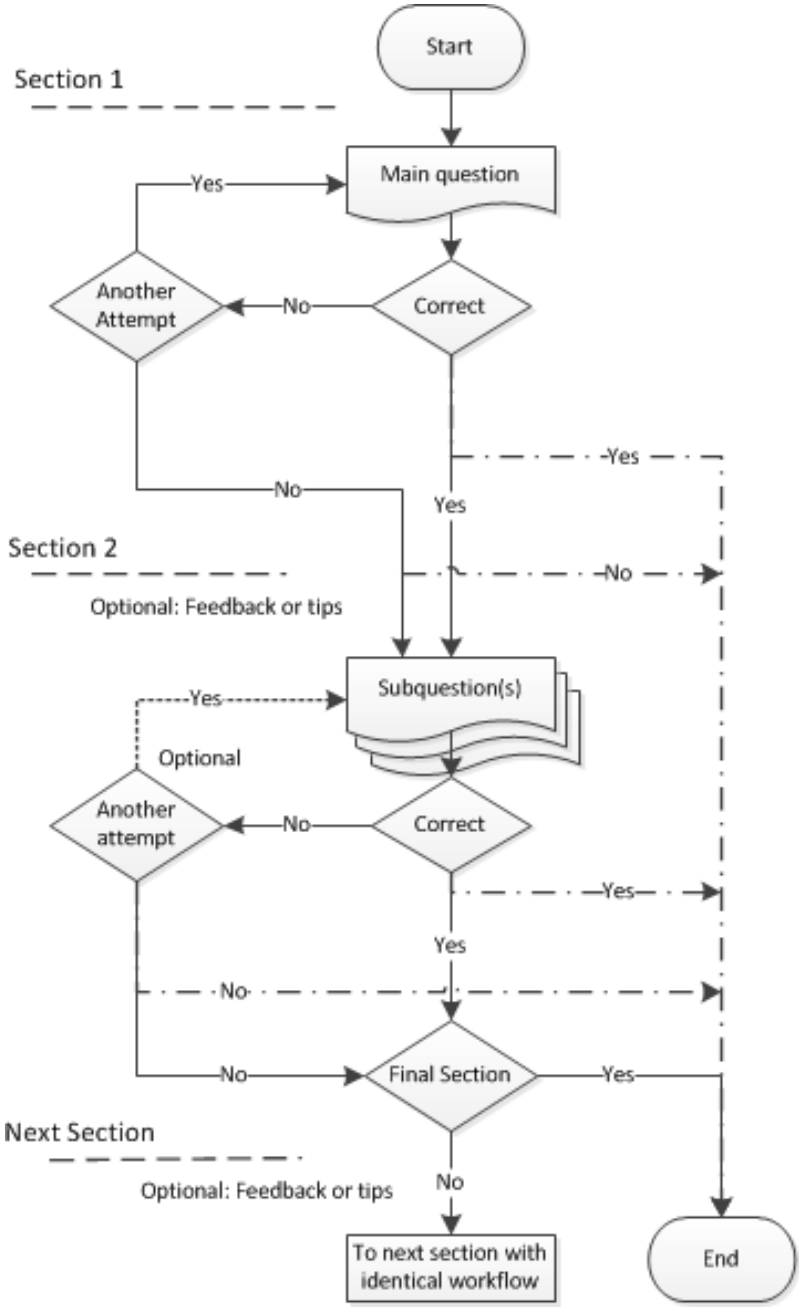
- Our pilot project
  - Improving quality of digital tests using scenario questions
  - Materials Science (2nd year mechanical engineering)
  - Data from:
    - Teacher input
    - Think aloud protocols (practice exams)
    - Student interviews
    - Results and analysis of exam
    - Evasys results

Workflow Scenario's

General set-up:

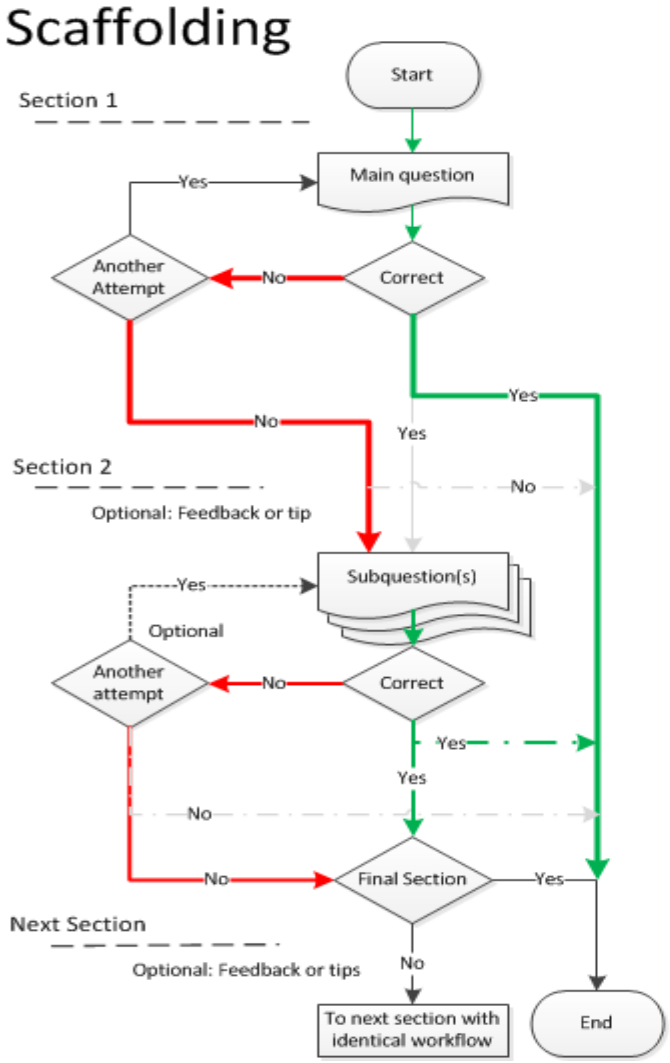
- Question is divided into 2 or more sections
- Sections are presented consecutively
- Each section has at least one response field
- Each response field must be automatically gradable
- When verifying the response the only 2 options are available:
  - Continue to the next section* (within the question)
  - Finish

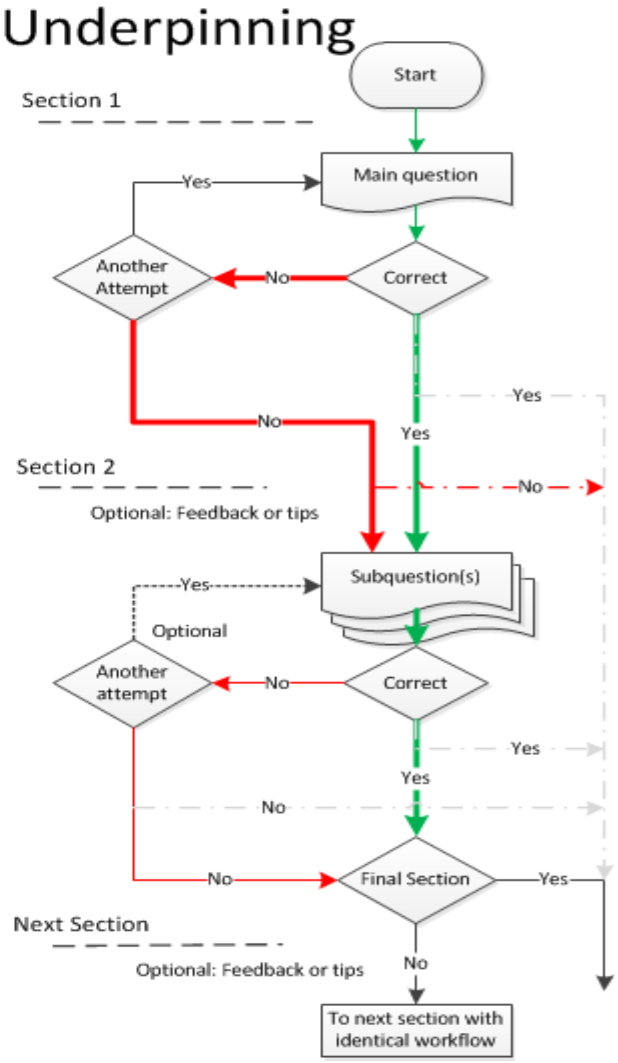
*There is no possibility for "parallel" sections: if correct one set of sub questions, if incorrect another set.



Workflow Scenario's

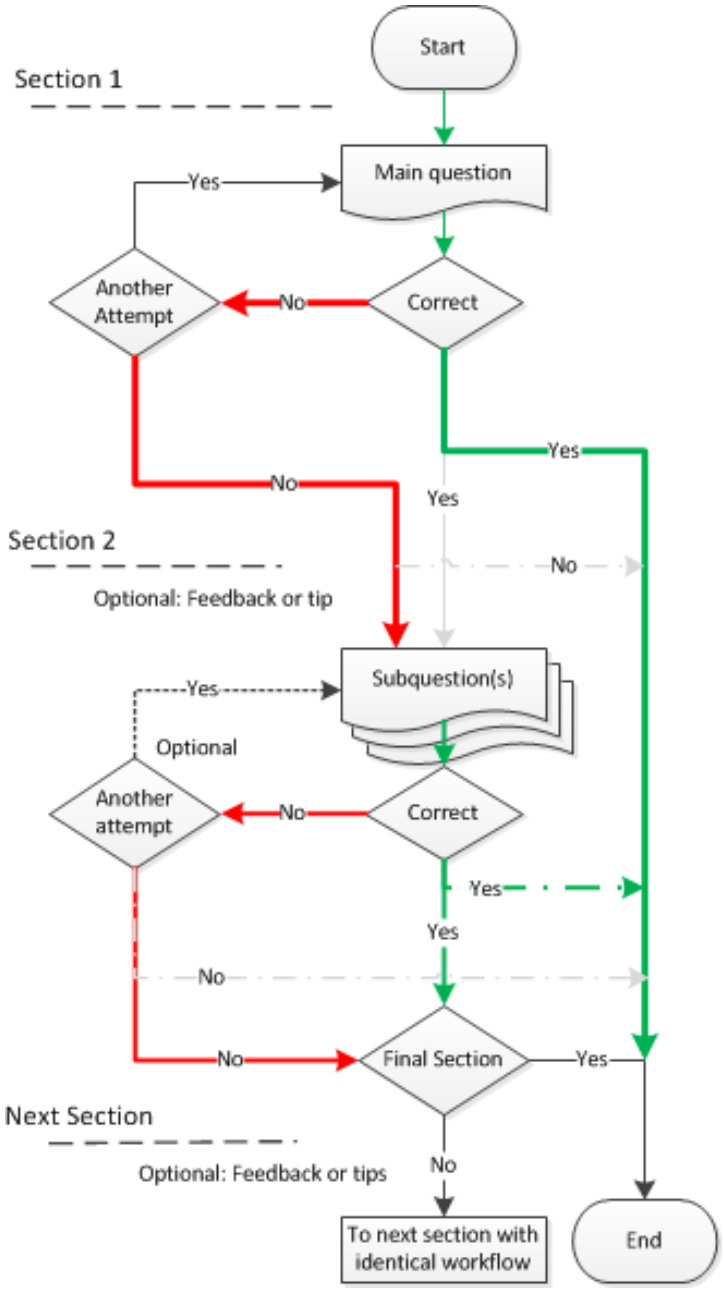
Combining different section outcomes determines the main scenario:





Scenario - Scaffolding

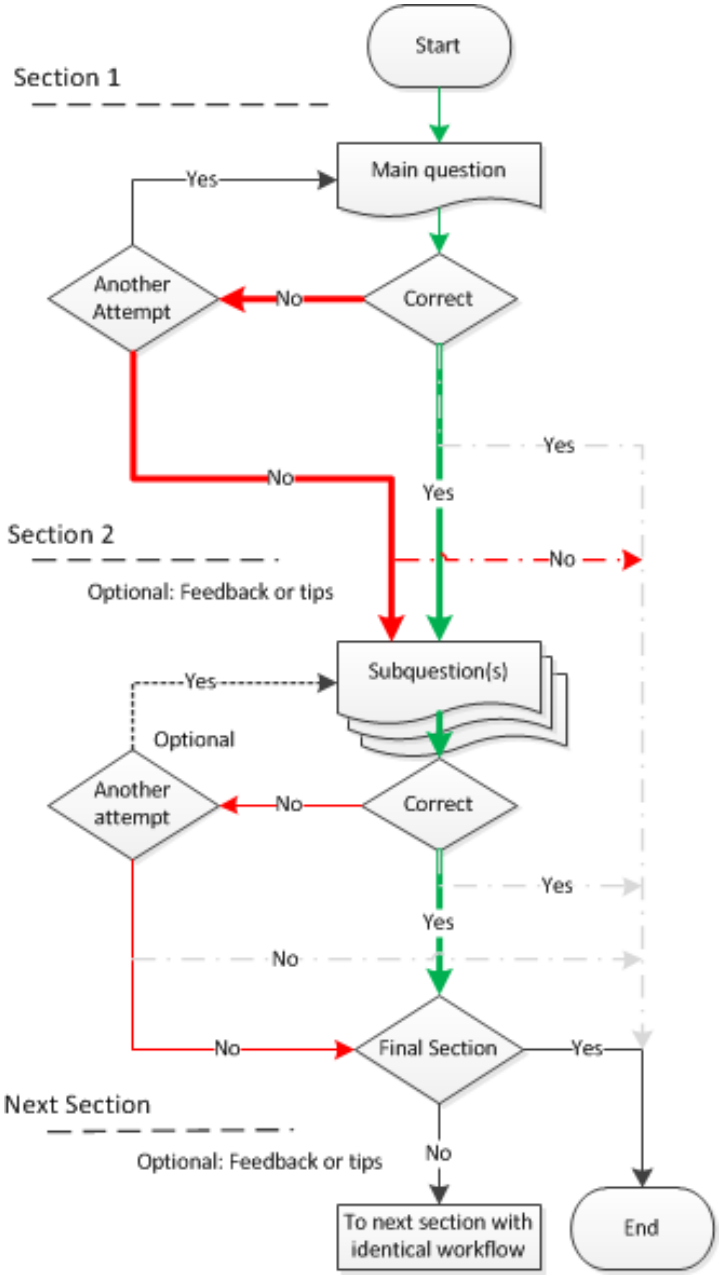
- Main question is posed first
  (can students figure out a way to solve the problem by themselves?)
- Alternate route (Section 2) checks knowledge through a set of additional questions
  - Give the necessary equations
  - Calculate the parameters you need for the final calculation
  - Question that evaluate the knowledge of the critical concepts



Scenario - Underpinning

Main question is posed first

- Section 2 should corroborate knowledge through a set of additional questions



Advantage and disadvantage

Advantages

- Ability to measure if students can solve the problem by themselves
  (students are not provided with the steps to solve the problem)
- Give feedback when needed (formative)
- Students can show their skills in small steps (summative)
- In case of mc question: eliminate guessing

Disadvantages

- Limited possibility for self correction along the path of solving a problem.
- Correct programming of the main question is essential, since it might have serious consequences
- Student anxiety when getting immediate feedback

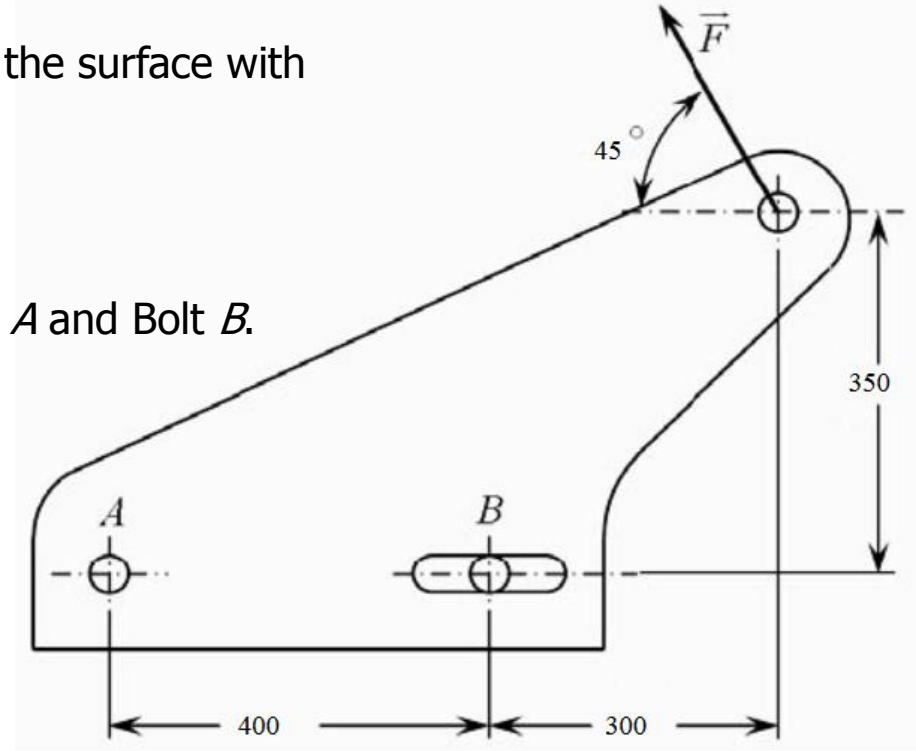
Example question on paper

A force F = 1000 N works at a given angle of 45° on a support block of a pneumatic cylinder.

The support block is attached to the surface with bolts *A* and *B*.

Bolt *B* is situated in a notch.

Calculate the forces on both bolt *A* and Bolt *B*.

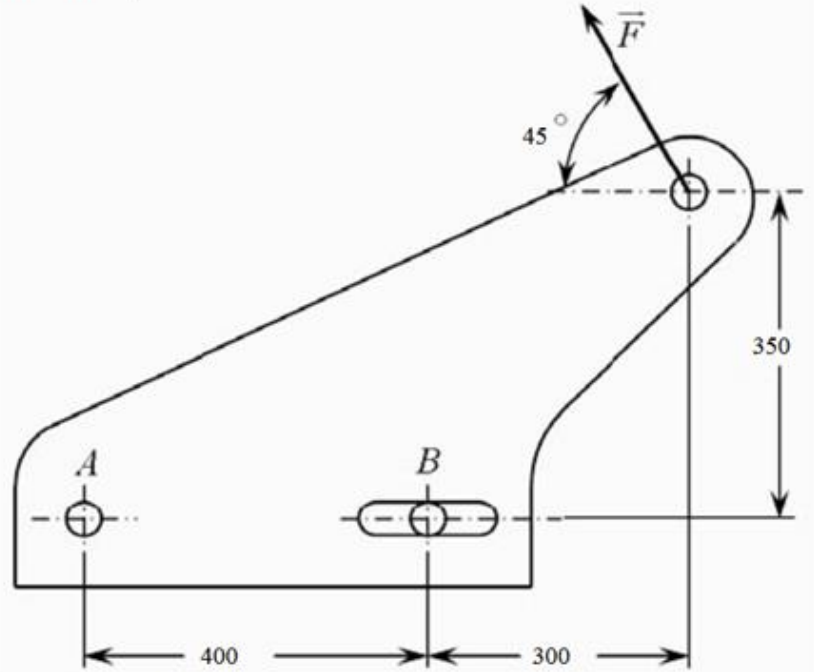


Description Example 1

- Scaffolding scenario
- Formative setting
- Feedback and tips along the ‘road’
- Multiple sections (5)

Scaffolding example section 1

Question:



A force F = 1000 N works at a given angle 45° 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.

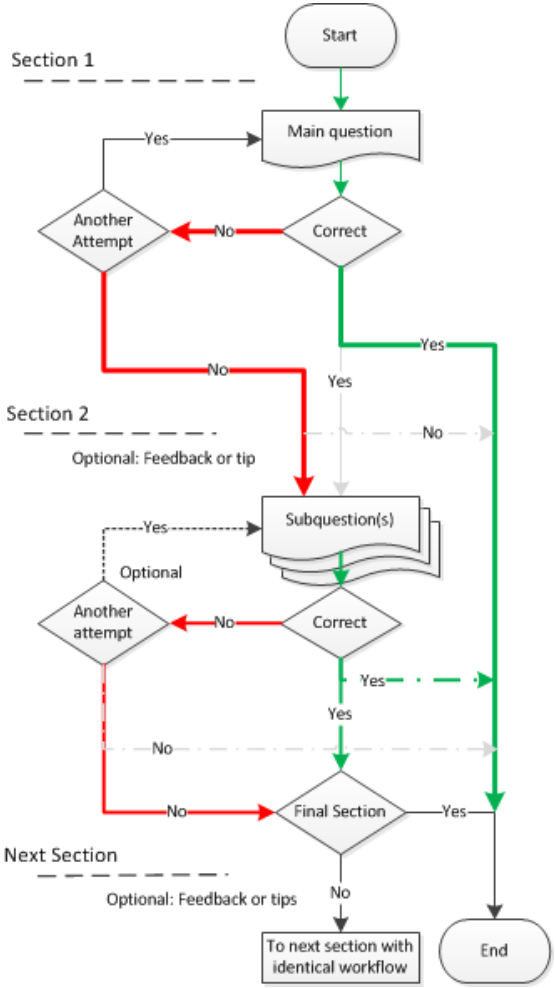
Calculate the forces on both bolt *A* and *B*.

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

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

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

Attempt 1 of 2 Verify



Scaffolding example section 2

Your answer(s) were incorrect.

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

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

$$\sum M = 0$$

The amount of 'help' is defined by the instructor

Subquestion A

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

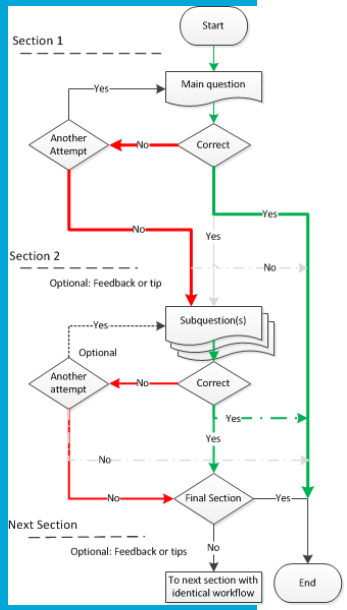
- $\sum M_A = 0$
- $\sum M_B = 0$

A correct answer adds 10% to your score

Click 'verify' to continue to the next subquestion.

Attempt 1 of 1

Verify



Scaffolding example section 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*.

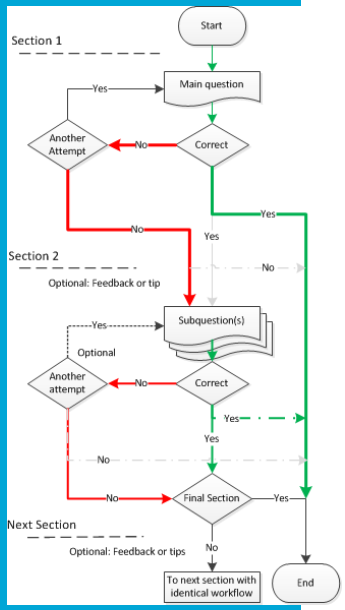
The force on bolt *B* is [Num] N. (Round to one decimal)

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

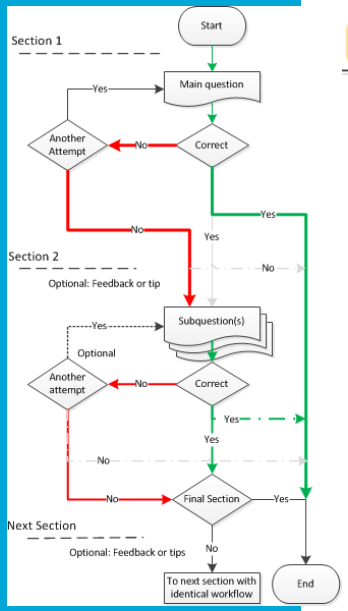
Click verify to continue

Attempt 1 of 1

Verify



Scaffolding example section 4



Now calculate the force in *B*.

The force on bolt *B* is 45 [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.

Use this response in further calculations

Subquestion C

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

Scaffolding example section 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 1000 [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.)

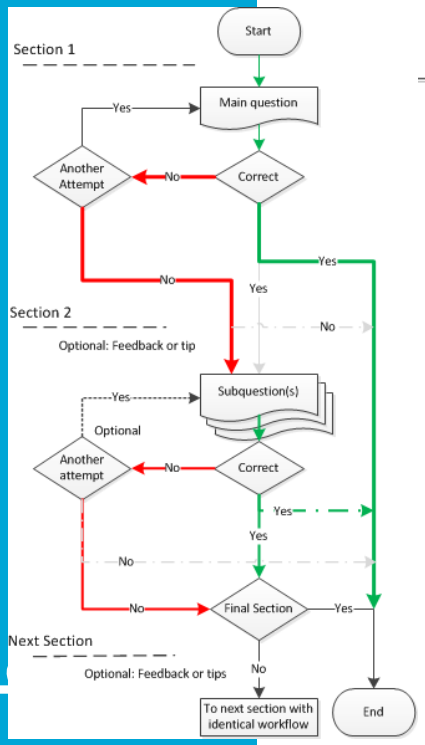
F_y = [Num] N. (Exact or rounded.)

Each correct answer adds 5% to your score

Attempt 1 of 1

Verify

Verify and continue



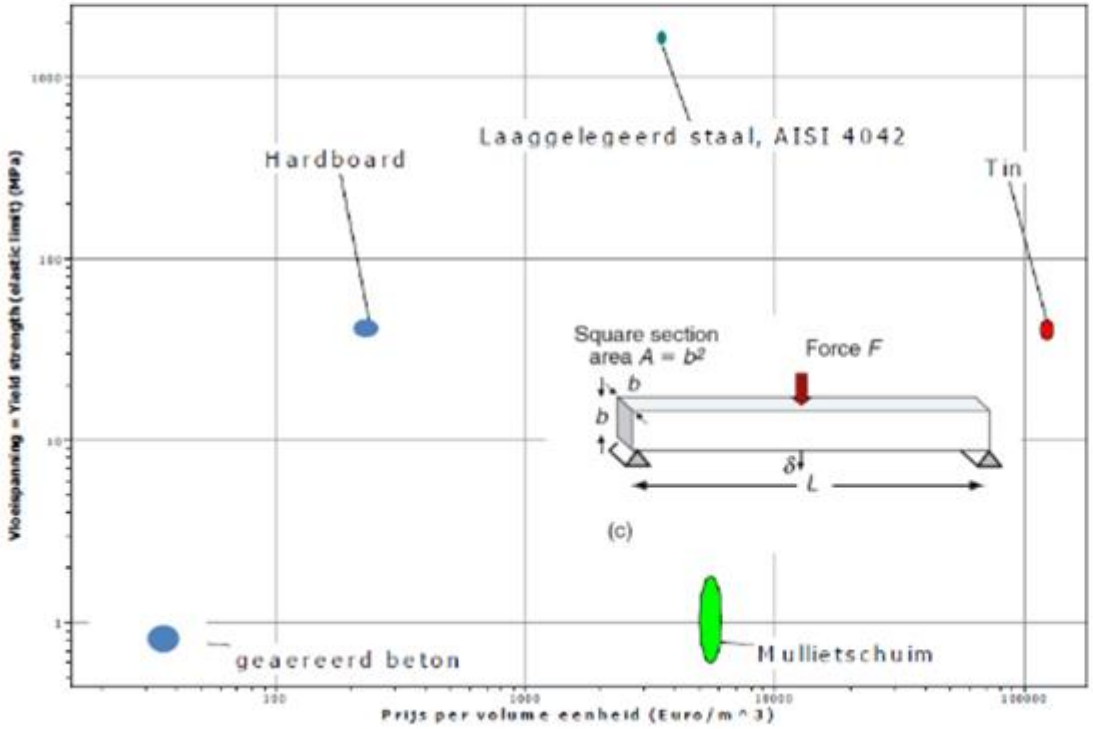
Optional: as a last step repeat main question

Example 2: On paper

Een balk met een vierkante dwarsdoorsnede wordt op buiging belast, zoals aangegeven in de figuur.

In onderstaande Ashby-grafiek staat de vloeispanning of elastische limiet uitgezet tegen de prijs per volume eenheid voor een aantal materialen.

Selecteer uit de Ashby-grafiek het materiaal waarmee de goedkoopste balk kan worden gemaakt voor deze belastingstoestand zonder dat de buitenste vezel plastisch gaat vervormen of de elastische limiet bereikt voor een gegeven lengte van de balk. Er worden géén aanvullende eisen (gewicht, breuktaaiheid e.d.) gesteld ten aanzien van het materiaal.

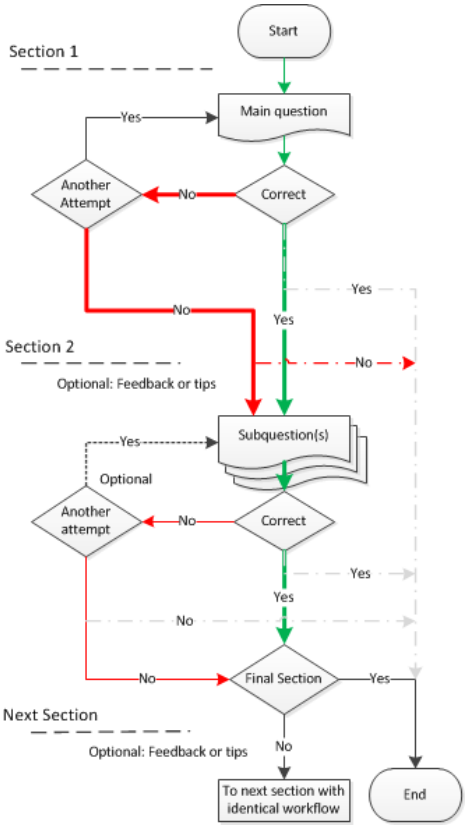


- Geaereerd Beton
- Hardboard
- Mullietschuim
- Laaggelegeerd Staal, AISI 4042
- Tin

Description Example 2

- Underpinning scenario
- Summative setting
- Eliminate Guessing
- 2 sections
- Score: All or nothing

Underpinning example section1



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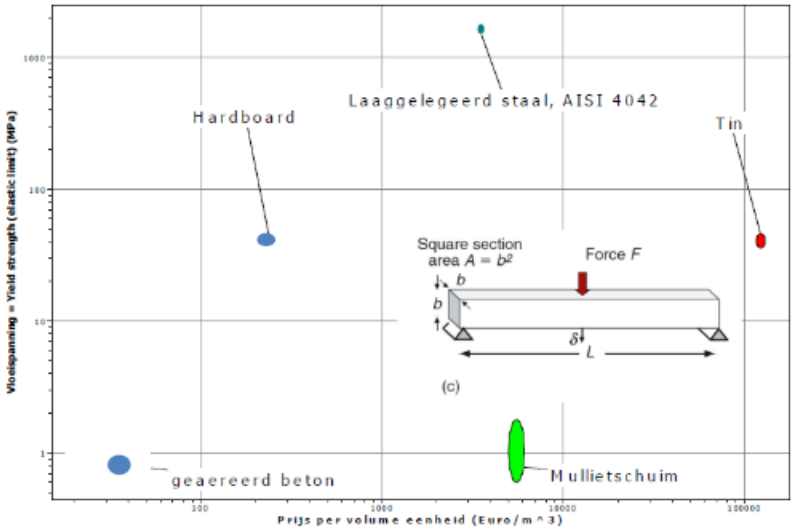

Klik op de figuur om deze te vergroten.

a. Selecteer uit de Ashby-grafiek het materiaal waarmee de goedkoopste balk kan worden gemaakt voor deze belastingstoestand zonder dat de buitenste vezel plastisch gaat vervormen of de elastische limiet bereikt voor een gegeven lengte van de balk. Er worden géén aanvullende eisen (gewicht, breuktaaiheid e.d.) gesteld ten aanzien van het materiaal.

- Geaereerd Beton
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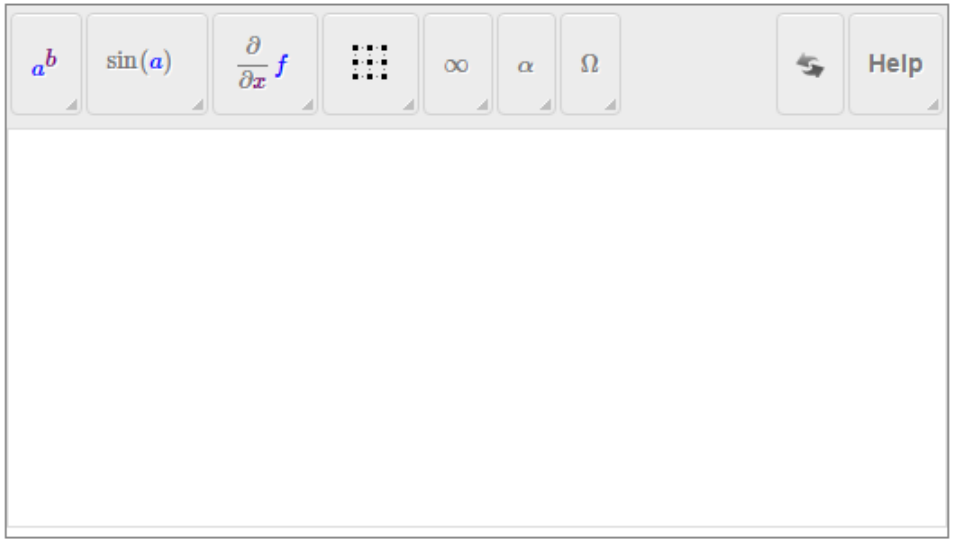
Underpinning example Section 2

b. Geef de materiaalindex

Equation Editor

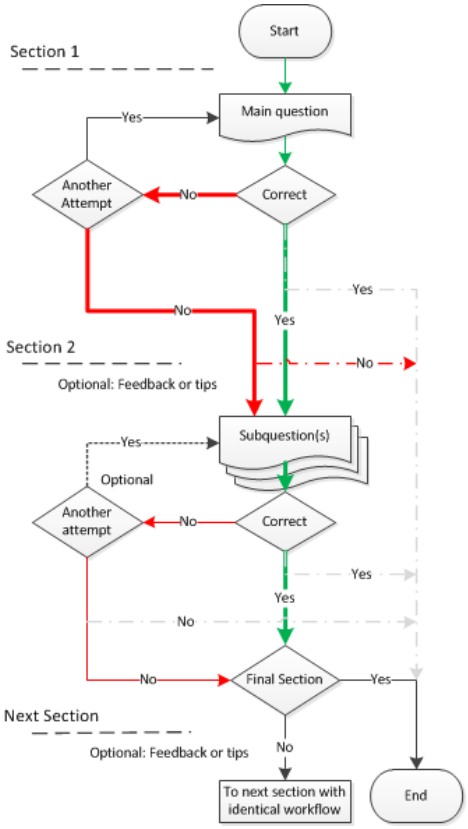


c. Geef de helling van de richtlijn

Number

d. Welke richting moet de richtlijn worden verschoven om de materiaalindex te maximaliseren?

- Linksboven
- Linksonder
- Rechtsboven
- Rechtsonder



1 – Choose example

- Form groups of 2
- Select **one** paper-and-pencil question to transform to a digital adaptive question.
  - Solving the problem requires multiple steps (calculations or reasoning)
  - Response must be automatically gradable
  - Summative: First have students solve it on their own
  - Formative: Step-by-step instructions (and feedback)
  - Formative: Some students will be able to solve it by themselves

2 – Analyse problem

- What level of knowledge do you want to measure?
  (remember, understand, apply, analyse, evaluate, create)
- Is the focus on process/strategy or final answer?
- Are different strategies possible?
- Do you want to measure one specific strategy?
- What are common mistakes of students?

- Does this paper based question measure what I want?

3 – Create scenario question

- Choose formative or summative setting
- Choose a scenario (scaffolding or underpinning)
- Formulate a main question
- Formulate sub questions

  (single or multiple questions per section)
- Determine which mistakes (do not) weigh heavily.

  (partial grading is possible)

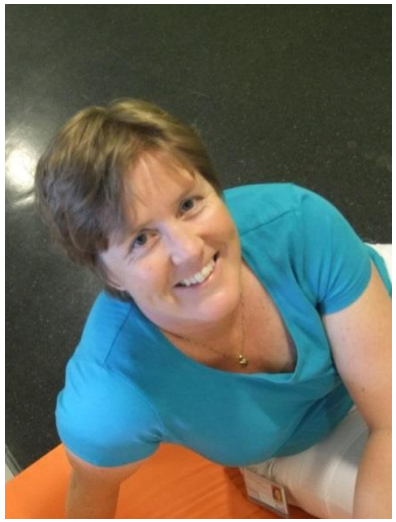
- Evaluate your scenario question
  - Do you make concessions?

Wrapping Up

- Feedback on this session
- Any one interested in a follow up?
  (creating exam questions in MapleTA)

How to contact us

- Celine Goedee
  Mail: c.goedee@tudelft.nl



- Meta Keijzer – De Ruijter
  Blog: https://maderuijter.weblog.tudelft.nl
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