

# Secondary Students Intrinsic Motivation during Multidisciplinary STEAM projects

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# Motivation of secondary students

For science tends to decline when they become older

Does a more multidisciplinary project-based learning approach increase motivation?

# Integrated STEAM subject “ Research & Design”

Since 2004 in the Netherlands

Research & design projects related to STEM  
3-6 hours a week

Entirely project-based: design- and research  
tasks from local organizations

Interaction with client and an expert, e.g.  
architect

Certified schools -> Technasia

40% girls – 60% boys

(see Vossen 2019 and

[Onderzoek & Ontwerpen - Stichting Technasium](#))



# Pilot with 8 schools

## New type of research & design projects

- Multidisciplinary
- STEM and various other disciplines involved
- Social cooperative methods

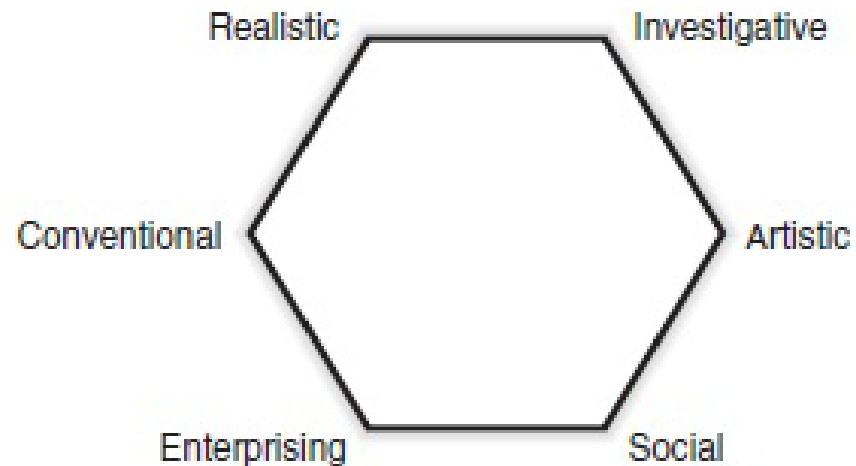
Involve: students from non-STEM tracks



# Research question from Technasium schools

Students' motivation for monodisciplinary STEM subjects declines during secondary education.

Will these **Multidisciplinary Integrated STEAM projects** enhance motivation?



Klapwijk and Rommes, 2009

John Holland. See Klapwijk e.a. 2005 for relation between personalities and motivation for STEM

# Goal and outline presentation

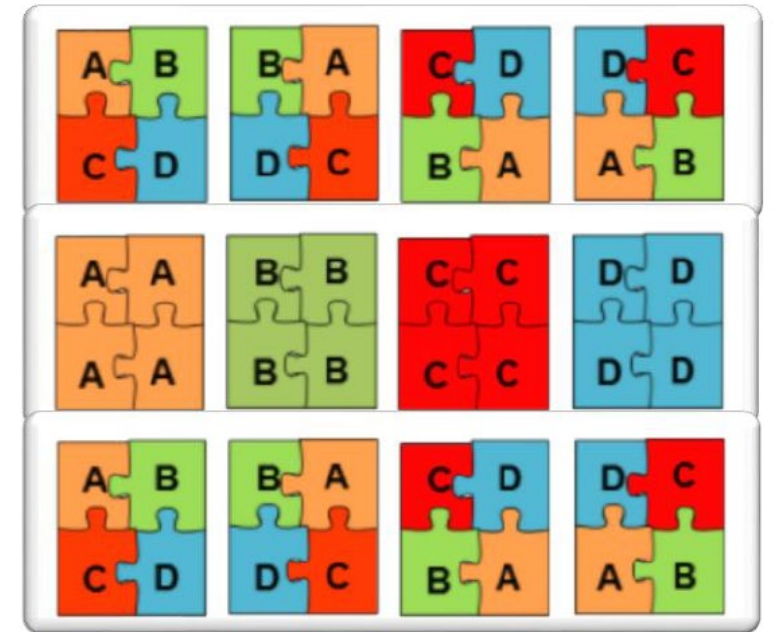
Nature of the STEAM Projects

Cooperation through Jigsaw

Prompts for each perspective

Methodology: Intrinsic Motivation Inventory

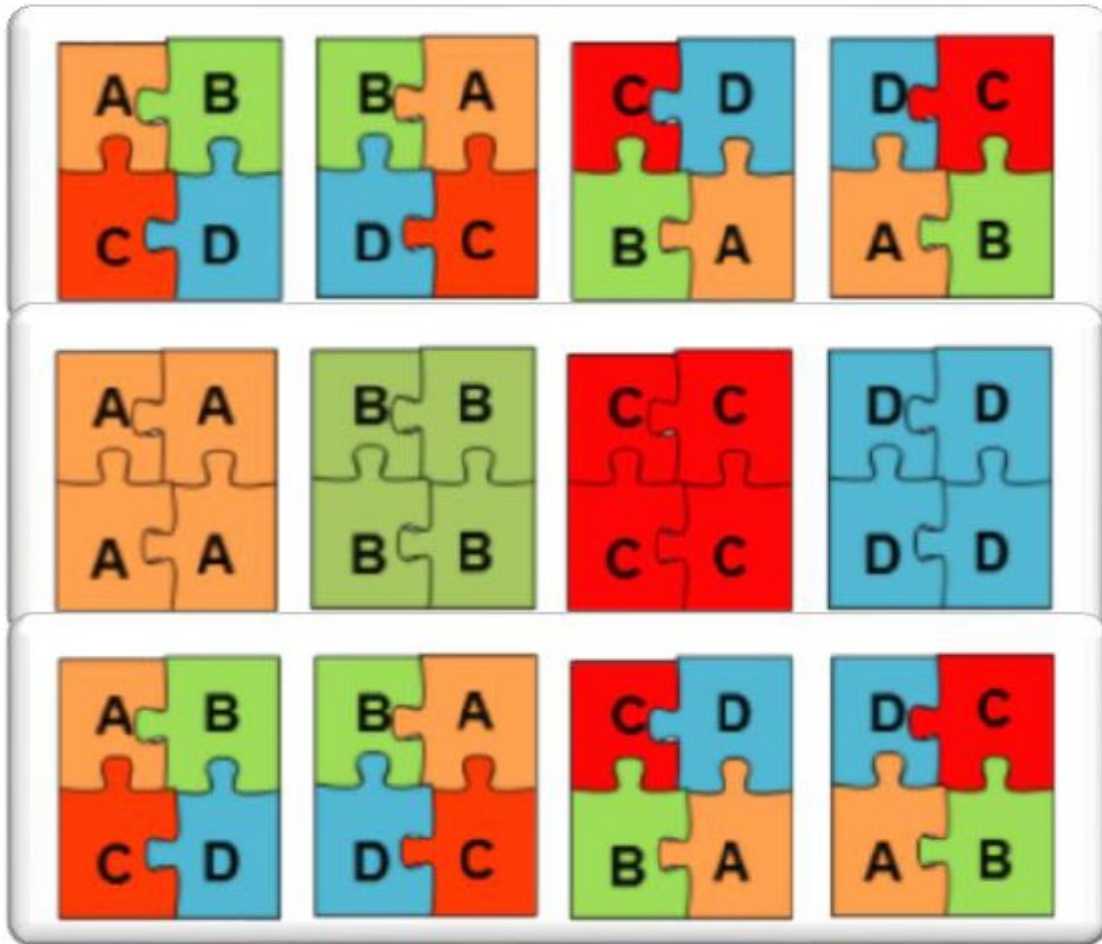
Results



# Design and research using the Jigsaw methode



# Jigsaw

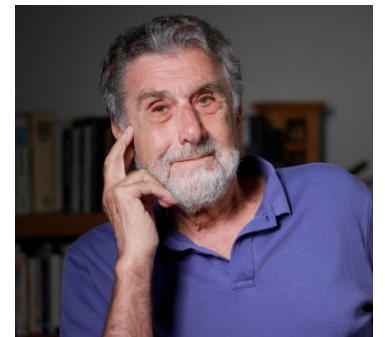


## Jigsaw – social cooperative approach

Roles divided

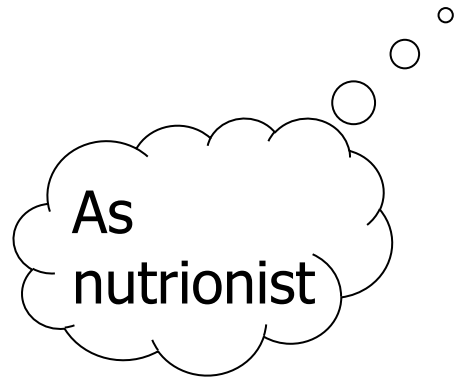
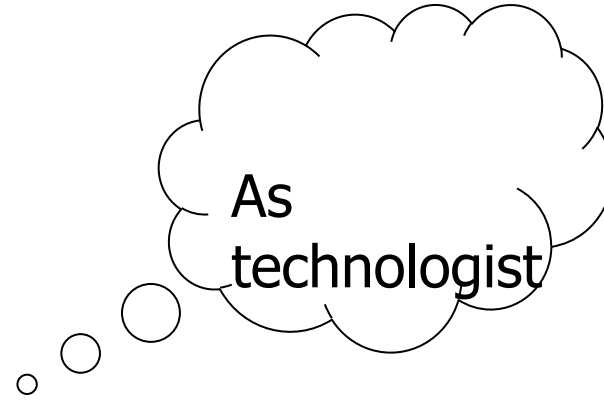
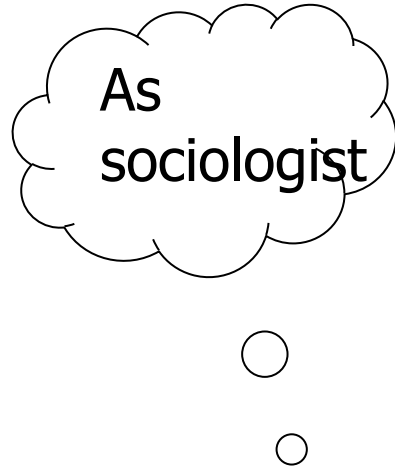
Students depend on each other

Applied in reading education, math, science  
(Aronson 2023, [www.jigsaw.org](http://www.jigsaw.org))





# Design and research using various perspectives



# Question prompting



## Question prompting - Perspective Approach Leiden

### **Substances:**

Where is it made of?

- Of which materials and substances does it consist?
- What are its characteristics?
- How can we transform these materials or substances?
- Of which particles does it consist and how do these behave?

### **Place:**

What is where and why there?

- Where is this?
- What is over there?
- Why is this there?
- How will it be there?
- How can we improve it?

# Student motivation

Motivation involves internal processes that **initiate and maintain goal-directed** behaviour (Pintrich & Zusho, 2002)

## **Expectancy-value theory:**

Expectation of success & value assigned to the task influence motivation (Wigfield & Eccles 2000)

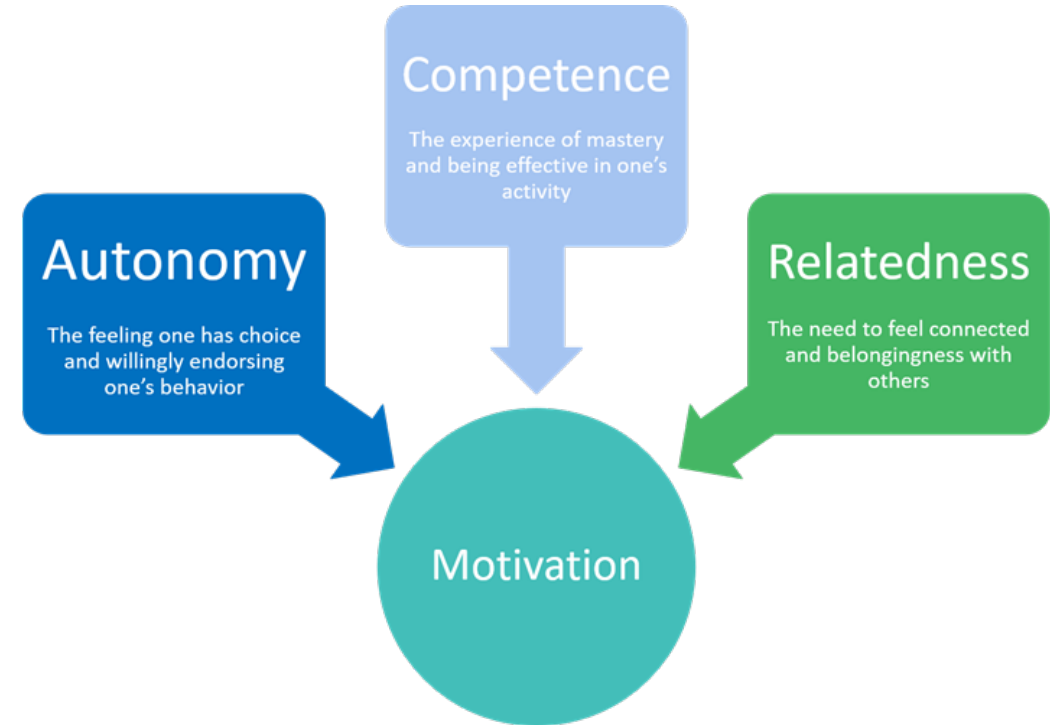
## **Self-determination theory:**

Intrinsic motivation (I enjoy doing the task) .....extrinsic motivation (reward/value) (Ryan & Deci)

# IMI inventory

## Themes:

- interest/enjoyment
- effort
- perceived competence
- perceived choice
- relatedness
- pressure
- value/usefulness



# Modifications

## A Specify activity:

Original item: ' I would describe this activity as very interesting.'

Modified Item: 'I thought this R&D project was very interesting.'

## B. Specify Persons

"I'd really prefer not to interact with this **client** anymore"

"I'd like a change to interact with these **teammates** more often"

## C. Specify Perspectives

I am good in **combining insights** from **different disciplines**.

# Outcomes

Results on motivation of students doing STEAM projects

&

Quality of methodology and statements for determining motivation

# Motivation

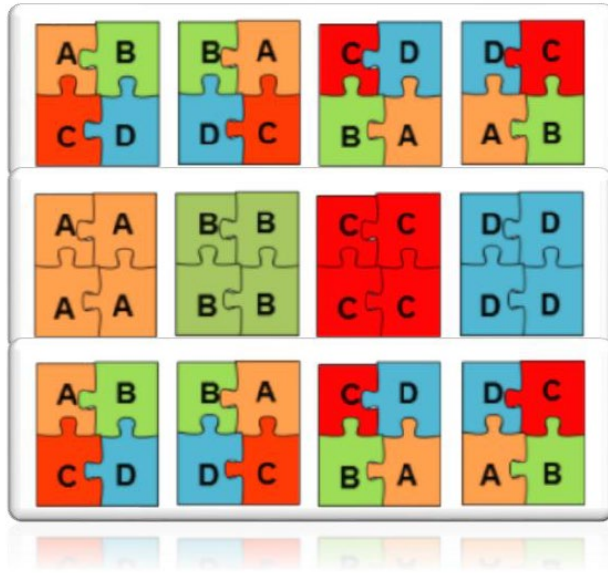
- No differences between motivation halfway the project and just after the project
- Students experience rather strong relatedness with team members
- This influences their experienced competences positive
- Pressure is rather low

# Motivation

- Intrinsic motivation is on average a little bit above neutral, 35% are positive
- Students experience choice, in general not overwhelmed
- Students in grade 9 are significantly less motivated than grade 10 & 11
- No big differences between boys and girls
- Question: how well did we measure motivation?



# Value of perspectives (jigsaw, perspective prompts)



- Learning to work with perspectives is useful (3.8)

- I am good in combining insights from
- different disciplines (3.5)



# Value items (% selecting agree or strongly agree)

Project	Society	Client	Own future	Perspectives
Repurpose Agriculture buildings	50%	25%	63%	87%
Waste management as day care	70%	60%	50%	85%
Tiny houses	37%	27%	53%	79%
Attractive Municipality	35%	61%	35%	57%
Conference room	38%	25%	38%	25%
Demolish Schools?	31%	35%	42%	62%
Local use of Hydrogen	34%	6%	43%	72%
Meat substitutes	32%	23%	40%	67%

# Relatedness with clients and experts

What do these statements measure?

- I'd really prefer not to interact with this client in the future (R): 2.86
- I had a strong bond with the client: 2.21
- The experts were very approachable: 2.54

5-point Likert (strongly disagree → disagree → neutral → agree → strongly agree)

# Future research

- Qualitative interviews with respondents to understand outcomes
- Improve measurements of motivation in project-based context with clients/external people
- Teachers are continuing to improve Jigsaw and perspective approach as well as other aspects of motivation
- Teacher training to better support basic needs (Chiu, 2021)

# Delft Your Turn To Make Your Mark in Design Toolbox



Does your design have an impact on the lives of children? Do you care enough to involve children in shaping the design so that its impact is in line with children's concerns, values and preferences? If your answer is yes, then we recommend co-design with

kids.

Check out our toolbox

New tools like jigsaw will be placed here after we have developed them

<https://studiolab.ide.tudelft.nl/studiolab/codesignwithkids>

<https://www.tudelft.nl/en/wetenschapsknooppunt/your-turn>

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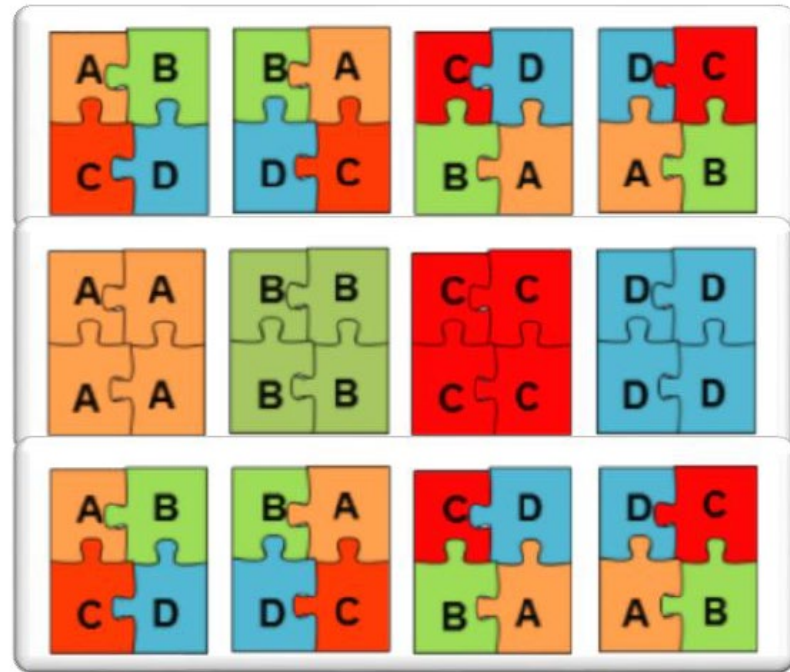
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# Questions, suggestions....



, [www.jigsaw.org](http://www.jigsaw.org)

<https://www.universiteitleiden.nl/iclon/onderwijs/onderzoek/perspectiefgericht->  
onderwijs