

# Comparison of the participating countries' curricula

A descriptive presentation of the occurrence  
of NGSS Science and Engineering Practices  
(first results)

Thomas Plotz und Hannah Loidl



# 8 Science and Engineering Practices (NGSS 2013)

- 1  Asking questions and defining problems
- 2  Developing and using models
- 3  Planning and carrying out investigations
- 4  Analysing and interpreting data
- 5  Using mathematics and computational thinking
- 6  Constructing explanations and designing solutions
- 7  Engaging in argument from evidence
- 8  Obtaining, evaluating and communicating information

# Guiding Research Questions

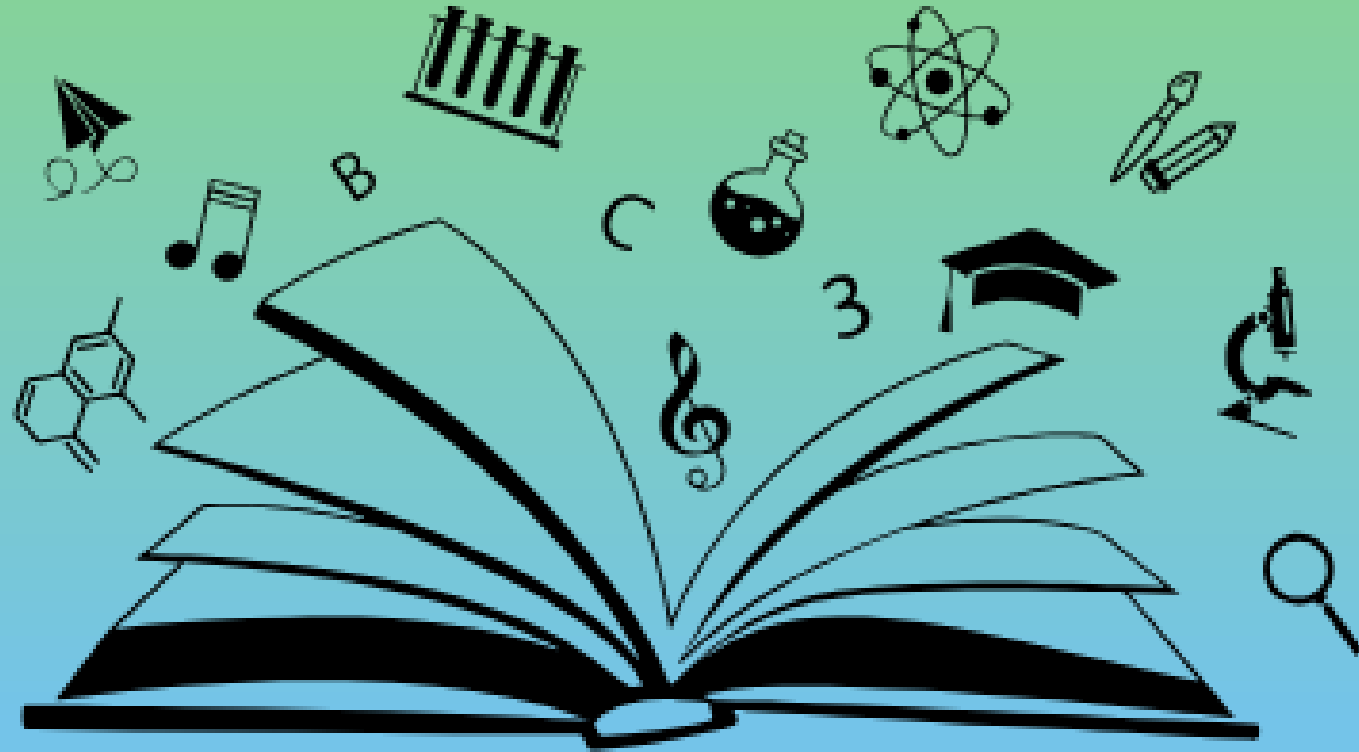
1. Which NGSS science and engineering practices occur **most frequently**, and which occur least frequently **across subjects in the curricula** of the participating countries?
2. How does the distribution of NGSS science and engineering practices **vary across educational levels** within and between the participating countries?

# Limitations

- First results
- Some missing data in the coding
- No report of intercoder reliability yet possible
- BUT: Interrater agreement between teachers ✓



# NATURAL & SOCIAL STUDIES IN PRIMARY EDUCATION



primary education

# Natural & Social Studies in Primary Education



## General Studies

- Level 1-4 (6-10y)
- Natural Sciences
- Social Studies
- History
- Technology
- Geography



## Knowledge of the Natural, Social, and Cultural Environment

- Level 1-6 (6-12y)
- Natural Science
- Social Sciences
- Cultural Sciences



## Environmental Studies

- Level 1-6 (6-12y)
- Environmental Studies
- Biology
- Ecology
- Geography
- Chemistry

# Natural & Social Sciences (primary)

- Common grounds

- Top 3
- Analysing and interpreting data (all)
  - Constructing explanations (ESP & GRC)
  - Obtaining, evaluating and communicating information (AUT & ESP)

- Top 5
- Planning and carrying out investigations (all)
  - Asking questions (AUT & GRC)
  - Engaging in argument from evidence (AUT & ESP)



# Natural & Social Sciences (primary)

Differences in the distribution of NGSS practices in participating countries in detail



Underrepresented  
practices

|                                                     | ESP > ESP-General Studi... | AUT > AUT-General Stu... | GRC > GRC-General Stu... | Total      |
|-----------------------------------------------------|----------------------------|--------------------------|--------------------------|------------|
| Asking questions and defining problems              | 4,8%                       | 17,3%                    | 8,1%                     | 8,4%       |
| Developing and using models                         | 4,8%                       | 3,8%                     | 5,7%                     | 5,5%       |
| Planning and carrying out investigations            | 11,9%                      | 9,6%                     | 24,1%                    | 21,3%      |
| Analyzing and interpreting data                     | 34,5%                      | 15,4%                    | 20,0%                    | 21,5%      |
| Using mathematics and computational thinking        | 3,6%                       |                          | 0,4%                     | 0,8%       |
| Constructing explanations and designing solutions   | 19,0%                      | 3,8%                     | 25,7%                    | 23,1%      |
| Engaging in argument from evidence                  | 7,1%                       | 13,5%                    | 4,9%                     | 5,9%       |
| Obtaining, evaluating and communicating information | 14,3%                      | 36,5%                    | 11,1%                    | 13,6%      |
| Σ SUM                                               | 100,0%                     | 100,0%                   | 100,0%                   | 100,0%     |
| # N = Documents                                     | 2 (28,6%)                  | 1 (14,3%)                | 4 (57,1%)                | 7 (100,0%) |

# MATHEMATICS



primary education

# Mathematics (primary)

Differences in the distribution of NGSS practices in participating countries

Common grounds:

- Using mathematics and computational thinking
- Analysing and interpreting data
- Developing and using models



Underrepresented practices:

- Engaging in argument from evidence
- Asking questions and defining problems



# Mathematics (primary)

Most frequently counted practices in the participating countries' curricula  
(smaller size of icons = same percentage of occurrence)

|                                                                                    | Level 1 (6 -7y)                                                                                                                                                                                                                                          | Level 2 (7-8y)                                                                                                                                                                                                                                               | Level 3 (8-9y)                                                                                                                                                                                                                                                                                                                                  | Level 4 (9-10y)                                                                                                                                                                                                                                                |
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|   |      |                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                |
|  |    |    |                                                                                     |    |

# MATHEMATICS



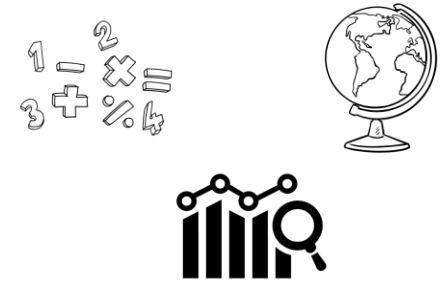
secondary education

# Mathematics (secondary)

Differences in the distribution of NGSS practices in participating countries

Common grounds:

- Using mathematics and computational thinking
- Analysing and interpreting data
- Developing and using models (ESP & GRC)



Underrepresented practices:

- Engaging in argument from evidence
- Asking questions and defining problems (AUT 0)



# Mathematics (secondary)

Most frequently counted practices in the participating countries' curricula

|                                                                                    | Level 5 (10 -11y)                                                                                                                                                                                                                                        | Level 6 (11-12y)                                                                                                                                                                                                                                                                                                                                | Level 7 (12-13y)                                                                                                                                                                                                                                                                                                                                     | Level 8 (13-14y)                                                                                                                                                                                                                                                                                                                                     | Level 9 (14-15y)                                                                                                                                                                                                                                                                                                                                                                                                                           |
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|   |       |                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                   |                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|  |    |     |     |     |      |

 Codes missing

# overview natural sciences



secondary education

# Distribution of NGSS practices in natural sciences from level 5-9 in all countries



# BIOLOGY



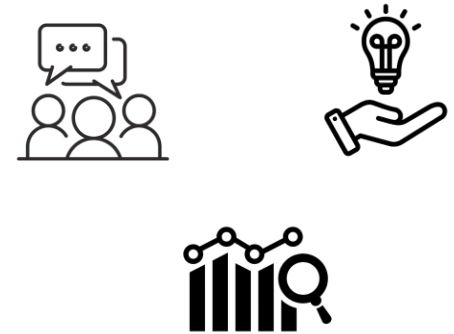
secondary education

# Biology (secondary)

Differences in the distribution of NGSS practices in participating countries

Common grounds:

- Constructing explanations
- Analysing and interpreting data (AUT & GRC)
- Engaging in argument from evidence (AUT & ESP)



Underrepresented practices:

- Using mathematics and computational thinking
- Asking questions and defining problems (AUT & GRC)
- Engaging in argument from evidence (GRC)



# Biology (secondary)

Most frequently counted practices in the participating countries' curricula

|                                                                                   | Level 5 (10 -11y)                                                                                                                                                                                                                                        | Level 6 (11-12y)                                                                                                                                                                                                                                          | Level 7 (12-13y)                                                                                                                                                                                                                                               | Level 8 (13-14y)                                                                                                                                                                                                                                               | Level 9 (14-15y)                                                                                                                                                                                                                                               |
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|  |       |                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                |       |                                                                                                                                                                                                                                                                |
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Combined Subject Knowledge of the Natural, Social, and Cultural Environment



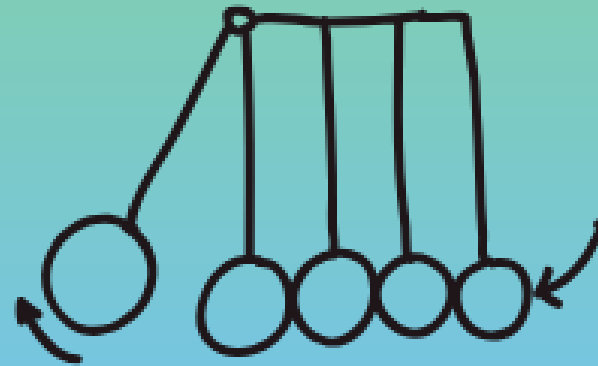
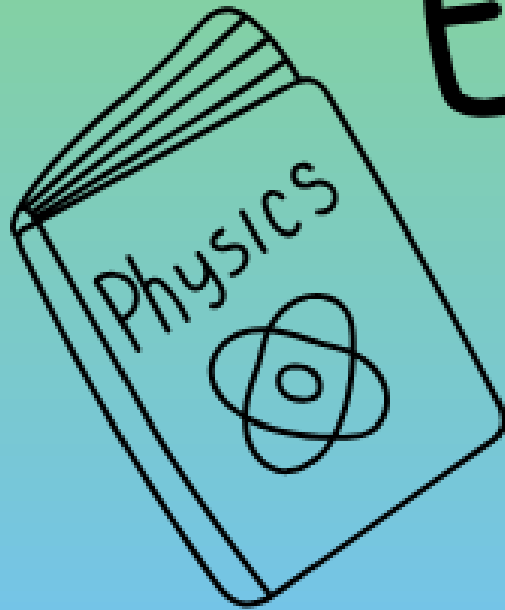
Combined Subject (PH, CH, BIO)



One model of competencies for levels 5-8

# PHYSICS

$$E=mc^2$$



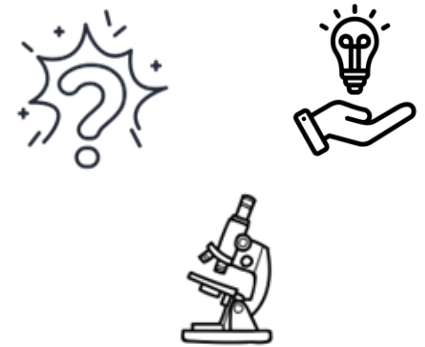
secondary education

# Physics (secondary)

Differences in the distribution of NGSS practices in participating countries

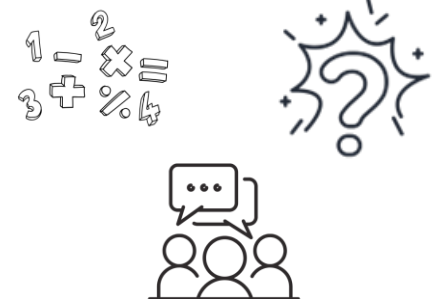
Common grounds:

- Constructing explanations (ESP & GRC)
- Planning and carrying out investigations (AUT & GRC)
- Asking questions and defining problems (ESP & GRC)



Underrepresented practices:

- Using mathematics and computational thinking
- Asking questions and defining problems (AUT)
- Engaging in argument from evidence (ESP & GRC)



# Physics

Most frequently counted practices in the participating countries' curricula  
(smaller size of icons = same percentage of occurrence)

|                                                                                    | Level 5 (10 -11y)                                                                                                                                                                                                                                        | Level 6 (11-12y)                                                                                                                                                                                                                                                                                                                          | Level 7 (12-13y)                                                                                                                                                                                                                                                                                                                                                                                                                           | Level 8 (13-14y)                                                                                                                                                                                                                                                                                                                                      | Level 9 (14-15y)                                                                                                                                                                                                                                                                                                                                     |
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|  |    |                                                                                    |      |     |     |



Combined Subject Knowledge of the Natural, Social, and Cultural Environment

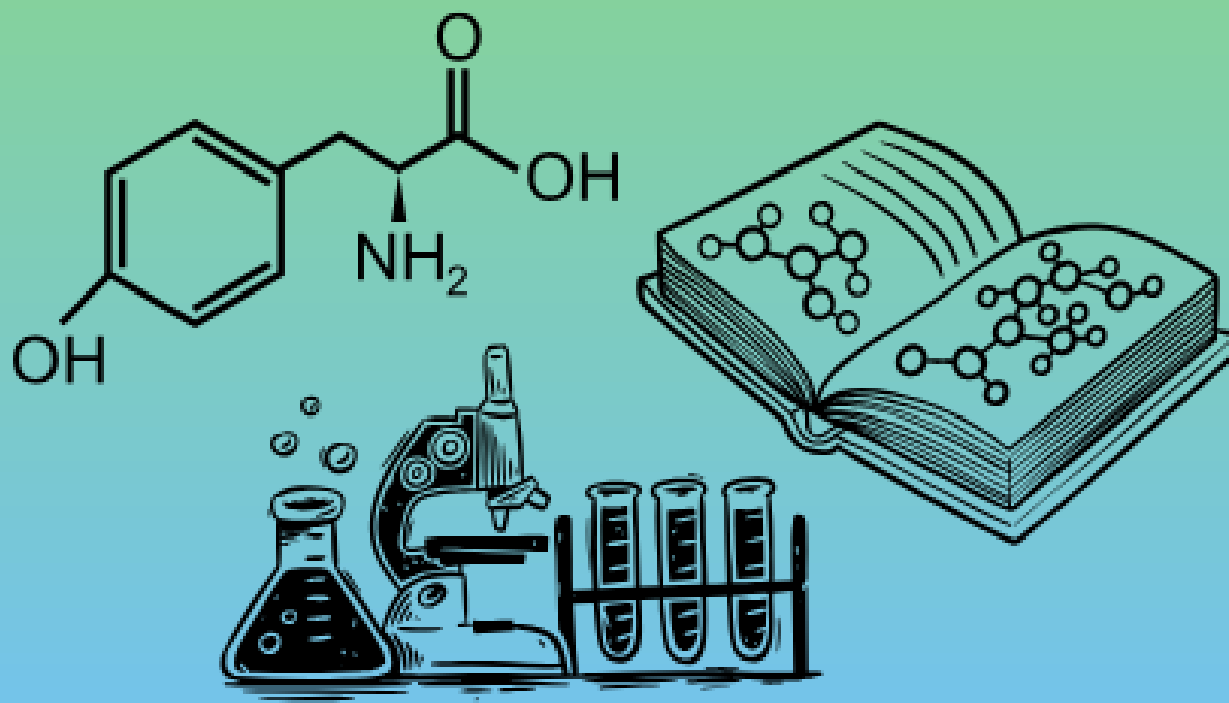


Combined Subject (PH, CH, BIO)



Combined Subject (PH, CH)

# CHEMISTRY



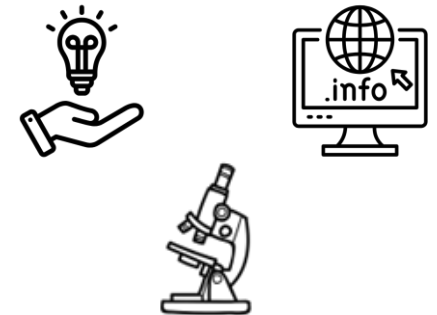
secondary education

# Chemistry (secondary)

Differences in the distribution of NGSS practices in participating countries

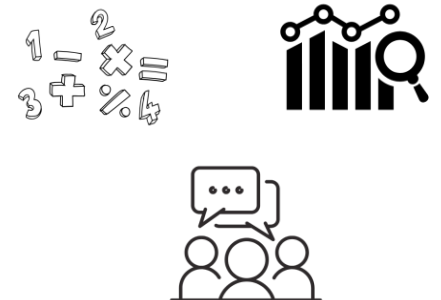
Common grounds:

- Constructing explanations
- Obtaining, evaluating and communicating information (AUT & GRC)
- Planning and carrying out investigations (AUT & GRC)



Underrepresented practices:

- Using mathematics and computational thinking
- Engaging in argument from evidence (ESP & GRC)
- Analysing and interpreting data (ESP)



# Chemistry

Most frequently counted practices in the participating countries' curricula (smaller size of icons = same percentage of occurrence)

|                                                                                    | Level 5 (10 -11y)                                                                                                                                                                                                                                        | Level 6 (11-12y)                                                                                                                                                                                                                                           | Level 7 (12-13y)                                                                                                                                                                                                                                                                                                                                                                                                                           | Level 8 (13-14y)                                                                                                                                                                                                                                                                                                                                | Level 9 (14-15y)                                                                                                                                                                                                                                                                                                                                     |
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|   |       |        |                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                      |
|  |    |    |      |                                                                                    |     |



Combined Subject Knowledge of the Natural, Social, and Cultural Environment



Combined Subject (PH, CH, BIO)



Combined Subject (PH, CH)

# engineering and Design



secondary education

# Technology (secondary)

Differences in the distribution of NGSS practices in participating countries

*(ESP missing)*

Common grounds:

- Obtaining, evaluating and communicating information
- Developing and using models
- Designing solutions (GRC only)



Underrepresented practices:

- Analysing and interpreting data
- Using mathematics and computational thinking (AUT only)



# Technology

Most frequently counted practices in the participating countries' curricula (smaller size of icons = same percentage of occurrence)

|                                                                                   | Level 5 (10 -11y)                                                                                                                                                                                                                                                                                                                       | Level 6 (11-12y)                                                                                                                                                                                                                                                                                                                                                                                                             | Level 7 (12-13y)                                                                                                                                                                                                                                                                                                                                    | Level 8 (13-14y)                                                                                                                                                                                                                                                                                                                                    | Level 9 (14-15y)                                                                                                                                                                                                                                               |
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|  |     |      |         |         |                                                                                                                                                                                                                                                                |
|  |                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                |
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Codes missing

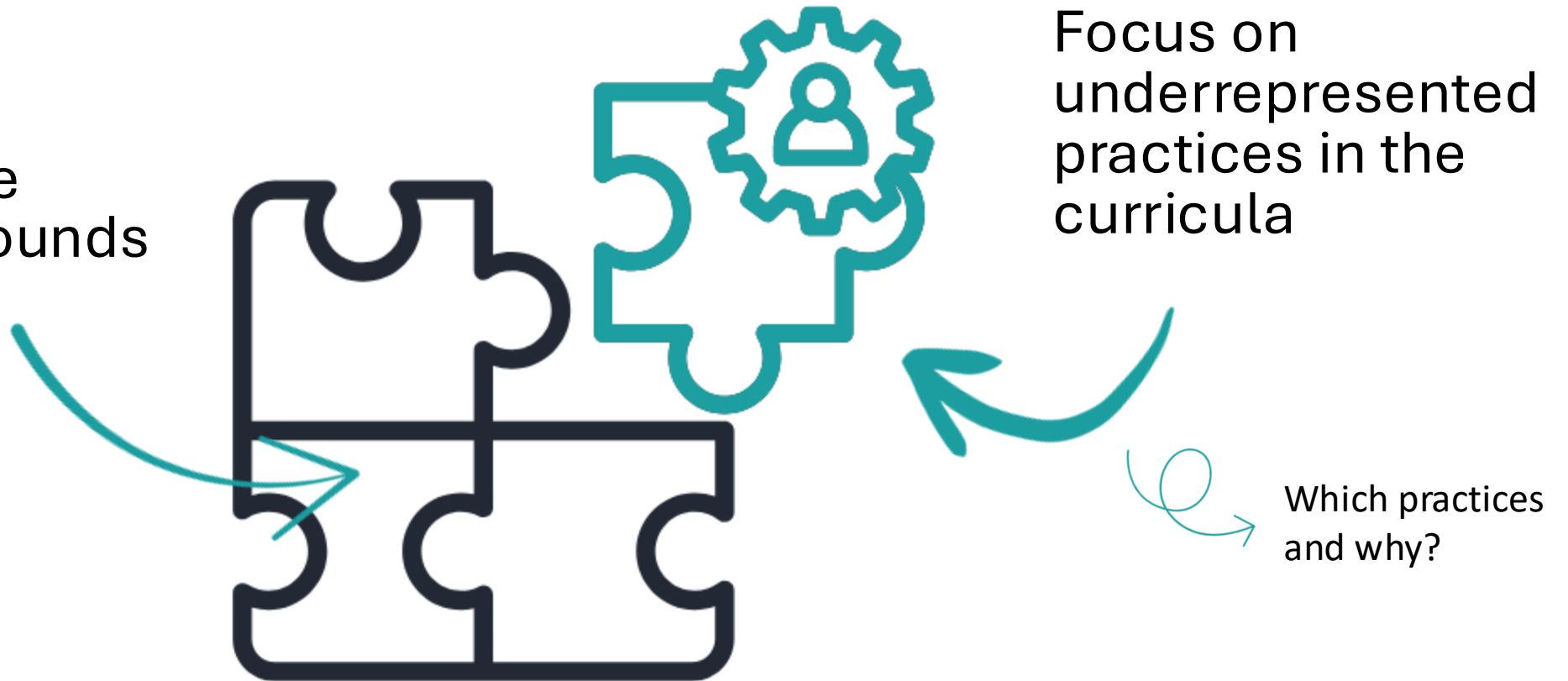
# TWO CHOICES UP TO DEBATE

**FIT IN THE CURRICULA?**

Focus on the common grounds

**FILL THE gap?**

Focus on underrepresented practices in the curricula





PRIVATE  
UNIVERSITY  
COLLEGE  
OF TEACHER EDUCATION  
OF CHRISTIAN CHURCHES  
AUSTRIA



# THANK YOU!

Thomas Plotz and Hannah Loidl



Co-funded by  
the European Union

# Appendix

Information in detail

# Technology

[illegible]

# Technology

|                                                       | AUT SECOND... | ESP SEC > ES... | Secondary GR... | Total      |
|-------------------------------------------------------|---------------|-----------------|-----------------|------------|
| • Asking questions and defining problems              | 12,8%         |                 | 3,8%            | 5,9%       |
| • Developing and using models                         | 17,9%         |                 | 19,8%           | 19,4%      |
| • Planning and carrying out investigations            | 17,9%         |                 | 7,6%            | 10,0%      |
| • Analyzing and interpreting data                     | 2,6%          |                 | 6,9%            | 5,9%       |
| • Using mathematics and computational thinking        |               |                 | 17,6%           | 13,5%      |
| • Constructing explanations and designing solutions   | 12,8%         |                 | 23,7%           | 21,2%      |
| • Engaging in argument from evidence                  | 15,4%         |                 | 1,5%            | 4,7%       |
| • Obtaining, evaluating and communicating information | 20,5%         |                 | 19,1%           | 19,4%      |
|                                                       |               |                 |                 |            |
| Σ SUM                                                 | 100,0%        |                 | 100,0%          | 100,0%     |
| # N = Documents                                       | 4 (50,0%)     | 1 (12,5%)       | 3 (37,5%)       | 8 (100,0%) |

# Physics

[illegible]

# Physics

|                                                                                                                         | AUT SECOND... | ESP SEC > Ph... | Secondary GR... | Total      |  |
|-------------------------------------------------------------------------------------------------------------------------|---------------|-----------------|-----------------|------------|--|
|  Asking questions and defining probl   |               | 18,8%           | 13,4%           | 13,6%      |  |
|  Developing and using models           | 18,2%         | 10,7%           | 13,0%           | 12,9%      |  |
|  Planning and carrying out investigati | 30,3%         | 19,6%           | 15,7%           | 16,9%      |  |
|  Analyzing and interpreting data       | 9,1%          | 3,6%            | 16,1%           | 14,0%      |  |
|  Using mathematics and computation     |               | 3,6%            | 7,3%            | 6,5%       |  |
|  Constructing explanations and design  | 3,0%          | 27,7%           | 17,0%           | 18,0%      |  |
|  Engaging in argument from evidence    | 18,2%         | 7,1%            | 4,1%            | 5,2%       |  |
|  Obtaining, evaluating and communic   | 21,2%         | 8,9%            | 13,4%           | 13,0%      |  |
|                                                                                                                         |               |                 |                 |            |  |
| $\Sigma$ SUM                                                                                                            | 100,0%        | 100,0%          | 100,0%          | 100,0%     |  |
| # N = Documents                                                                                                         | 3 (33,3%)     | 1 (11,1%)       | 5 (55,6%)       | 9 (100,0%) |  |

# Chemistry

[illegible]

# Chemistry

|                                                                                                                         | AUT - CH 4 | ESP SEC > ES... | Secondary GR... | Total      |
|-------------------------------------------------------------------------------------------------------------------------|------------|-----------------|-----------------|------------|
|  Asking questions and defining probl   | 7,7%       | 18,8%           | 7,0%            | 8,9%       |
|  Developing and using models           | 7,7%       | 10,7%           | 9,0%            | 9,3%       |
|  Planning and carrying out investigati | 15,4%      | 19,6%           | 15,1%           | 15,8%      |
|  Analyzing and interpreting data       | 15,4%      | 3,6%            | 17,9%           | 15,7%      |
|  Using mathematics and computation     | 7,7%       | 3,6%            | 4,2%            | 4,2%       |
|  Constructing explanations and design  | 15,4%      | 27,7%           | 23,8%           | 24,2%      |
|  Engaging in argument from evidence    | 7,7%       | 7,1%            | 3,5%            | 4,2%       |
|  Obtaining, evaluating and communic   | 23,1%      | 8,9%            | 19,4%           | 17,9%      |
|                                                                                                                         |            |                 |                 |            |
| $\Sigma$ SUM                                                                                                            | 100,0%     | 100,0%          | 100,0%          | 100,0%     |
| # N = Documents                                                                                                         | 1 (16,7%)  | 1 (16,7%)       | 4 (66,7%)       | 6 (100,0%) |

# Biology

[illegible]

# Biology

|                                                     | AUT - BIO | ESP SEC > BIO | Secondary GR... | Total      |
|-----------------------------------------------------|-----------|---------------|-----------------|------------|
| Asking questions and defining problems              | 8,3%      | 18,0%         | 4,0%            | 5,9%       |
| Developing and using models                         | 8,3%      | 16,5%         | 11,7%           | 12,3%      |
| Planning and carrying out investigations            | 8,3%      | 12,8%         | 10,5%           | 10,8%      |
| Analyzing and interpreting data                     | 16,7%     | 9,0%          | 16,9%           | 15,8%      |
| Using mathematics and computation                   | 8,3%      | 1,5%          | 2,9%            | 2,8%       |
| Constructing explanations and designing solutions   | 25,0%     | 18,0%         | 29,3%           | 27,7%      |
| Engaging in argument from evidence                  | 16,7%     | 17,3%         | 3,2%            | 5,2%       |
| Obtaining, evaluating and communicating information | 8,3%      | 6,8%          | 21,5%           | 19,4%      |
|                                                     |           |               |                 |            |
| $\Sigma$ SUM                                        | 100,0%    | 100,0%        | 100,0%          | 100,0%     |
| # N = Documents                                     | 1 (14,3%) | 1 (14,3%)     | 5 (71,4%)       | 7 (100,0%) |

# Math (secondary)

[illegible]

# Math (primary)

|                                                     | AUT > AUT - Math - PRI... | ESP > ESP - Math - PRI... | GRC > GRC - Math - PRI... | Total      |
|-----------------------------------------------------|---------------------------|---------------------------|---------------------------|------------|
| Asking questions and defining problems              | 5,0%                      | 2,8%                      | 3,6%                      | 3,7%       |
| Developing and using models                         | 22,8%                     | 16,0%                     | 11,3%                     | 14,9%      |
| Planning and carrying out investigations            | 3,0%                      | 6,6%                      | 19,4%                     | 12,7%      |
| Analyzing and interpreting data                     | 14,9%                     | 14,2%                     | 15,3%                     | 14,9%      |
| Using mathematics and computational thinking        | 32,7%                     | 42,5%                     | 33,9%                     | 35,6%      |
| Constructing explanations and designing solutions   | 6,9%                      | 3,8%                      | 13,3%                     | 9,7%       |
| Engaging in argument from evidence                  | 1,0%                      | 4,7%                      | 0,4%                      | 1,5%       |
| Obtaining, evaluating and communicating information | 13,9%                     | 9,4%                      | 2,8%                      | 6,8%       |
|                                                     |                           |                           |                           |            |
| Σ SUM                                               | 100,0%                    | 100,0%                    | 100,0%                    | 100,0%     |
| # N = Documents                                     | 1 (14,3%)                 | 2 (28,6%)                 | 4 (57,1%)                 | 7 (100,0%) |

# Math (primary)

[illegible]

# Math (secondary)

|                                       | AUT SECOND... | ESP SEC > ES... | Secondary GR... | Total      |
|---------------------------------------|---------------|-----------------|-----------------|------------|
| Asking questions and defining probl   |               | 6,1%            | 5,6%            | 5,7%       |
| Developing and using models           | 6,7%          | 21,5%           | 13,6%           | 16,5%      |
| Planning and carrying out investigati | 13,3%         | 1,2%            | 13,9%           | 9,0%       |
| Analyzing and interpreting data       | 26,7%         | 15,4%           | 13,6%           | 14,6%      |
| Using mathematics and computation     | 33,3%         | 30,1%           | 25,9%           | 27,7%      |
| Constructing explanations and design  | 6,7%          | 5,3%            | 17,9%           | 12,8%      |
| Engaging in argument from evidence    | 6,7%          | 4,9%            | 3,5%            | 4,1%       |
| Obtaining, evaluating and communic    | 6,7%          | 15,4%           | 5,9%            | 9,6%       |
|                                       |               |                 |                 |            |
| $\Sigma$ SUM                          | 100,0%        | 100,0%          | 100,0%          | 100,0%     |
| # N = Documents                       | 1 (12,5%)     | 2 (25,0%)       | 5 (62,5%)       | 8 (100,0%) |