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 III 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



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

Analysing and interpretating data (all)

- Constructing explanations (ESP & GRC)
 Obtaining, evaluating and communicating information (AUT & ESP)

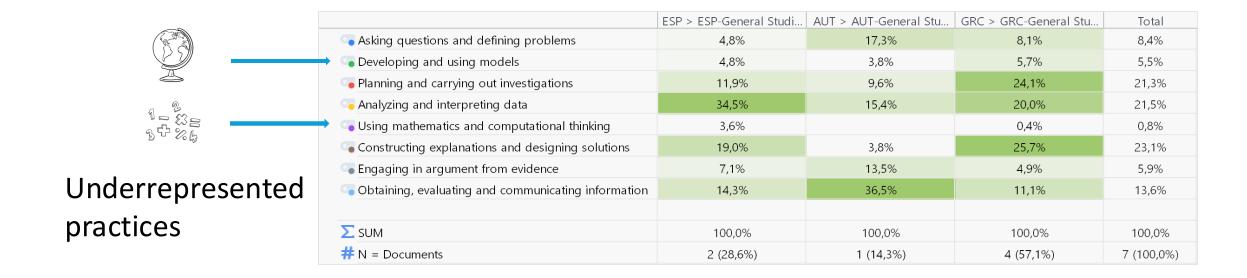
Planning and carrying out investigations (all)
 Asking questions (AUT & GRC)
 Engaging in argument from evidence (AUT &

ESP)

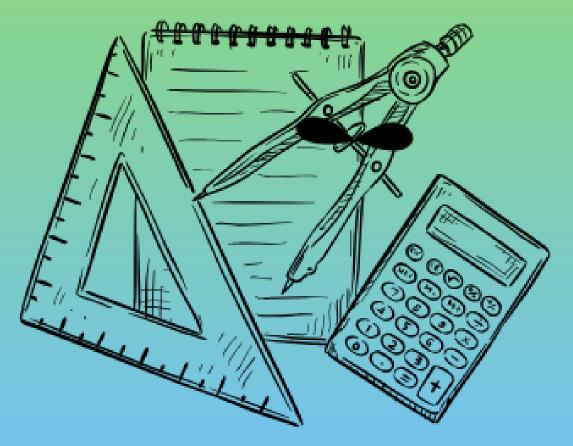


Natural & Social Sciences (primary)

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



Mathematics



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)		-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)

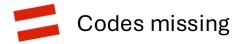




Mathematics (secondary)

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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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

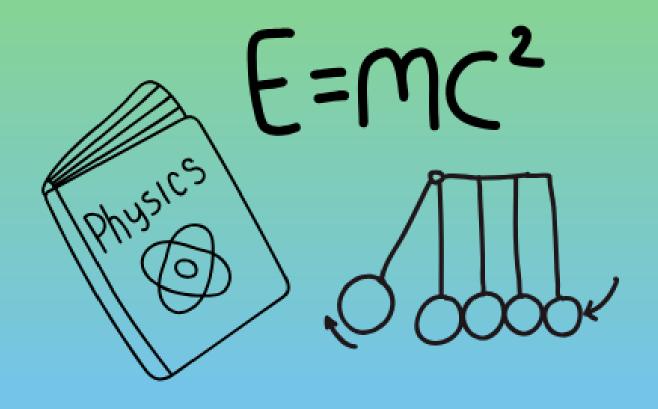
Level 5 (10 -11y)	Level 6 (11-12y)	Level 7 (12-13y)	Level 8 (13-14y)	Level 9 (14-15y)
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Combined Subject Knowledge of the Natural, Social, and Cultural Environment





PHYSICS



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)

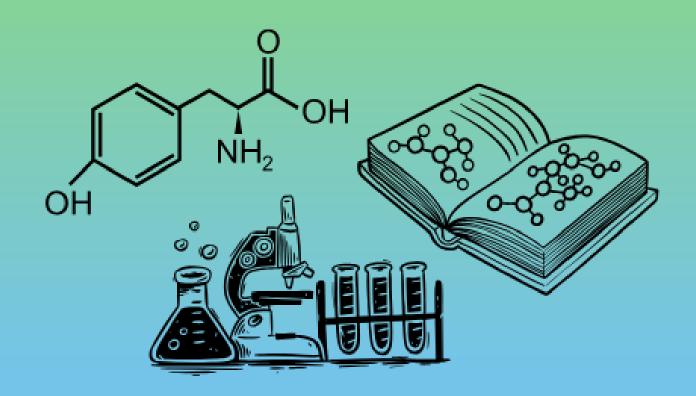
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Combined Subject Knowledge of the Natural, Social, and Cultural Environment

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

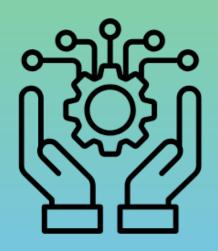
Combined Subject (PH, CH, BIO)

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)

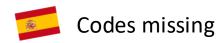




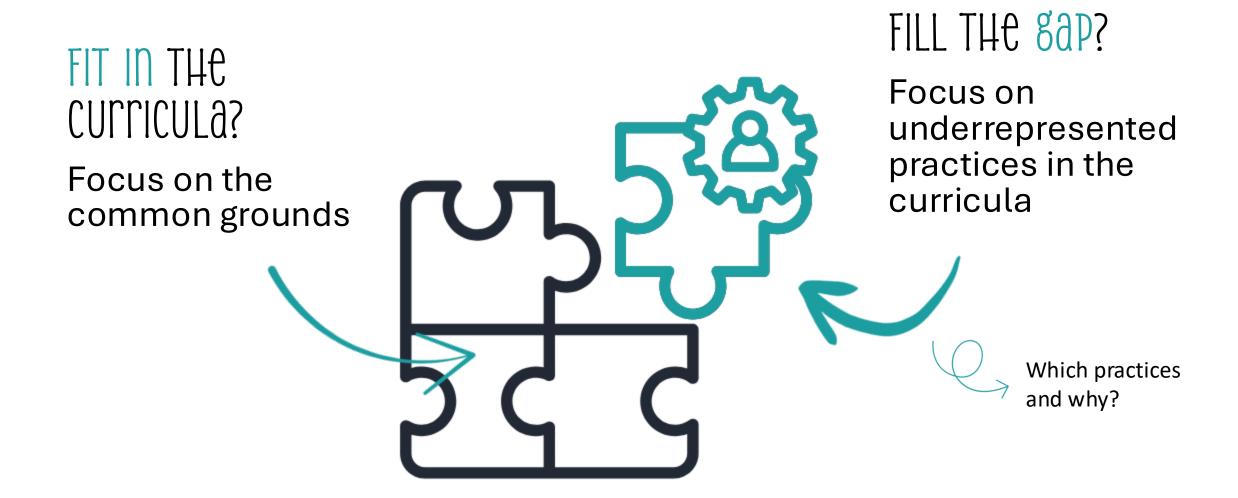
Technology

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

Lev	el 5 (10 -11y)	Level 6 (11-12y)		7 (12-13y)	Leve	l 8 (13-14y)	Level	9 (14-15y)
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TWO CHOICES UP TO DEBATE







THank You!

Thomas Plotz and Hannah Loidl





Appendix

Information in detail

Technology

	AUT Technolo	AUT Technolo	AUT Technolo	AUT Technolo	ESP Technolo	GRC Technolo	GRC Technolo	GRC Technolo	Total
Asking questions and defining problems	22,2%	10,0%	20,0%				2,1%	8,9%	5,9%
Developing and using models	33,3%	20,0%	10,0%	10,0%		17,9%	19,1%	22,2%	19,4%
🔽 Planning and carrying out investigations		30,0%	20,0%	20,0%		10,3%	10,6%	2,2%	10,0%
Analyzing and interpreting data			10,0%			5,1%	6,4%	8,9%	5,9%
Using mathematics and computational thinking						7,7%	21,3%	22,2%	13,5%
Constructing explanations and designing solutions	22,2%	10,0%		20,0%		28,2%	19,1%	24,4%	21,2%
Engaging in argument from evidence		20,0%	20,0%	20,0%		2,6%	2,1%		4,7%
Obtaining, evaluating and communicating information	22,2%	10,0%	20,0%	30,0%		28,2%	19,1%	11,1%	19,4%
∑ SUM	100,0%	100,0%	100,0%	100,0%		100,0%	100,0%	100,0%	100,0%
# N = Documents	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	8 (100,0%)

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%
∑ SUM	100,0%		100,0%	100,0%
# N = Documents	4 (50,0%)	1 (12,5%)	3 (37,5%)	8 (100,0%)

Physics

	AUT - PH 4	AUT - PH 3	AUT - PH 2	ESP - PH,CH (GRC - PH 12	GRC - PH 13	GRC - PH 14	GRC - PH/CH/	GRC - PH/CH/	Total
Asking questions and defining problems				18,8%	14,1%	14,3%	18,3%	14,0%	8,2%	13,6%
operation and using models	8,3%	8,3%	44,4%	10,7%	14,1%	12,5%	12,9%	11,8%	14,3%	12,9%
Planning and carrying out investigations	25,0%	33,3%	33,3%	19,6%	14,1%	14,3%	19,4%	15,4%	16,3%	16,9%
	16,7%	8,3%		3,6%	12,9%	14,3%	17,2%	17,6%	17,7%	14,0%
Gusing mathematics and computational thinking				3,6%	10,6%	10,7%	9,7%	3,7%	3,4%	6,5%
Constructing explanations and designing solutions			11,1%	27,7%	14,1%	14,3%	18,3%	17,6%	20,4%	18,0%
😘 Engaging in argument from evidence	33,3%	16,7%		7,1%	5,9%	7,7%	1,1%	2,9%	2,0%	5,2%
Gobtaining, evaluating and communicating information	16,7%	33,3%	11,1%	8,9%	14,1%	11,9%	3,2%	16,9%	17,7%	13,0%
∑ SUM	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
# N = Documents	1 (11,1%)	1 (11,1%)	1 (11,1%)	1 (11,1%)	1 (11,1%)	1 (11,1%)	1 (11,1%)	1 (11,1%)	1 (11,1%)	9 (100,0%)

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 investigat	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 designation	3,0%	27,7%	17,0%	18,0%
Engaging in argument from evidence	18,2%	7,1%	4,1%	5,2%
Obtaining, evaluating and communication	21,2%	8,9%	13,4%	13,0%
∑ SUM	100,0%	100,0%	100,0%	100,0%
# N = Documents	3 (33,3%)	1 (11,1%)	5 (55,6%)	9 (100,0%)

Chemistry

	AUT - CH 4	ESP - PH,CH (GRC - CH 13	GRC - CH 14	GRC - PH/CH/BIO_10	GRC - PH/CH/BIO_11	Total
Asking questions and defining problems	7,7%	18,8%	6,1%	1,2%	14,0%	8,2%	8,9%
Developing and using models	7,7%	10,7%	3,4%	7,2%	11,8%	14,3%	9,3%
Planning and carrying out investigations	15,4%	19,6%	13,6%	15,0%	15,4%	16,3%	15,8%
Analyzing and interpreting data	15,4%	3,6%	16,3%	19,8%	17,6%	17,7%	15,7%
Using mathematics and computational thinking	7,7%	3,6%	5,4%	4,2%	3,7%	3,4%	4,2%
Constructing explanations and designing solutions	15,4%	27,7%	26,5%	29,3%	17,6%	20,4%	24,2%
Engaging in argument from evidence	7,7%	7,1%	5,4%	3,6%	2,9%	2,0%	4,2%
Obtaining, evaluating and communicating information	23,1%	8,9%	23,1%	19,8%	16,9%	17,7%	17,9%
∑ SUM	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
# N = Documents	1 (16,7%)	1 (16,7%)	1 (16,7%)	1 (16,7%)	1 (16,7%)	1 (16,7%)	6 (100,0%)

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 desig	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%
∑ SUM	100,0%	100,0%	100,0%	100,0%
# N = Documents	1 (16,7%)	1 (16,7%)	4 (66,7%)	6 (100,0%)

Biology

	AUT - BIO	ESP - Bio (12	ESP Natura	GRC - BIO 12	GRC - BIO 13	GRC - BIO 14	GRC - PH/CH/	GRC - PH/CH/	Total
Asking questions and defining prob	8,3%	18,0%		0,8%		0,7%	14,0%	8,2%	5,6%
■ Developing and using models	8,3%	16,5%		8,4%	10,8%	15,6%	11,8%	14,3%	11,7%
🔽 Planning and carrying out investigat	8,3%	12,8%	12,0%	8,8%	8,6%	5,4%	15,4%	16,3%	10,9%
Analyzing and interpreting data	16,7%	9,0%	66,0%	20,6%	13,4%	13,6%	17,6%	17,7%	18,2%
写 Using mathematics and computation	8,3%	1,5%		0,4%	2,7%	6,1%	3,7%	3,4%	2,7%
ີ Constructing explanations and desiເ	25,0%	18,0%	10,0%	32,8%	38,7%	31,3%	17,6%	20,4%	26,9%
😘 Engaging in argument from evidenc	16,7%	17,3%		1,3%	3,2%	7,5%	2,9%	2,0%	5,0%
写 Obtaining, evaluating and communic	8,3%	6,8%	12,0%	26,9%	22,6%	19,7%	16,9%	17,7%	19,1%
∑ SUM	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
# N = Documents	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	8 (100,0%)

Biology

	AUT - BIO	ESP SEC > BIO	Secondary GR	Total
Asking questions and defining probl	8,3%	18,0%	4,0%	5,9%
Developing and using models	8,3%	16,5%	11,7%	12,3%
Planning and carrying out investigati	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 desig	25,0%	18,0%	29,3%	27,7%
 Engaging in argument from evidence 	16,7%	17,3%	3,2%	5,2%
Obtaining, evaluating and communic	8,3%	6,8%	21,5%	19,4%
∑ 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)

	AUT - Math	ESP - Math 5-6	ESP - Math 7-9	GRC Math 10	GRC Math 11	GRC Math 12	GRC Math 13	GRC Math 14	Total
Asking questions and defining prob		6,6%	5,8%	Site Matil_10	Site Hiddi_11	10,7%	11,8%	5,3%	5,7%
Developing and using models	6,7%	11,0%	27,7%	8,1%	11,0%	16,0%	17,1%	15,8%	16,5%
Planning and carrying out investigat	13,3%	1,1%	1,3%	23,0%	23,3%	2,7%	9,2%	11,8%	9,0%
	26,7%	12,1%	17,4%	8,1%	17,8%	10,7%	15,8%	15,8%	14,6%
😘 Using mathematics and computation	33,3%	47,3%	20,0%	45,9%	30,1%	16,0%	19,7%	18,4%	27,7%
Gonstructing explanations and designations	6,7%	2,2%	7,1%	14,9%	17,8%	18,7%	19,7%	18,4%	12,8%
😘 Engaging in argument from evidenc	6,7%	2,2%	6,5%			10,7%	2,6%	3,9%	4,1%
😘 Obtaining, evaluating and communic	6,7%	17,6%	14,2%			14,7%	3,9%	10,5%	9,6%
∑ SUM	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
# N = Documents	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	1 (12,5%)	8 (100,0%)

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%
∑ 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)

	AUT Mathe_P	AUT Mathe_P	AUT Mathe_P	AUT Mathe_P	Matematique	Matematique	Mathematics_6	Mathematics_7	Mathematics_8	Mathematics_9	Total
Asking questions and defining prob)		4,0%	10,3%	2,1%	3,4%	8,8%	1,7%		1,9%	3,7%
Developing and using models	29,4%	30,0%	20,0%	17,9%	18,8%	13,8%	8,8%	11,9%	16,4%	9,3%	14,9%
🔽 Planning and carrying out investiga	t		4,0%	5,1%	8,3%	5,2%	17,5%	18,6%	20,0%	22,2%	12,7%
Analyzing and interpreting data	23,5%	25,0%	12,0%	7,7%	12,5%	15,5%	13,8%	22,0%	10,9%	14,8%	14,9%
Using mathematics and computatio	23,5%	30,0%	40,0%	33,3%	37,5%	46,6%	27,5%	27,1%	45,5%	38,9%	35,6%
Constructing explanations and design	5,9%		8,0%	10,3%	8,3%		17,5%	15,3%	7,3%	11,1%	9,7%
😘 Engaging in argument from eviden	c			2,6%	6,3%	3,4%		1,7%			1,5%
Obtaining, evaluating and communi	17,6%	15,0%	12,0%	12,8%	6,3%	12,1%	6,3%	1,7%		1,9%	6,8%
∑ SUM	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
# N = Documents	1 (10,0%)	1 (10,0%)	1 (10,0%)	1 (10,0%)	1 (10,0%)	1 (10,0%)	1 (10,0%)	1 (10,0%)	1 (10,0%)	1 (10,0%)	10 (100,0%)

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 investigat	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 designation	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%
∑ SUM	100,0%	100,0%	100,0%	100,0%
# N = Documents	1 (12,5%)	2 (25,0%)	5 (62,5%)	8 (100,0%)