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IEA

TIMSS ADVANCED IN FRANCE

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TIMSS Advanced specifics

1995, 2008, 2015
Trends as old as TIMSS
End of Upper Secondary School
Advanced Maths and Physics students
Transitioning towards STEM Higher Education

Coverage Index
Cohorts' age
Usual TIMSS background variables + expectations for further education

Altogether, 22 countries participated at least once in TIMSS Advanced

Armenia
Australia
Austria
Canada
Cyprus
Czech Republic
Denmark
France
Germany
Greece
Islamic Republic of Iran
Italy
Lebanon
Lithuania
Netherlands
Norway
Philippines
Russian Federation
Slovenia
Sweden
Switzerland
United States

One cycle
Two cycles
Three cycles

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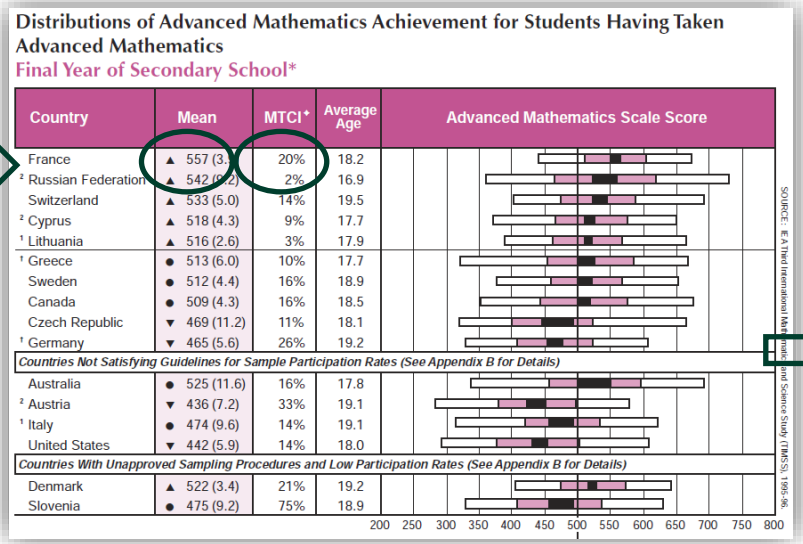
TIMSS Advanced in France:
Challenging stereotypes on Advanced Maths Education
Structural and curricular reform in 2021

1995

2015



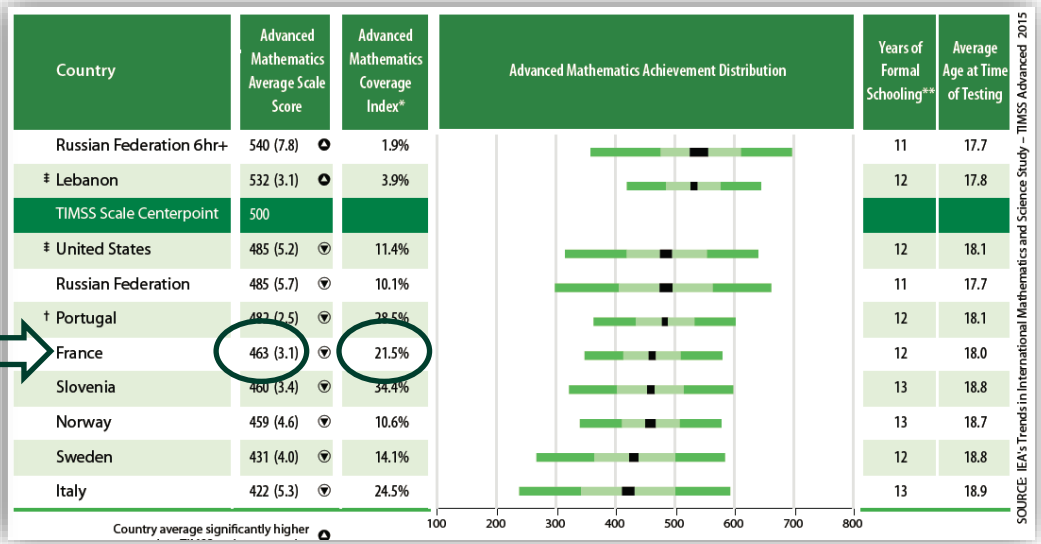
Distributions of Advanced Mathematics Achievement for Students Having Taken Advanced Mathematics

Final Year of Secondary School*

Country	Mean	MTCI*	Average Age	Advanced Mathematics Scale Score
France	▲ 557 (3.)	20%	18.2	
² Russian Federation	▲ 542 (6.2)	2%	16.9	
Switzerland	▲ 533 (5.0)	14%	19.5	
² Cyprus	▲ 518 (4.3)	9%	17.7	
¹ Lithuania	▲ 516 (2.6)	3%	17.9	
¹ Greece	● 513 (6.0)	10%	17.7	
Sweden	● 512 (4.4)	16%	18.9	
Canada	● 509 (4.3)	16%	18.5	
Czech Republic	▼ 469 (11.2)	11%	18.1	
¹ Germany	▼ 465 (5.6)	26%	19.2	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details)				
Australia	● 525 (11.6)	16%	17.8	
² Austria	▼ 436 (7.2)	33%	19.1	
¹ Italy	● 474 (9.6)	14%	19.1	
United States	▼ 442 (5.9)	14%	18.0	
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details)				
Denmark	▲ 522 (3.4)	21%	19.2	
Slovenia	● 475 (9.2)	75%	18.9	

200 250 300 350 400 450 500 550 600 650 700 750 800

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1995-96.



Country	Advanced Mathematics Average Scale Score	Advanced Mathematics Coverage Index*	Advanced Mathematics Achievement Distribution	Years of Formal Schooling**	Average Age at Time of Testing
Russian Federation 6hr+	540 (7.8) ▲	1.9%		11	17.7
‡ Lebanon	532 (3.1) ▲	3.9%		12	17.8
TIMSS Scale Centerpoint	500				
‡ United States	485 (5.2) ▼	11.4%		12	18.1
Russian Federation	485 (5.7) ▼	10.1%		11	17.7
† Portugal	482 (2.5) ▼	28.5%		12	18.1
France	463 (3.1) ▼	21.5%		12	18.0
Slovenia	460 (3.4) ▼	34.4%		13	18.8
Norway	459 (4.6) ▼	10.6%		13	18.7
Sweden	431 (4.0) ▼	14.1%		12	18.8
Italy	422 (5.3) ▼	24.5%		13	18.9

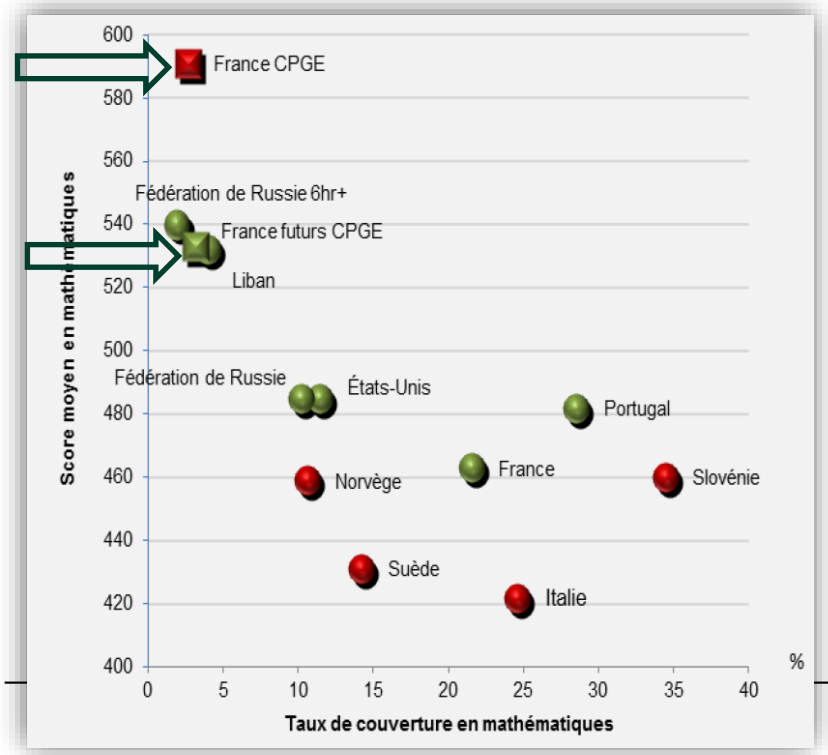
100 200 300 400 500 600 700 800

Country average significantly higher ▲

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS Advanced 2015

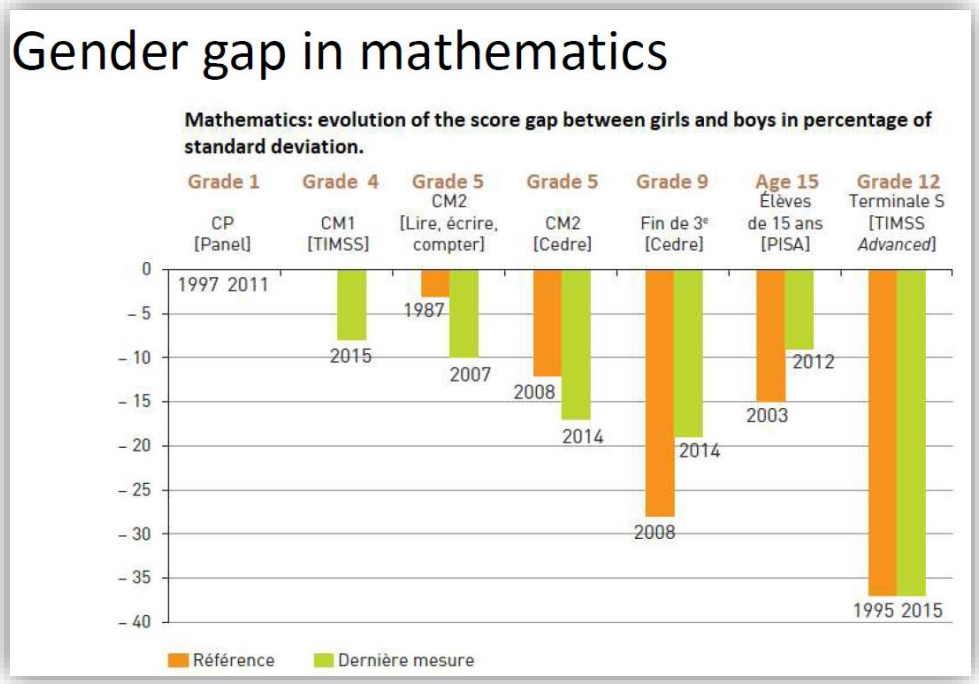
2015 Additional National Higher Ed Sample

(Preparatory Classes for Scientific Grandes Écoles, CPGE)



- In 2015, CPGE students outperformed TIMSS Advanced students aspiring to enter CPGE by 60 score points.
- Not related to Test/Curriculum match as 92% of TIMSS Advanced items are covered by the curriculum both at Grade 12 and CPGE.
- These 60 points are a good proxy of the learning gain of one CPGE year which was never measured before

Gender Gap in Mathematics in France



Widening of gender gap in Maths from Grade 1 to Grade12

Under representation of women in STEM Education

Conclusion

- Insight on populations never assessed before
- 2015 TIMSS Advanced findings informed deciders reforming Grade 11 and Grade 12 Education in 2021
- Opportunity to measure the impact of the 2021 reform on achievement in the next years
- Assess additional skills : Computanional Thinking, Creative Thinking, Problem Solving

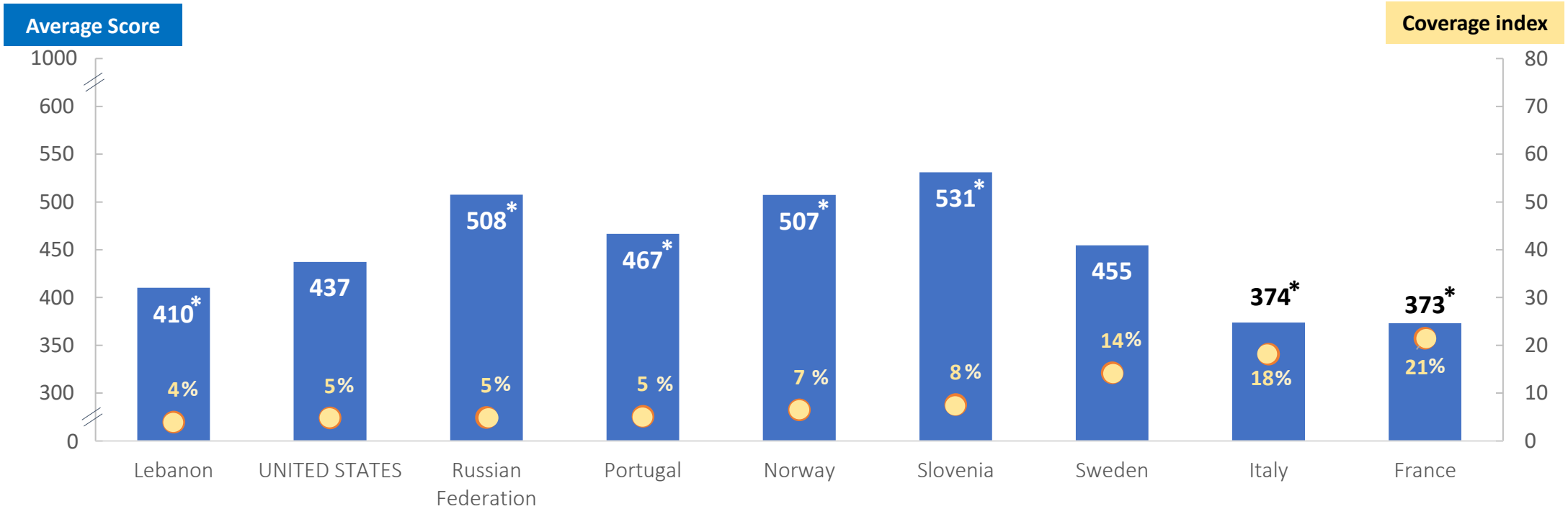
TIMSS Advanced 2015
U.S. Diagnostic Reports on Physics

Dr. Stephen Provasnik

Deputy Commissioner, National Center for Education Statistics (NCES)

Former TIMSS U.S. National Research Coordinator

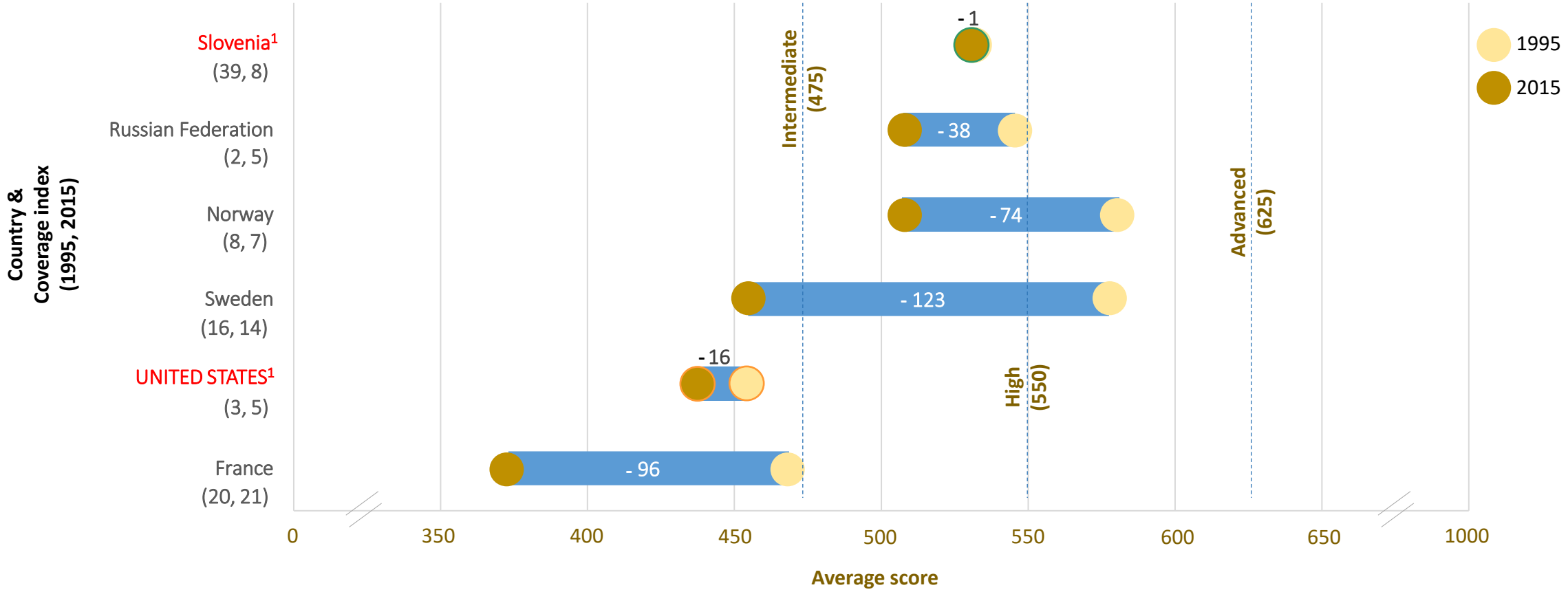
Average physics scores and coverage index of TIMSS Advanced students, by education system: 2015



*Score is different from U.S. score

NOTE: The physics coverage index is the percentage of the corresponding age cohort covered by the students taking the TIMSS Advanced physics assessment. The corresponding age cohort is determined for education systems individually. In the United States, the corresponding age cohort is 18-year-olds.

TIMSS Advanced Physics score changes: 1995-2015



[1] Change in average score was not measurably different

Coursetaking patterns of U.S. TIMSS Advanced physics students

(highest-level course taken based on sampling data from schools)

Course Type	Percentage of U.S. Students
All courses	**100%**
Total AP physics courses	**83%**
AP Physics C (M or EM)	25%
AP Physics B Prior to 2014-15	12%
AP Physics 1	42%
AP Physics 2 Starting in 2014-15	4%
Total Non-AP physics courses	**17%**
IB Physics	6%
Other physics courses	12%

- The majority of U.S. TIMSS Advanced students had taken an AP physics course (83%).
- Of those who had taken AP courses, more than half had taken the lowest-level AP course (Physics 1, 42%).
- In comparison, 25% had taken the highest-level Physics C course (M-*mechanics* or EM-*electricity & magnetism*).
- Smaller percentages (4% to 12%) had taken AP Physics B, AP Physics 2, IB Physics, or other non-AP, non-IB second-year physics courses as their highest-level course.

Average physics scores of U.S. TIMSS Advanced students, by highest course taken

	Physics Overall		Mechanics & Thermodynamics		Electricity & Magnetism		Wave Phenomena & Atomic/Nuclear Physics	
TIMSS scale centerpoint	**500**	↑	**500**	↑	**500**	↑	**500**	↑
Total U.S. average	**437**	-	**462**	-	**380**	-	**431**	-
AP physics courses								
AP Physics C-E/M	537	↑	556	↑	517	↑	516	↑
AP Physics C-M	482	↑	509	↑	435	↑	466	↑
AP Physics 2	486	↑	504	↑	451	↑	478	↑
AP Physics 1	407	↓	437	↓	339	↓	404	↓
AP Physics B	442	↔	460	↔	382	↔	432	↔
Non-AP physics courses								
IB Physics	360	↔	381	↔	286	↔	372	↔
Other physics courses	423	↔	443	↔	359	↔	421	↔

137

85

↑ = Higher than total U.S. average

↓ = Lower than total U.S. average

↔ = Not measurably different from total U.S. average

Differences in coursetaking patterns across student groups

Sex

- There were no measurable differences in the percentages of *males* and *females* taking AP versus non-AP physics courses
- Nearly twice as many *males* as *females* had taken AP Physics C (30% vs 16%)

Race/ethnicity

- More *Hispanic* students had taken an AP Physics course than the U.S. overall (91% vs 83%) due to their higher enrollment in AP Physics 1 (58% vs 42%)
- Fewer *Black* students had taken AP Physics C (14%) than *White* students (28%)

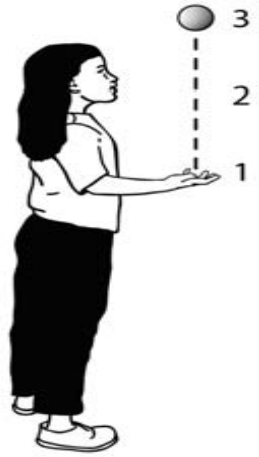
Areas of relative strength and weakness among U.S. TIMSS Advanced physics students

Relative Performance	Level of Topic Coverage		
	High	**Moderate**	**Low**
High	✓ Forces & motion	✓ Wave phenomena	✓ Laws of conservation ✓ Atomic & nuclear physics
Moderate	✓ Forces & motion ✓ Laws of conservation	✓✓ Forces & motion ✓ Laws of conservation	✓✓✓ Electricity ✓✓ Magnetism ✓✓ Wave phenomena ✓✓ Atomic & nuclear physics
Low			✓✓ Heat & temperature ✓ Magnetism ✓ Wave phenomena ✓ Atomic & nuclear physics

✓ = 1 topic in *mechanics & thermodynamics*
✓ = 1 topic in *electricity & magnetism*
✓ = 1 topic in *wave phenomena & atomic/nuclear physics*

Physics Example 1
Mechanics & Thermodynamics

Sally throws a ball vertically upward as shown. The ball moves from her hand at point 1 to a maximum height at point 3. Point 2 is halfway between points 1 and 3. The ball has an acceleration of -10m/s² at point 2.



A. What is the acceleration at point 3 at the instant between its upward motion and downward motion? Disregard air resistance.

Ⓐ zero m/s²

Ⓑ $\frac{-10}{2}$ m/s²

Ⓒ 2(−10) m/s²

● −10 m/s²

B. How does the time duration between points 2 and 3 on the way up compare to the time duration between points 3 and 2 on the way down? Disregard air resistance.

the time duration would be the same from 2-3 as 3-2 because the initial velocity of the ball from 2-3 is the same as the final velocity from 3-2 and the acceleration is the same.

Course type	Percent correct	
	Part A	Part B
International average	34% ▼	48% ▼
U.S. total	51%	64%
AP physics courses	**55%** ▲	**67%**
AP Physics C-E/M	75% ▲	73%
AP Physics C-M	77% ▲	73% ▲
AP Physics B	45%	75% ▲
AP Physics 2	53%	61%
AP Physics 1	46%	61%
Non-AP physics courses	**28%** ▼	**49%**

SOURCE: TIMSS 2015 Assessment. Copyright © 2017 IEA-International Association for the Evaluation of Educational Achievement. TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.

▲ Significantly higher than U.S. total
▼ Significantly lower than U.S. total

TIMSS Advanced 2015
International Scoring Guide - Physics

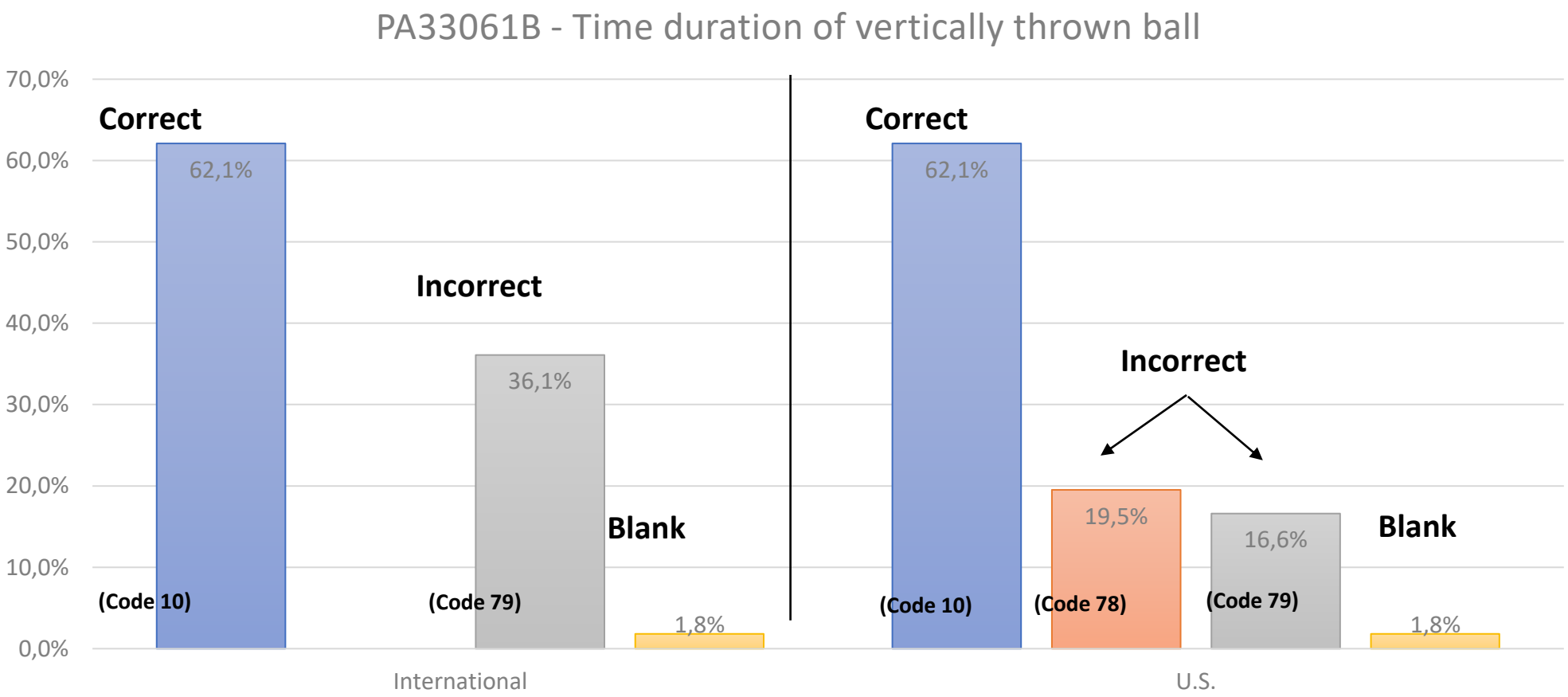
Code	Response	Item: PA33061B - P2_01B - Time duration of vertically thrown ball
	Correct Response	
10	Indicates that the times are equal. Examples: • It's the same. • $t_{up} = t_{down}$ • time up equals time down	
	Incorrect Response	
79	Incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	Nonresponse	
99	Blank	

TIMSS Advanced 2015
U.S. Scoring Guide - Physics

Code	Response	Item: PA33061B - P2_01B - Time duration of vertically thrown ball
	Correct Response	
10	Indicates that the times are equal. Examples: • It's the same. • $t_{up} = t_{down}$ • time up equals time down	
	Incorrect Response	
78	States that the time on the way down is shorter or time on the way up is longer. Responses may also explain that this is because the ball is accelerating (speeding up) on the way down or decelerating (slowing down) on the way up, but this is not required. Examples: • It takes a longer time on the way up. • The time on the way down is less since it is accelerating. It is slowing down on the way up.	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	Nonresponse	
99	Blank	

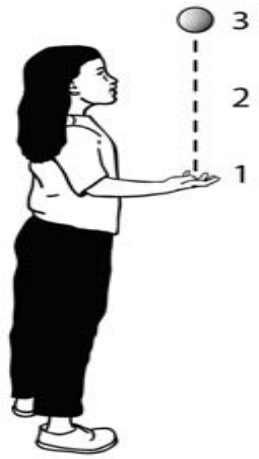
One diagnostic code that tracks a common misconception

Differences in code-level percentage distributions between International and U.S. Diagnostic scores



Physics Example 1
Mechanics & Thermodynamics

Sally throws a ball vertically upward as shown. The ball moves from her hand at point 1 to a maximum height at point 3. Point 2 is halfway between points 1 and 3. The ball has an acceleration of -10m/s² at point 2.



A. What is the acceleration at point 3 at the instant between its upward motion and downward motion? Disregard air resistance.

Ⓐ zero m/s² ⇦ 41%

Ⓑ $\frac{-10}{2}$ m/s²

Ⓒ 2(−10) m/s²

● −10 m/s² ⇦ 51%

B. How does the time duration between points 2 and 3 on the way up compare to the time duration between points 3 and 2 on the way down? Disregard air resistance.

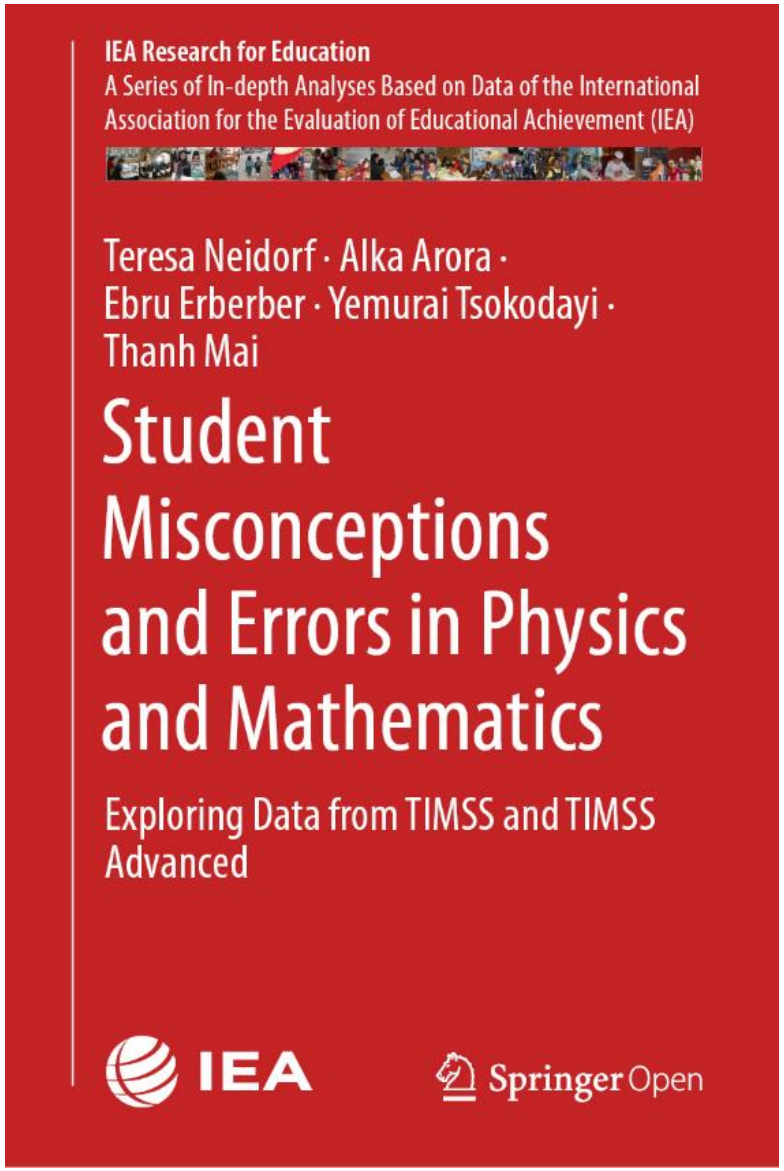
the time duration would from 2-3 as 3-2 because velocity of the ball from 2- as the final velocity from acceleration is the same.

Misconception: 19%

The time on the way down is shorter since the ball is accelerating on the way down and decelerating on the way up.

Course type	Percent correct	
	Part A	Part B
International average	34% ▼	48% ▼
U.S. total	51%	64%
AP physics courses	**55%** ▲	**67%**
AP Physics C-E/M	75% ▲	73%
AP Physics C-M	77% ▲	73% ▲
AP Physics B	45%	75% ▲
AP Physics 2	53%	61%
AP Physics 1	46%	61%
Non-AP physics courses	**28%** ▼	**49%**

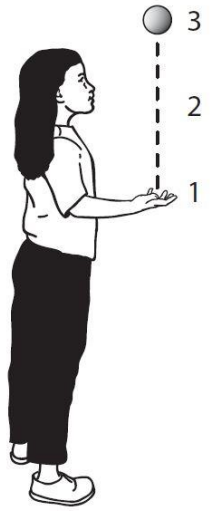
SOURCE: TIMSS 2015 Assessment. Copyright © 2017 IEA-International Association for the ...al Study Center, Lynch



https://link.springer.com/book/10.1007/978-3-030-30188-0

TIMSS Advanced – Gravity Item 1A

Sally throws a ball vertically upward as shown. The ball moves from her hand at point 1 to a maximum height at point 3. Point 2 is halfway between points 1 and 3. The ball has an acceleration of –10 m/s^2 at point 2.



A. What is the acceleration at point 3 at the instant between its upward motion and downward motion? Disregard air resistance.

A. zero m/s^2 — Misconception P1B: Acceleration is zero when the velocity is zero. ✗

B. $\frac{-10}{2}$ m/s^2 — Misconception P1A: The force of gravity changed with the height of the ball. ✗

C. 2(-10) m/s^2 ✗

✓ D. -10 m/s^2 — Acceleration due to gravity is constant

Student Responses (2015)
(International Average)

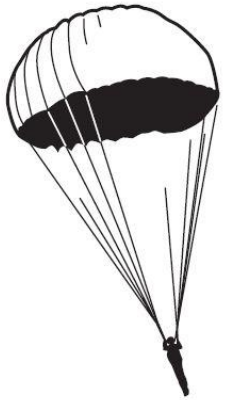
	A	48%
	B	4%
	C	4%
✓	D	42%
	Omitted	2%

TIMSS grade 8 – Gravity Item D

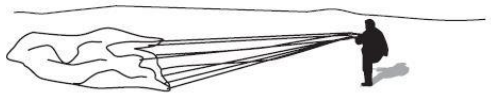
The figure shows a parachute jumper in four positions.

1. In the aircraft before the jump

2. In freefall immediately after jumping before parachute opens



3. Falling to the ground after the parachute opens



4. On the ground just after landing

In which of the positions does the force of gravity act on the jumper?

Student Responses (2011) (International Average)	
A	12%
B	45%
C	6%
✓ D	36%
Omitted	1%

A. Position 2 only.

B. Positions 2 and 3 only.

Misconception P3A: Gravity acts only when the jumper is falling (with parachute open or closed) ✗

C. Positions 1, 2 and 3 only.

Misconception P3A: Gravity does not act on objects at rest on the ground. ✗

D. Positions 1, 2, 3, and 4. **Gravity acts on the jumper at all four positions** ✓

TIMSS grade 8 – Gravity Item G

Bernie and Travis are sitting on a wall.

Are any forces acting on them?

(Check one box.)

☐ Yes

☐ No

Explain your answer.

Student Responses (2015)
(International Average)

✓ Correct	63%
Incorrect	34%
Omitted	3%

Yes. There is a downward force from gravity and an upward force from the wall. ✓

Misconception P3A: There are no forces acting on objects at rest. ✗

Opportunities if TIMSS Advanced repeated

University Students

- Compare advanced secondary students with university students in different courses of study?

Consider other domains

- Advanced mathematics and physics were the most straight-forward domains in 1995 (and repeating them allows for trend), but perhaps computer programming or English could be assessed now?

Thank you