Funded by ESRC

Leading education and social research
Institute of Education
University of London

Post-16 participation in physics and the factors that influence it

Fani Stylianidou, Tamjid Mujtaba, Michael Reiss & Bijan Riazi-Farzad

www.ioe.ac.uk

Aims and Objectives

Leading education and social research
Institute of Education
University of London

To identify range of factors (individual, school and out-of-school, including home) that influence post-16 participation in mathematics & physics

To assess the relative importance of such factors among different student populations

Structure of Project

Leading education and social research
Institute of Education
University of London

Strand 1: Mapping trajectories of engagement and disenchantment

A longitudinal design: survey on 23,337 students (12-13 & 14-15 yr olds) in 141 UK schools & followed up 18 months later

Strand 2: Investigating subjectivities and school culture

Interview and ethnography-based study, 9 students in each of 12 schools, 3 times in 3 years

Strand 3: Documenting the reasons for HE choices

Narrative interviews with 50 first-year University students

Strand 1 Instruments

Leading education and social research
Institute of Education
University of London

1. Student Questionnaire
   for 12-13 and 14-15 year olds
   for mathematics and physics
2. School Questionnaire

Strand 1 Sample

Leading education and social research
Institute of Education
University of London

Total sample of 23,337 students in two year-groups (aged 12-13 & 14-15) in 141 schools across the UK

For this presentation, one core dataset:

- physics survey responses of 5,642 year 10 students (aged 14-15) in 130 schools
- focus on gender and intention to participate in post-16 physics

	Total students	Boys	Girls	Schools
Physics Y10	5,642	2,663	2,917	130

Student Physics Questionnaire Constructs	Reliability	No items
Self concept of ability in physics	.844	5
Advice/pressure to study physics	.879	5
Attitudes to physics / physics lessons	.800	5
Perceptions of physics lessons	.783	4
Intrinsic perceived value of physics	.796	7
Extrinsic perceived value of physics	.847	9
Perceptions of physics teacher	.893	14
Social support for physics learning	.637	6
Sense of school belonging	.825	6
Home support for achievement in physics	.620	8
Home support for achievement in general	.868	3
Global motivations & aspirations	.730	4
Emotional stability	.710	6
Competitiveness / Cooperativeness	.677	8
Introversion / Extroversion	.785	7
Relationship with parents	.743	4
Engagement with ICT	.595	6

Intention to Participate in Post-16 Physics

Leading education and social research
Institute of Education
University of London

- More students reported that they *were not* intending to study physics post-16
- Intention to participate is just over 1.5 times as likely amongst boys than girls, with almost 3 times as many boys strongly agreeing

Question			Strongly agree	Agree	Slightly agree	Slightly disagree	Disagree	Strongly disagree
I intend to continue to study physics after my GCSEs.	Overall	%						
		n	527	793	1015	703	1250	1128
	Girls	%						
		n	144	293	511	378	792	685
	Boys	%	**14.5**	19.1	19.3	12.5	17.5	17
		n	370	489	494	321	449	436

43 %

57 %

33.8 %

66.2 %

53 %

47 %

Gender differences in physics participation: Self-concept of ability

Leading education and social research
Institute of Education
University of London

- Self-concept of ability – predictor of engagement
- Individuals interpret their achievements and abilities in ways congruent with prior self-conceptions (Jussim, Coleman & Nassau, 1987)
- Students with high academic self-concept may overestimate their academic performance (Wells and Sweeney, 1996)
- High academic self-concept positively related to motivation/diligence (Ommundsen, Haugen and Lund, 2005)

Gender differences in physics participation: Self-concept of ability

Leading education and social research
Institute of Education
University of London

I am good at physics.
I do well in physics tests.
When I am doing physics, I always know what I am doing.
Thinking about your physics lessons, how do you feel you compare with the others in your group?
I need help with physics.

- On the whole, IP students have greater self-concept of ability in physics than NON-IP.
- Also IPBoys (and non-IPBoys) have greater self-concept of ability in physics than IPGirls (and non-IPGirls respectively).
- More IPBoys than IPGirls strongly agree that they are good at physics (16.2% vs 6.4%) and that they do well in physics tests (17.3% vs 6.7%), though no sign. diff. in their mean score in the diagnostic conceptual questions on Forces and Electricity.

Gender diffs in physics participation: Advice / pressure to study physics

Leading education and social research
Institute of Education
University of London

My friends are going to study physics after their GCSEs.
My friends think that I should continue with physics after my GCSEs.
I have been advised by someone else that physics is a good subject to study after my GCSEs.
Someone in my family: thinks that I should continue with physics after my GCSEs.
My teacher thinks that I should continue with physics beyond my GCSEs.

- IP students state they have received more advice / pressure to study physics than NON-IP.
- More IPBoys than IPGirls have someone in their family who thought that they should continue with physics post-16 and have friends who will do so.
- More particularly, 31.6% of IPBoys vs 23.5% of IPGirls strongly agree that someone in their family thinks they should continue with physics.

Gender diffs in physics participation: Attitudes to physics / physics lessons

Leading education and social research
Institute of Education
University of London

I can see the relevance of physics lessons.
I find it difficult to apply most physics concepts to everyday problems.
When I am doing physics, I am bored.
I look forward to physics classes.
I enjoy my physics lessons.
When I am doing physics, I pay attention.
When I am doing physics, I get upset.
When I am doing physics, I daydream.
I look forward to spending time in the laboratory doing practical investigations.

- Less positive attitudes to physics lessons by IPGirls than IPBoys in all.
- Similar agreement by IPGirls and non-IPGirls that they find it difficult to apply physics concepts to everyday problems.
- More IPBoys than IPGirls strongly agree that they can see the relevance of physics lessons (20.2% vs 11.7%) and look forward to spending time in the laboratory doing practical investigations (32.5% vs 22.7%).

Gender diffs in physics participation: Intrinsic perceived value of physics

Leading education and social research
Institute of Education
University of London

Physics teaches you to think logically.
To be good at physics, you need to be creative.
To be good at physics, you need to work hard.
Physics is interesting.
Those who are good at physics are clever.
In physics, it is interesting to find out about the laws that explain different phenomena.

Deci and Ryan (1985)

Physics is perceived to have an intrinsic value:

- More by IP than by non-IP groups.
  BUT "To be good in physics you need to work hard" produces no sign. diffs between the groups.
- More by IPBoys than by IPGirls.
  BUT similar agreement in "to be good in physics you need to work hard" and in "physics teaches you to think logically".
- Worryingly, sign. fewer IPGirls than IPBoys (15% vs 23.6%) strongly agree that physics is interesting.

Gender diffs in physics participation: Extrinsic perceived value of physics

Leading education and social research
Institute of Education
University of London

People who are good at physics get well-paid jobs..
Being good at physics impresses people.
These days, everybody needs to know some physics.
Physics improves your social skills.
Being good at physics makes you popular.
Physics helps you in solving everyday problems.
I think physics is a useful subject.
I think physics will help me in the job I want to do in the future.

- Only with the latter 4 statements do IPGirls agree less overall than IPBoys.
- Almost no sign. gender diffs between non-IP groups.
- Overall agreement amongst all groups that “these days everybody needs to know some physics”.
- More IPBoys than IPGirls strongly agree that physics is a useful subject (29.3% vs 17.5%) and that it will help them in their future job (23.8% vs 16.3%).

Gender diffs in physics participation: Perceptions of physics teacher

Leading education and social research
Institute of Education
University of London

I like my physics teacher.
My physics teacher has high expectations of what the students can learn.
My physics teacher believes that all students can learn physics.
My physics teacher wants us to really understand physics.
My physics teacher sets us homework.
My physics teacher believes that mistakes are OK as long as we are learning
My physics teacher is interested in me as a person.
My physics teacher seems to like all the students.
My physics teacher is interested in what the students think.
My physics teacher only cares about students who get good marks in physics.
My physics teacher lets us get away with not doing our homework.
My physics teacher treats all students the same regardless of their physics ability.
My physics teacher is good at explaining physics.
My physics teacher marks and returns homework quickly.

Gender diffs in physics participation: Perceptions of physics teacher

Leading education and social research
Institute of Education
University of London

- Overall more positive perceptions of their physics teacher by IP groups than by non-IP groups.
- Whereas, very few sign. diffs between mean agreement of IPGirls and IPBoys.

Gender diffs in physics participation: Sense of school belonging

Leading education and social research
Institute of Education
University of London

This school will help me be successful.
Adults in this school seem to listen to students' concerns.
I can be myself at this school.
I feel like I belong at this school.
I am comfortable talking to teachers about problems in this school.
Students of all backgrounds are respected at my school.

Pittman and Richmond (2007)

- Only the last two statements produce sign. diffs in agreement between IPGirls and IPBoys: the former negative and the latter positive difference.
- Also, more IPBoys than IPGirls (35.9% vs 29.4%) strongly agree that their school will help them be successful.
- Finally, from the non-IP groups more Girls than Boys have a sense of school belonging.

Gender diffs in physics participation: Home support for achievement in general

Leading education and social research
Institute of Education
University of London

Someone in my family: wants me to work hard and try to the best of my ability.
Someone in my family: wants me to be successful in the subjects that I am interested in.
Someone in my family: wants me to do well in order to (find) a good job

- No significant differences in the mean agreement with these statements, both by gender and by participation in post-16 physics.

Gender diffs in physics participation: Emotional stability

Leading education and social research
Institute of Education
University of London

I am often depressed.
I get upset very easily.
I am a calm person.
I am usually relaxed.
I worry about a lot of things.
I am a nervous person.

- For almost all the statements there are sign. diffs between boys and girls.
- E.g. 20.7% of IPGirls vs 12.6% of IPBoys strongly agree that they worry about a lot of things; whereas 24.7% IPBoys vs 14.5% IPGirls strongly agree that they are usually relaxed.
- No sign. diffs in the mean agreement between IP and non-IP groups.

Gender diffs in physics participation: Cooperativeness / Competitiveness

Leading education and social research
Institute of Education
University of London

I like to see the whole class do well on a test.
I try not to speak unkindly of others.
I don't trust very many people.
I want to be successful, even if it's at the expense of others.
A group slows me down.
I like to help others.
It is important to treat others with kindness.
I do not give anyone a second chance.

Martin and Larsen (1976); Roseth, Johnson and Johnson (2008)

- For almost all the statements there are sign. diffs between boys and girls, with girls being more cooperative and less competitive than boys.
- Also IP groups seem more cooperative than non-IP groups, but as competitive.

Gender diffs in physics participation: Introversion / Extroversion

Leading education and social research
Institute of Education
University of London

I feel comfortable around people.
I don't like to draw attention to myself.
I start conversations easily.
I am quiet around strangers.
I talk to a lot of different people at parties.
I like to keep in the background.
I don't mind being the centre of attention.

- There is no sign. diff. between IPGirls and IPBoys in their mean agreement for the above statements, with the exception of the last statement where more IPBoys seem not to mind being the centre of attention.
- Also IP groups seem more introvert than non-IP groups, i.e. like more keeping in the background; are quiet around strangers and don't like drawing attention to themselves - see Matthews (1992)

Gender diffs in physics participation: Systemising skills

Leading education and social research
Institute of Education
University of London

I enjoy strategy games (e.g. Chess, battleships, Sudoku).
I am fascinated by how machines work.
I find it difficult to read and understand maps.
I have organised collections (e.g. music files, photos, Pokemon cards).
I think memorising dates is important in learning about history.
What I like about learning a foreign language is the way I can learn the grammar by following a pattern.
I like to find the reasons for things.
I like to solve problems.
I watch science documentaries on television and/or read about science.
There is only one right way to solve any physics problem.
I watch science documentaries on television and/or read about science.

Baron-Cohen (2003)

Gender diffs in physics participation: Systemising skills

Leading education and social research
Institute of Education
University of London

- There are sign. diffs between IPGirls and IPBoys (and between non-IPGirls and non-IPBoys) in their mean agreement for only half of these statements, and especially IPGirls stating less agreement for:
  - ❖ I find it difficult to read and understand maps
  - ❖ I am fascinated by how machines work –
    only 9.2% IPGirls compared to 26.5% IPBoys strongly agree
  - ❖ I enjoy strategy games
  - ❖ I watch science documentaries on TV and/or read about science
- IPGirls however like more following a pattern in learning foreign language grammar.
- Less strong systemising skills for non-IP groups overall.

Gender diffs in physics participation: Internality (Locus of control)

Leading education and social research
Institute of Education
University of London

How many friends I have depends on how nice a person I am.
When I make plans, I am almost certain to make them work.
When I get what I want, it's usually because I worked hard for it.
I can pretty much determine what will happen in my life.

Nordstrom and Segrist (2009)

- No sign. diff. between girls and boys, with one exception: Girls agree less that they can determine what will happen to their lives.
- However, in almost all the cases IP groups seem to believe more that they control what is happening to their lives, than non-IP groups.

Gender diffs in physics participation: Engagement with ICT

Leading education and social research
Institute of Education
University of London

I think ICT is very useful in helping me learn physics.
I use physics programmes on my computer to help me with my physics, e.g. podcasts, BBC Bite size, games etc.
I use online groups to help me learn physics.
I use my mobile to access the internet for information and/or email.
I like to interact with people online.
I upload digital pictures and videos on to internet sites such as Facebook, Flickr, Youtube etc.

- More girls than boys like to interact with people online, upload digital content to social networking sites and use physics programmes on their computer; fewer however, think that ICT is useful in learning physics.
- E.g. 44.5% IPGirls vs 38.1% IPBoys strongly agree that they like to interact with people online; and
  44.4% IPGirls vs 30.9% IPBoys strongly agree that they upload digital content to social networking sites.
- Almost no sign. diff. between IP groups and non-IP groups in their general (i.e. non-physics specific) engagement with ICT.

Strand 1 Instruments

Leading education and social research
Institute of Education
University of London

2. Physics School Questionnaire

School Physics Questionnaire Core Themes	N of items
Extent of informal & formal internal collaboration	**3**
Number of students taking post 16 physics courses	**2**
Awareness of the issues of post-16 engagement in physics	**6**
Engaged in physics enrichment activities to promote post-16 engagement	**4**
Schools with policies that promote continuation	**12**
Schools that value physics teachers (CPD)	**13**
Schools that ensure good careers advice are in place	**3**
Schools with adequate and stable physics staff	**7**
Priorities of physics department	**5**
How schools deploy physics staff	**10**
Explore whether schools have adequate physics resources	**8**
Qualitative approach of schools with adequate physics resources	**2**
Background information on the teacher who filled in the questionnaire	**9**

Next steps

Leading education and social research
Institute of Education
University of London

- Use multi-level model analysis to tease out:
  - significant student and school characteristics
  - differential school effects

  that impact on students' intentions to participate in physics post-16.
- E.g. Results from pilot work suggest that gender diffs in intention to participate in physics post-16 were reduced in schools that had:
  - high proportions of KS3 (11-14 years) physics classes taught by specialist physics teachers;
  - high ability selection
- Combine with strand 2 interview and ethnography-based study findings on subjectivities and school culture and strand 3 results about Higher Education choices.

Leading education and social research
Institute of Education
University of London

Thank you

For further information on UPMAP

http://www.ioe.ac.uk/study/departments/gems/4814.html

Or email: upmap@ioe.ac.uk

Institute of Education
University of London
20 Bedford Way
London WC1H 0AL

Tel +44 (0)20 7612 6000
Fax +44 (0)20 7612 6126
Email info@ioe.ac.uk
Web www.ioe.ac.uk