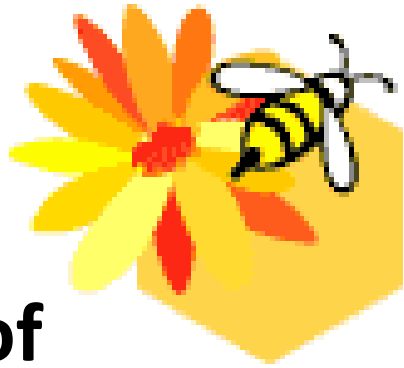


An International Comparison of Primary Teachers' Changing Confidence and Attitudes during Two Years of a Major EU In-service Programme

Prof. Tina Jarvis, Dr Anthony Pell & Phil Hingley

University of Leicester, UK

- **Science education in Europe has recently been the focus of considerable attention. The predominant factor behind this interest is the declining numbers of young people choosing to pursue the study of science and the threat this poses to the Lisbon agenda which seeks to place the EU at the forefront of the knowledge economy of the future.**

- **All students, including future scientists, need to be educated to be critical consumers of scientific knowledge, improving the public's ability to engage with such socio-scientific issues.**

- **A growing body of recent research has shown that most students develop their interest in and attitudes towards school science before the age of 14.**

Osborne J. and Dillon J (2008) *Science Education in Europe, Critical Reflections*: A Report to the Nuffield Foundation

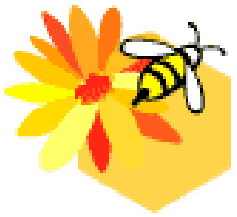
p.o.l.l.e.n.

Seed Cities for Science

A COMMUNITY APPROACH FOR A SUSTAINABLE GROWTH OF SCIENCE EDUCATION IN EUROPE

Hands-on Inquiry-Based Education (IBSE) investigative strategies for primary schools were trialled and shared in 12 countries.

(2006 – 2009)



This presentation reports on:-

1. **Teachers' confidence and attitudes to science education in 10 countries before the in-service**
2. **Content of the in-service in the different countries**
3. **Confidence and attitudes after 2 years in-service**
4. **Factors that appear to influence the teachers' response to the in-service**

Methodology : Quantitative & Qualitative

Pre & post questionnaires using 5-point Likert scales administered Sept 2006 and July 2008

Coordinators and trainers in all countries were interviewed & asked to comment on their perception of the validity of data and analysis in 2007, 2008 & 2009

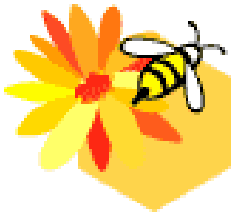
Case study of 33 teachers, their trainers & city coordinators in England, Germany & Sweden

Examination of yearly reports to EU from each country

Primary teachers completing pre & post tests

Nationality	Autumn 2006 Cohort 1 pre-test	Summer 2008 Cohort 1 post-test	Summer 2008 Cohort 2 post-test only
Belgian	64	17	2
English	27	10	20
Estonian	55	1	12
French	28	8	8
German	40	30	57
Hungarian	20	11	24
Italian	89	24	24
Portuguese	23	15	13
Slovenian	47	15	38
Swedish	27	13	3
All	**420**	**144**	**201**

Confidence & attitude test



1. **Personal information** re gender, year group etc.
2. **Confidence scales** to teach home language, mathematics, science & information technology
3. **Confidence scales** to teach physics, chemistry, biology & investigations
4. **A science attitude scale of 59 items**

- Investigative pupil-centred science
- Classroom management of science activities
- The importance of scientific method or skills
- Value of in-service training
- Using a constructivist approach in science lessons
- Working with the wider science community (parents, business, museums etc.

Kérdőív

Tanárok attitüdje a természettudományokkal kapcsolatban a projekt 2. évében

Tisztelt Pedagógus!

Jelen kérdőív célja, hogy megismerjük az általános iskolai tanítók elképzeléseit a POLLEN projekt indulását **követő 2. évben**. Köszönjük, hogy kitöltötte a kérdőívet a projekt kezdetén. A kérdőívet a projektben együttműködő 12 európai ország minden résztvevő pedagógusa kitölti függetlenül attól, hogy a projekt kezdetekor ezt megtette-e. A kérdőív célja, hogy megismerjük az Ön természettudományos attitüdjét, nézeteit, mint természettudományokat tanító pedagógus. **Minden információt bizalmasan kezelünk, és név nélkül közlünk.** Az Ön nevének feltüntetését csupán azért kérjük, hogy lehetővé váljon az összehasonlító elemzés a kutatás folyamán.

Köszönjük, hogy elfoglaltsági mellett időt szakít a kérdőív kitöltésére, értékesen hozzájárulva ezáltal a projekt eredményességéhez. Kérjük, egyedül töltse ki a kérdőívet.

Kitöltés időpontja 2008. 05. 02.

Név Karikázza be a megfelelő választ! Férfi Nő

Város .....

Iskola .....

Osztály 4.

Az osztály diákjainak életkora: 10-11 év

Az osztály létszáma: 23 fő

A tanári pályán töltött évek száma: 13 év

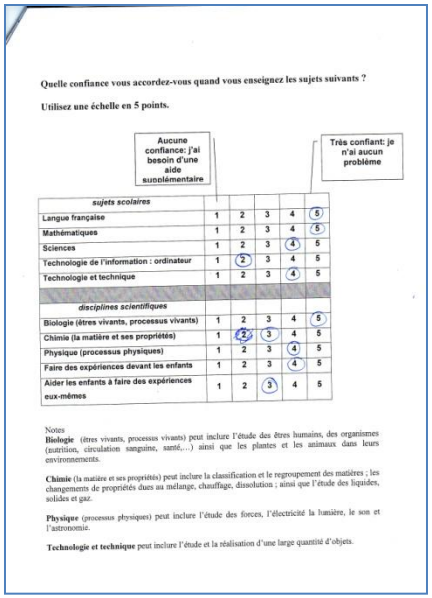
Alkalmaz pedagógiai asszisztenst a természettudománnyal kapcsolatos óráikon? Karikázza be a megfelelő választ! Igen Nem

Melyik évben, hónapban kapcsolódott be a Pollen projektbe? 2006. 10.

Hány osztályban tanított a projektbe történő bekapcsolódás időpontjában? 1

	Sokat	Egészen sokat	Néhányat	Keveset	Nem sokat
Mennyi ötletet tudott hasznosítani a Pollen projektből iskolai munkája során?	X				

12 AUG 2008



Quelle confiance vous accordez-vous quand vous enseignez les sujets suivants ?

Utilisez une échelle en 5 points.

	Aucune confiance: j'ai besoin d'une aide supplémentaire				Très confiant: je n'ai aucun problème
sujets scolaires					
Langue française	1	2	3	4	(5)
Mathématiques	1	2	3	4	(5)
Sciences	1	2	3	(4)	5
Technologie de l'information : ordinateur	1	(2)	3	4	5
Technologie et technique	1	2	3	(4)	5
disciplines scientifiques					
Biologie (êtres vivants, processus vivants)	1	2	3	4	(5)
Chimie (la matière et ses propriétés)	1	(2)	(3)	4	5
Physique (processus physiques)	1	2	3	(4)	5
Faire des expériences devant les enfants	1	2	3	(4)	5
Aider les enfants à faire des expériences eux-mêmes	1	2	(3)	4	5

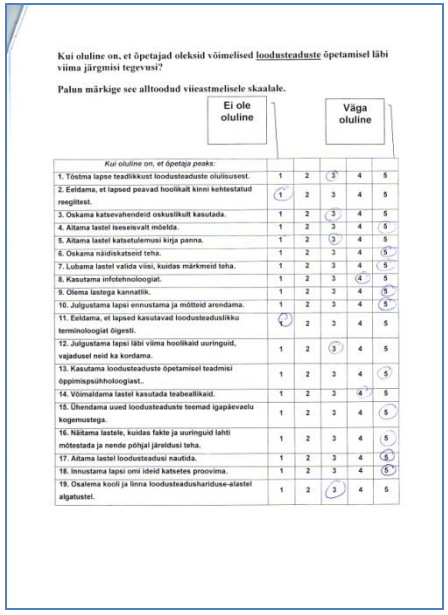
Notes

Biologie (êtres vivants, processus vivants) peut inclure l'étude des êtres humains, des organismes (nutrition, circulation sanguine, santé,…) ainsi que les plantes et les animaux dans leurs environnements.

Chimie (la matière et ses propriétés) peut inclure la classification et le regroupement des matières ; les changements de propriétés dues au melange, chauffage, dissolution ; ainsi que l'étude des liquides, solides et gaz.

Physique (processus physiques) peut inclure l'étude des forces, l'électricité la lumière, le son et l'astronomie.

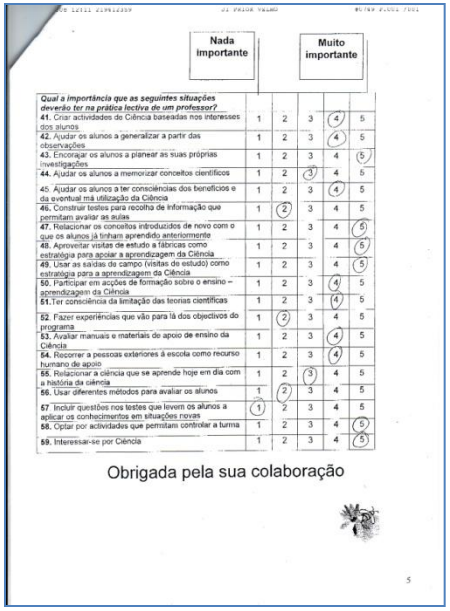
Technologie et technique peut inclure l'étude et la réalisation d'une large quantité d'objets.



Kui oluline on, et õpetajad oleksid võimelised loodusteaduste õpetamisel läbi viima järgmisi tegevusi?

Palun märkige see alltoodud viieastmelisele skaalale.

	Ei ole oluline				Väga oluline
Kui oluline on, et õpetaja peaks:					
1. Tõstma lapse teadlikkust loodusteaduste olulisusest.	1	2	(3)	4	5
2. Eeldama, et lapsed peavad hoolikalt kinni kehtestatud reeglitest.	(1)	2	3	4	5
3. Oskama katsevahendeid oskuslikult kasutada.	1	2	(3)	4	5
4. Aitama lastel iseseisvalt mõelda.	1	2	3	4	(5)
5. Aitama lastel katsetulemusi kirja panna.	1	2	(3)	4	5
6. Oskama näidiskatseid teha.	1	2	3	4	(5)
7. Lubama lastel valida viisi, kuidas märkmeid teha.	1	2	3	4	(5)
8. Kasutama infotehnoloogiat.	1	2	3	(4)	5
9. Olema lastega kannatlik.	1	2	3	4	(5)
10. Julgustama lapsi ennustama ja mõtteid arendama.	1	2	3	4	(5)
11. Eeldama, et lapsed kasutavad loodusteaduslikku terminoloogiat õigesti.	(1)	2	3	4	5
12. Julgustama lapsi läbi viima hoolikaid uuringuid, vajadusel neid ka kordama.	1	2	(3)	4	5
13. Kasutama looduteaduste õpetamisel teadmisi õppimispsühholoogiast..	1	2	3	4	(5)
14. Võimaldama lastel kasutada teabeallikaid.	1	2	3	(4)	5
15. Ühendama uued loodusteaduste teemad igapäevaelu kogemustega.	1	2	3	4	(5)
16. Näitama lastele, kuidas fakte ja uuringuid lahti mõtestada ja nende põhjal järeldusi teha.	1	2	3	4	(5)
17. Aitama lastel loodusteadusi naudida.	1	2	3	4	(5)
18. Innustama lapsi omi ideid katsetes proovima.	1	2	3	4	(5)
19. Osalema kooli ja linna loodusteadushariduse-alastel algatustel.	1	2	(3)	4	5



	Nada importante				Muito importante
Qual a importância que as seguintes situações deverão ter na prática lectiva de um professor?					
41. Criar actividades de Ciência baseadas nos interesses dos alunos	1	2	3	(4)	5
42. Ajudar os alunos a generalizar a partir das observações	1	2	3	(4)	5
43. Encorajar os alunos a planear as suas próprias investigações	1	2	3	4	(5)
44. Ajudar os alunos a memorizar conceitos científicos	1	2	(3)	4	5
45. Ajudar os alunos a ter consciências dos benefícios e da eventual má utilização da Ciência	1	2	3	(4)	5
46. Construir testes para recolha de informação que permitam avaliar as aulas	1	(2)	3	4	5
47. Relacionar os conceitos introduzidos de novo com o que os alunos já tinham aprendido anteriormente	1	2	3	4	(5)
48. Aproveitar visitas de estudo a fábricas como estratégia para apoiar a aprendizagem da Ciência	1	2	3	4	(5)
49. Usar as saídas de campo (visitas de estudo) como estratégia para a aprendizagem da Ciência	1	2	3	4	(5)
50. Participar em acções de formação sobre o ensino – aprendizagem da Ciência	1	2	3	(4)	5
51. Ter consciência da limitação das teorias científicas	1	2	3	(4)	5
52. Fazer experiências que vão para lá dos objectivos do programa	1	(2)	3	4	5
53. Avaliar manuais e materiais de apoio de ensino da Ciência	1	2	3	(4)	5
54. Recorrer a pessoas exteriores à escola como recurso humano de apoio	1	2	3	(4)	5
55. Relacionar a ciência que se aprende hoje em dia com a história da ciência	1	2	(3)	4	5
56. Usar diferentes métodos para avaliar os alunos	1	(2)	3	4	5
57. Incluir questões nos testes que levem os alunos a aplicar os conhecimentos em situações novas	(1)	2	3	4	5
58. Optar por actividades que permitam controlar a turma	1	2	3	4	(5)
59. Interessar-se por Ciência	1	2	3	4	(5)

Obrigada pela sua colaboração

5

Teachers' pre-existing attitude questionnaire adapted to include views about science in each city.

Translated into home language of each country.

Teachers' Confidence and Attitudes Before In-service

Science Curricula in primary schools

- **Centrally defined curricula - France, England, Sweden and Slovenia**
- **Close monitoring by inspection - France, England, Sweden**
- **Lighter touch with national guidelines mediated by states, local authorities or school management.**
- **A few countries had little central control eg Hungary**

Variations in content

- **Biology is the most common science subject.**
- **Variable level from naming of parts, and nature walks (eg Belgium) to in-depth conceptual development such as understanding photosynthesis.**
- **Most countries include physics but little chemistry.**

Confidence in teaching different subjects

In all countries the confidence rating of teaching the school subjects differs significantly but the patterns between subjects are similar.

Teachers are:-

Most confident with teaching their home language or mathematics.

Least confident with teaching information technology.

Confidence in teaching parts of science also shows a significant variation with physics and chemistry causing the greatest problems, with physics generally being the most problematic.

National variation in *overall science teaching confidence* ratings (mean scores/item)

Belgium	2.97 **
England	3.82 **
Estonia	3.35
France	2.82 **
Germany	3.14
Hungary	4.14 **
Italy	3.44
Portugal	3.23
Slovenia	3.67 **
Sweden	3.95 **
Total	3.38

Significantly below mean of all other countries

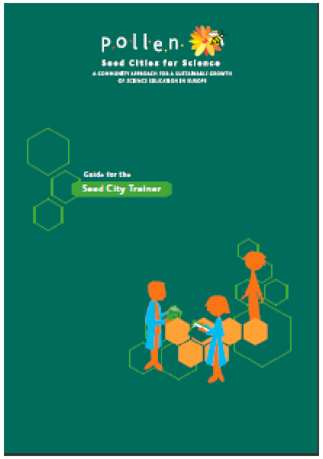
Significantly above mean of all other countries

**p<1%

Flavour of Teachers' views before Pollen

Factor Analysis Scales	Relatively highly rated	Relatively low rating
Overall attitudes to teaching science	**Italy**	**France, Sweden & England**
Science as a pupil-centred relevant creative experience	All Italy very high rating France & UK lower than others	
Development of correct knowledge & skills	Hungary & Slovenia	Belgium & France
Note-taking & recording	Portugal & Slovenia	Belgium, France & England
Science in context: field trips & visits to industry	Hungary, Italy & Portugal	Belgium, France, Sweden & England
Importance of working with city organisations outside school eg scientists	Italy & Portugal	France, Sweden, & England

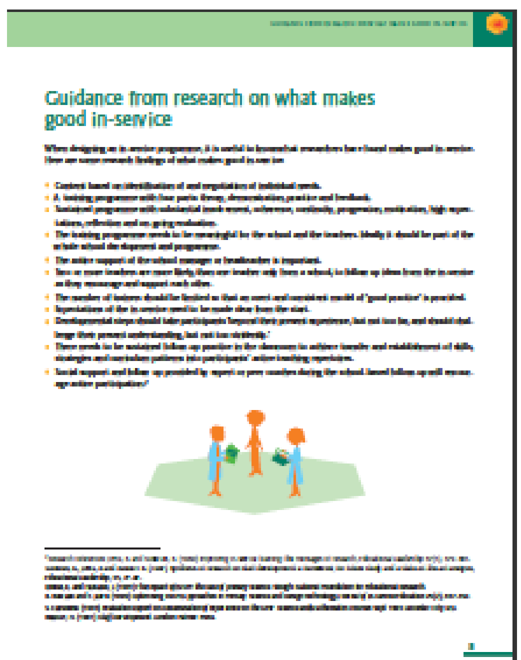
Content of the in-service in the different countries

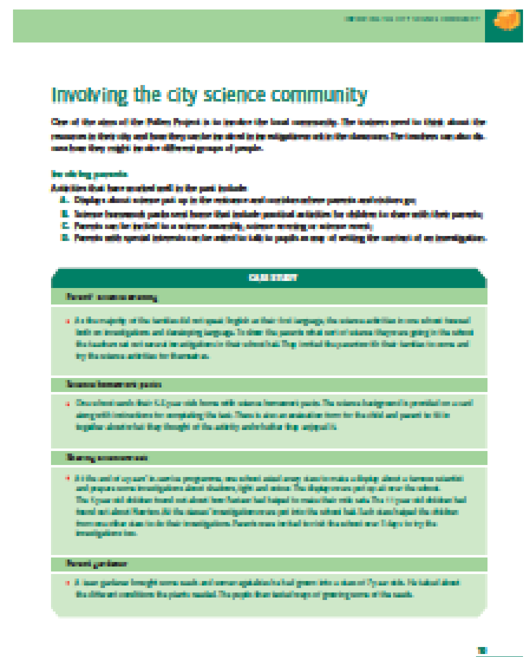


Trainers' booklet based on research on what makes effective in-service was provided for all participating countries.


Planning an in-service session


CASE STUDY


Guidance from research on what makes good in-service


Involving the city science community

CASE STUDY

In-service approach

- **Training sessions**
- **Trainer visits**
- **Support**

  i) Kit boxes

  ii) Learning units and / or exemplar activities

Hands-on investigative science

Relevant contexts

Linking with the community

Changes in Confidence and Attitudes After In-service

Subject confidence means for pre- and post-test scores for teachers in Project for 2 years (N=114-127)

	Pre-test Sept. 2007	Post-test July 2008
Home language	4.26	4.33
Maths	4.37	4.41
Science	3.64 **	3.99 **
Information technology	3.20 **	3.43 **
Design & Technology	3.17 **	3.56 **
Biology	3.85	3.99
Chemistry	3.13 **	3.58 **
Physics	3.05 **	3.45 **
Doing experiments in front of the pupils	3.69 **	4.06 **
Helping pupils do experiments themselves	3.58 **m	4.06 **m

**p<1%, t-test, small effect size (m medium)

Mean score/item changes in *overall science teaching confidence* ratings by country

	Pre-test	Post-test	
Belgium (13)	2.74	3.01	
England (9)	3.67	4.33	Sig. improvement p<1%, large effect size
France (7)	2.80	3.45	Sig. improvement p<5%, large effect size
Germany (22)	3.35	3.89	Sig. improvement p<1%, large effect size
Hungary (4)	3.71	4.07	
Italy (14)	3.57	3.95	
Portugal (12)	3.31	3.33	
Slovenia (9)	4.03	4.41	Sig. improvement p<1%, large effect size
Sweden (12)	4.18	4.19	
Total (102)	3.46	3.82	Sig. improvement p<1% medium effect size

No significant overall or individual country attitudinal change.

Significant changes in attitudinal individual questionnaire items for teachers who had been in the Pollen programme for 2 years

Importance for teachers to:-	Pre-test Mean / score item		Post-test Mean / score item
Encourage pupils to try out their own ideas in experiments	4.52 *	→	4.68 *
Teach pupils to understand science ideas	4.09 **	→	4.32 **
Expect pupils to use scientific words correctly	3.83 **	→	4.10 **
Participate in local and city science education initiatives	3.93 *	→	4.08 *
Use field trips to support science learning	4.22 *	→	4.41 *
Use information technology	3.84 *	→	3.99 *
Choose activities so that the class is easy to control	4.04 **	←	3.81 **

*p<5%, **p<1%, Wilcoxon matched pairs

Factors that Appear to Influence Teachers' Response to the In-service

Factors influencing teachers' responses to in-service

1 Teachers' original levels of knowledge - limited improvement in confidence may relate to teachers' initial low levels of knowledge.

Belgian teachers are mainly non-graduates with low levels of confidence made little change.

Italian teachers tend to be very well trained and committed to learning. They have high attitudes and confidence.

2. Time spent in the Programme - Teachers in the Project for two years show significant increases in confidence particularly on the foci of the Pollen Project.

One-year teachers showed improvement but did not reach significance.

3. Match with national needs

Where in-service matched closely with the countries' national objectives teachers and schools were motivated to practise their new skills in school.

Progress in Slovenia was particularly marked where there was both a positive view of in-service education and a match with national objectives.

Inconsistent messages to schools made implementation difficult (Hungary).

Where the science curriculum was already very prescribed and inspected, teachers' existing negative attitudes appear difficult to shift (England, France & Sweden).

4. Quality of in-service

Good in-service was important in developing confidence and improved attitudes. Teachers appreciated the opportunities to try the pupils' activities themselves.

5. Kit boxes

Gave inexperienced teachers confidence & the equipment to try whole-class practical activities.

A few experienced and very confident teachers found them restrictive.

More useful if there were enough topics to cover most of the science curriculum.

6. Range of topics covered

Teachers developed more confidence if in-service covered many science topics.

7. Support from senior school management & match to individual school needs

Supportive school management made more positive teachers.

Negative effect where the management or school colleagues were uninterested or dismissive of the teachers' work and/or ability.

Slovenian teachers get credit and status for participation in the in-service. Their Ministry of Education also funded additional kit boxes.

In England tests for 11-year olds reduced opportunities to trial new ideas.

8. Additional funds and / or voluntary support were advantageous

In Slovenia, France, Germany and England the EU grant was supplemented to provide support documents, dissemination, additional places on the programme or volunteers to support teachers in the classroom.

9. Time, finance and support to develop community links

Teachers in the Pollen Project have involved parents.

Making links with individual organisations in the community was not easy. Teachers needed advice on contacts. Time-consuming to arrange visit. Funds for travel sparse.

Additionally teachers could only take on a limited number of the aims of the project at a time.

Stage 1 Initially develop confidence to provide hands-on investigations in their first year.

Stage 2 More prepared to involve the community.

Implications for Future Practice

- **High quality in-service is essential.**
- **The programme needs to be staged over several years.**
- **The initial focus should be on developing science knowledge & skills.**
- **This stage needs to be longer for inexperienced 'new' teachers and those with initial low science knowledge.**
- **Maximise opportunities for teachers to practise new ideas by covering a wide range of topics.**
- **Kit boxes are valuable for teachers with little background in teaching science. Increasing flexibility is recommended as teachers become more experienced.**
- **In-service should be matched to national and local needs. This can be difficult to achieve for a complex programme. It might be helpful to discuss possible conflicts with teachers.**
- **Involve higher education, industry and business if possible as additional funds and/or voluntary support enhance outcomes.**