
The Effective Provision of Pre-School Education [EPPE] Project

A Longitudinal Study funded by the DfEE (1997 – 2003)

**Ratios in Pre-School Settings:
An exploration of the relationships with children's educational outcomes**

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About this paper

In October 2000 the EPPE team responded, with this paper, to a query from the Department for Education and Employment (now the Department for Education, DfE) regarding the impact of ratios in pre-school settings.

At the time of writing it was a confidential document, written to help policy colleagues understand better the many influences on young children's academic and social-behavioural development.

In February 2013 the DfE launched the 'More great childcare: Raising quality and giving parents more choice' report (MGC). This report sets out a plan of action for how the Government will achieve its vision of a dynamic childcare market, delivering high quality early education. It incorporates the Government's response to Professor Cathy Nutbrown's independent review 'Foundations for Quality'.

One of the recommendations of the MGC report is to alter statutory ratios across the early years sector. In the light of this the DfE have given permission for this paper to be placed in the public domain in order to contribute to the debate about ratios in setting with very young children.

The only difference between this paper and the original is this page plus some amendments to the front page to update contact details and an Appendix with updated publication details. The rest of the paper is unchanged from the original submitted to funders in October 2000.

About the EPPSE research

The Effective Provision of Pre-school Education (EPPE) project began in 1997. The first phase studied children between the ages of 3- 7 and showed the benefits to all children of attending pre-school (Sylva et al., 2004; Sammons et al., 2002; 2003; Siraj-Blatchford et al., 2003).

The second phase; the Effective Pre-school and Primary Education project (EPPE 3-11) followed the same children from age 7 to 11 years (Sylva et al., 2008; Melhuish, 2008; Sammons et al., 2008a; 2008b) and showed that the effects of children's pre-school experiences remained until they were age 11, in both academic and social-behavioural outcomes.

The emerging findings of EPPE documented the gains to children's development that early childhood education could provide and influenced government policy, especially during the period 2002 onwards (Children's Plan, DCSF, 2007; Taggart, Siraj-Blatchford, Sylva, Melhuish, and Sammons, 2008) EPPE suggested that some early experiences were better than others both at home or in pre-school settings, providing a sound evidence base for government policy (the development of and expansion of provision). Its qualitative case studies (Siraj-Blatchford, Sammons, Sylva, Melhuish and Taggart, 2006) were influential in identifying what is meant by "effective" early education.

EPPE has now become the Effective Pre-School, Primary and Secondary Education (EPPSE) project has followed the same children through Key Stage 3, their GCSE year and beyond to their post 16 choices. The EPPSE longitudinal study is due to end in December 2013.

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Executive Summary

The EPPE project was set up to investigate the effectiveness of pre-school education and explore the contribution of pre-school to children's development, controlling for child and home level factors. We have robust measurements of cognitive, social and behavioural outcomes allowing us to estimate the 'value added' by a particular centre to children's development in these three domains. The EPPE research was intended to investigate the effectiveness of existing forms of pre-school provision. As such we have studied 'packages' of variables in their naturally occurring contexts rather than artificially disentangling the separate effects of ratio, staff training or age of entry as in an experimental design.

It is impossible to study the effects of ratio as a stand-alone variable in existing British practice, without using an experimental study (unethical and perhaps illegal). The actual effect of ratio in EPPE is inevitably confounded with training, resources and pedagogical practices. Moreover, children from disadvantaged and/or minority ethnic backgrounds were concentrated in local authority day care and combined centres whereas children from advantaged backgrounds clustered in private day nurseries. We stress again that EPPE studies the effects of naturally occurring combinations of variables. Nevertheless, the EPPE research enables important analyses of these packages which help to illuminate the question of whether ratio influences children's social, behavioural and cognitive outcomes, in a way not previously studied in such depth.

The EPPE research in 141 pre-school centres drawn from 6 English local authorities has shown great variation in observed ratios. Playgroups managed to reach their statutory ratios of 1:8 only through the contribution of volunteer staff, whereas many nursery schools consistently operated well below their permitted ratio of 1:13. This demonstrated the advantage of observing ratios rather than relying on statutory numbers in any study of the impact of different ratios on children. We found an apparent paradox: many centres with the least favourable ratios had higher quality ratings on measures of quality (ECERS-R and ECERS-E). This might be attributed, in part, by the higher childcare/education qualifications levels found amongst the staff in these settings (LEA provision with 'official' ratios of 1:13).

- The issue of ratios is not straightforward and our results show how different methods of estimating ratios leads to different results.
- The best measure of ratios is that which is directly observed over several points in time.
- Variation in ratios within the pre-school is confounded with a range of potentially important variables such as staff qualifications/training, pre-school type and quality characteristics.
- The observations indicate that statutory ratios do not adequately reflect 'on the ground' ratios experienced by children in pre-school centres.
- Statistical analyses of children's cognitive and social behavioural progress over the pre-school period reveal no clear association between ratio levels and better outcomes at entry to school which is independent of other variables.
- In one part of the cognitive domain, children's language progress across the pre-school period, the research suggests that higher observed ratios are associated with better progress. However, this relationship may reflect the influence of confounding factors. The positive relationship between an observed ratio category of 1 adult to 8-12 children and language development is associated with the education sector (in some nursery classes and schools).
- In the social behavioural domain, the factor of co-operation/conformity at first appears to be associated with lower ratios but further analyses reveal that this apparent association is accounted for by variation in type of pre-school. The results suggest there is no independent effect of ratio on social, behavioural measures over the pre-school period.

Ratios In Pre-School Settings: Preliminary Findings

The Effective Provision of Pre-School Education (EPPE) Project

Part One : The EPPE study and the issue of adult : child ratios.

EPPE as a study of existing practice:

The EPPE project was set up to investigate the effectiveness of pre-school education and explore the contribution of pre-school to children's development, controlling for child and home level factors. We have robust measurements of cognitive, social and behavioural outcomes allowing us to estimate the 'value added' by a particular centre to children's development in these three domains. The EPPE research was intended to investigate the effectiveness of existing forms of pre-school provision. As such we have studied 'packages' of variables in their naturally occurring contexts rather than artificially disentangling the separate effects of ratio, staff training or age of entry as in an experimental design.

It is impossible to study the effects of ratio as a stand-alone variable in existing British practice, without using an experimental study (unethical and perhaps illegal). The actual effect of ratio in EPPE is inevitably confounded with training, resources and pedagogical practices. Moreover, children from disadvantaged and/or minority ethnic backgrounds were concentrated in local authority day care and combined centres whereas children from advantaged backgrounds clustered in private day nurseries. We stress again that EPPE project studies the effects of naturally occurring combinations of variables. Nevertheless, the EPPE research enables important analyses of these packages which help to illuminate the question of whether ratio influences children's social, behavioural and cognitive outcomes, in a way not previously studied in such depth.

Staffing ratios in EPPE centres.

The study has compared three kinds of information on staffing ratios:

1) The statutory minimum levels

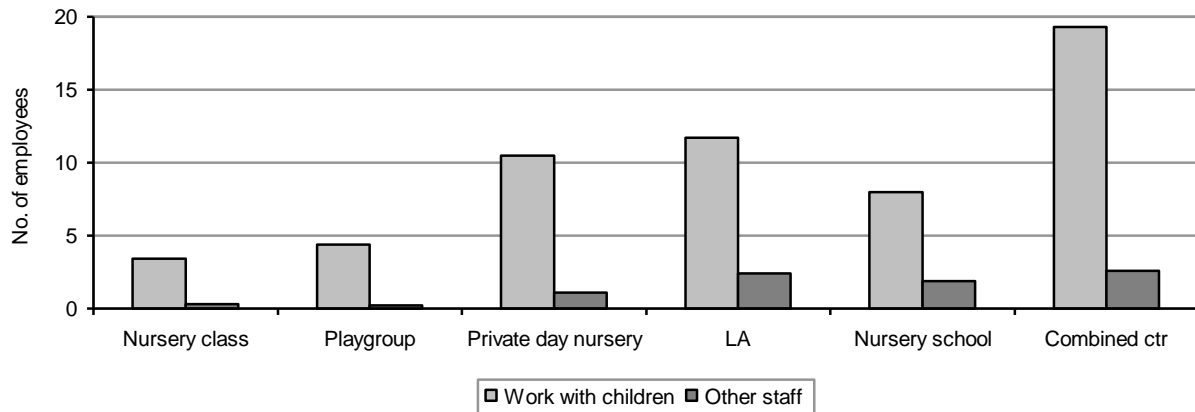
The minimum staffing level across the 6 types of pre-school provision in the EPPE sample is not uniform. In playgroups, private day nurseries, local authority day care and the combined centres the ratios of 1 adult to 8 children in the age group 3-5 are laid down by the 1989 Children Act. This sets out the statutory levels of staffing which would enable a pre-school setting to comply with the appropriate Children Act inspection framework which historically was undertaken by Social Services. All settings with children under three are required to have this inspection of care. In addition, after the introduction of the Desirable Learning Outcomes [(1996), (now the Early Learning Goals, 1999 for children 3-5)] the Government introduced an education inspection conducted by the Office for Standards in Education (OFSTED). In the other 'educational' forms of provision, nursery classes and nursery schools, the ratios are 1 adult to 13 for three to five-year-olds, although in nursery schools it can quite often be as low as 1:10 because the head teacher has a major teaching function in addition to administration. These government ratios are determined by the Nursery Education Act (1996). Inspections are conducted by OFSTED but they are similar to school inspections. The combined centres may differ from these arrangements. If their local authority considers them as nursery schools, they can have the 'education' ratios. However, most combined centre heads have negotiated lower ratios with their LA because they argue they need lower ratios to carry out the family support aspects of their work. They are inspected under both social services and education frameworks.

2) Interview data from the centre managers' interviews

It was possible to calculate staffing levels from the managers' reports of the number of children and staff in their centre. These figures did not necessarily reflect the usual number of children and adults in the centre at any one time and thus provide only a very limited guide to actual ratios usually experienced by children in the centres.

Figure 1 below shows the number of paid employees as reported by managers during the interview across pre-school types. This was used in conjunction with child enrolment figures but the resulting ratio did not take account of the number of hours attended.

Figure 1 – Mean number of employees per setting (by pre school type)



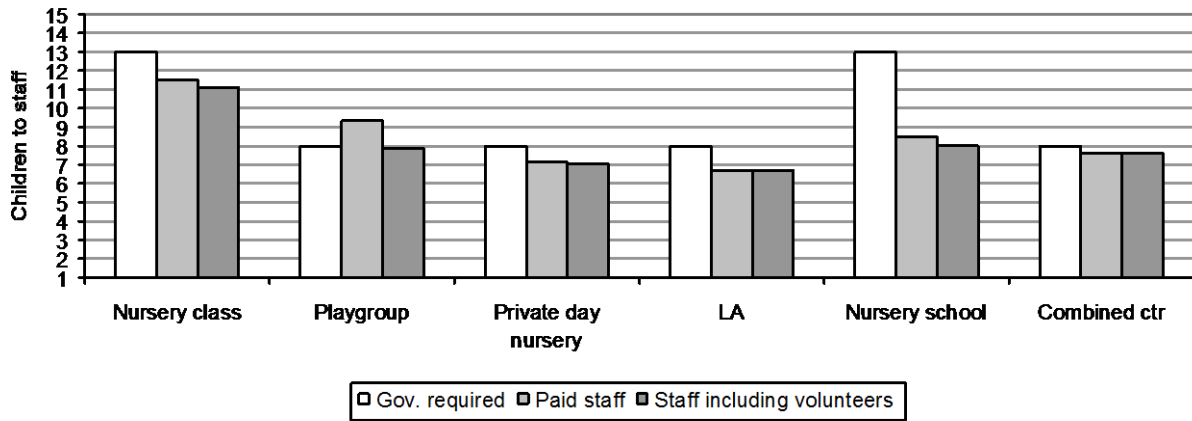
3) Observational data from EPPE research officers' visits

Independent observations on 'usual' ratios were made over a period of time by research officers during their visits to centres to assess children. In these time-point observations, the number of children in the centre, the number of paid staff, and also the number of voluntary staff were observed. Volunteer staff were only included in the staffing levels if they attended the centre on a regular basis, over a substantial period of time, sufficient to serve as unpaid staff rather than casual visitor. Field officer observations were made on the basis of at least 20 or more separate visits to each centre.

Across all 141 centres the average ratio observed without volunteers was 1:8.4 (sd 2.8), with volunteers the average ratio is lower at 1:7.9 (sd 2.7).

Shown in Figure 2 are the government required ratios as well as the observed staff child ratios with and without volunteers, collected through observation. (Note that the requirement of 1:8 staff to children usually applies to combined centres.)

Figure 2 – Mean number of children to staff (by pre school type)

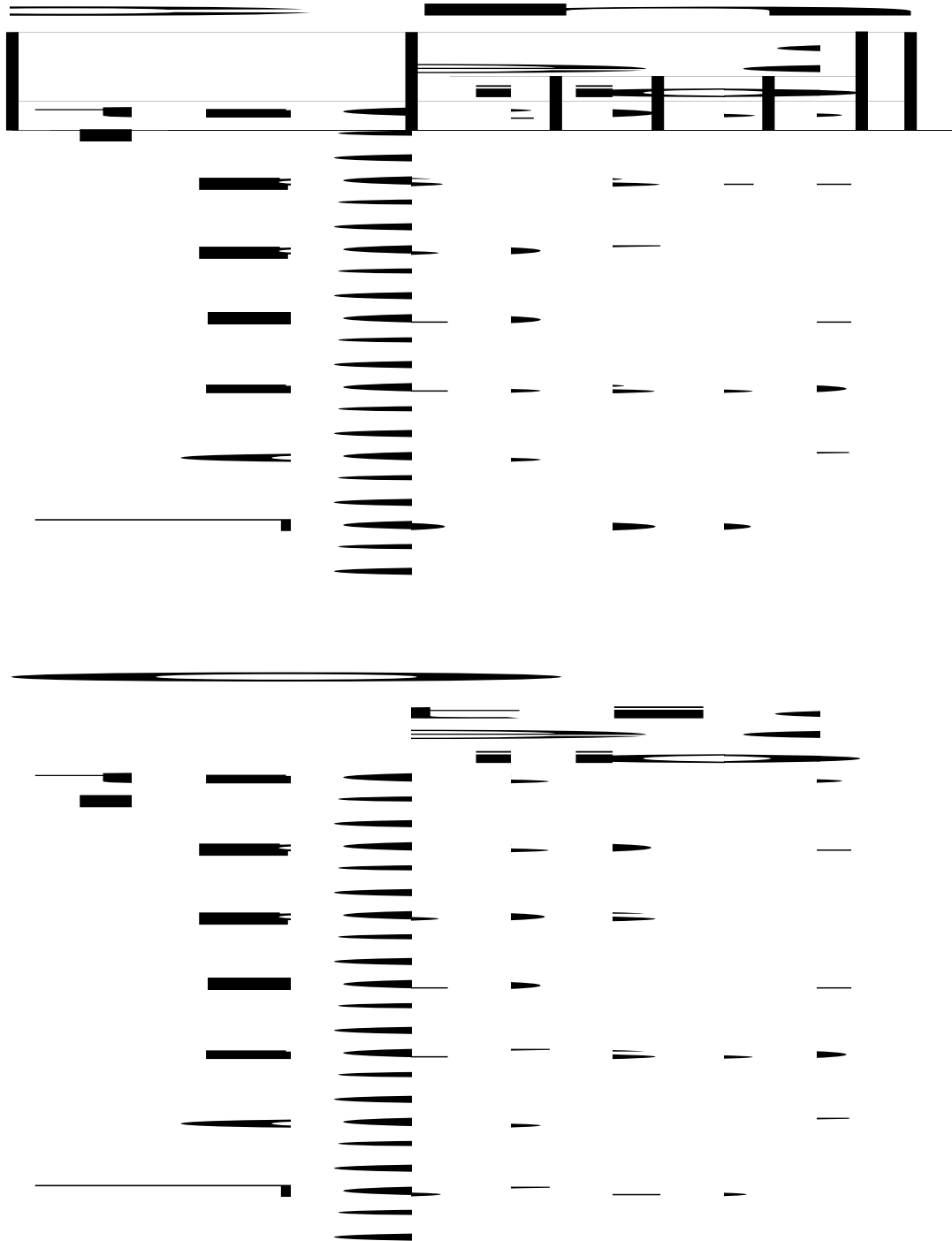


Analysis of the observed ratios reported by research officers shows clear differences by pre-school type, both with and without volunteers, (paid staff only, $F(4,140)=8.8$, $p<.001$; paid staff and volunteers, $F(4,140)=7.3$, $p<.001$). The difference between the two ratios was compared across pre-school type, and this also revealed significant differences, ($H(5)=35.5$, $p<.001$). All providers were able to meet or improve on statutory requirements without the help of volunteers except in playgroups, where the addition of volunteers was essential to maintain statutory ratios. In practice the average figures suggest that both nursery classes and nursery schools appeared to offer ratios which were notably lower than the statutory requirements for their sector. Many of them have extra staff to support children with special needs or children with English as an additional language and these have been included in the usual ratio.¹

¹ The analysis above only included volunteers who worked in the centres on a regular basis with sufficient regularity to act a unpaid staff. As well as this type of additional help most centres in each type of provision benefited from other unpaid help on a less regular basis i.e. students etc.

Observed Ratio Groupings

Centres were classified by ratio into four groups (under 5, 5-8, 8-12, and 13 or above) first on the basis of ratios without volunteers, secondly on the basis of ratios with volunteers. The results are shown in Tables 1 and 2. These groupings were chosen to reflect statutory ratio categories and the distribution of EPPE centres observed ratios.



Within each type of provision there was variation between centres in their staff child ratios. This demonstrates the need to explore the impact of both type and ratio in models of children's progress and development. It cannot be assumed that all centres of a particular

type have similar ratios in practice, thus any comparisons merely based on statutory ratios are likely to be flawed.

Qualifications, Quality Measures and Ratios

Qualifications - managers

As has been stated earlier in this paper, ratios are confounded in the EPPE research with type of provision and qualifications. In this section of the paper we will explore ratios in relation to the qualifications of pre-school centre managers and their staff. Childcare qualifications have traditionally been something of a 'hotch-potch'. The past lack of a national framework has meant that institutions of further education, higher education and national awarding bodies have offered a complex range of awards; the distinction between care and education qualifications has compounded differences. Whilst it could be argued that diversity can be beneficial, the lack of comparability across qualifications has led to difficulties in establishing national qualification standards. The most recent initiatives by the Qualifications and Curriculum Authority (QCA 1999) to provide a framework for nationally accredited qualifications in early years education is a welcome development. We asked the centre managers about their highest childcare/education qualification.

Table 3– Managers' highest childcare/education qualifications

High frequency qualifications		Middle frequency qualifications		Low frequency qualifications	
NNEB	22.6% (30)	NVQ Level 3	4.5% (6)	Dip. Ed	1.5% (2)
Cert. Ed	18.0% (24)	PPA Foundation Level	3.8% (5)	Overseas	1.5% (2)
B. Ed	12.0% (16)	Montessori	3.8% (5)	ADCE	1.5% (2)
DPP Level III	8.3% (11)	BTEC Certificate	3.0% (4)	Other degree	0.8% (1)
PGCE	7.5% (10)	PA Level II	3.0% (4)	CECS	0.8% (1)
No qualifications	4.5% (6)	NVQ Level 2	2.3% (3)	PLA Learning Through Play	0.8% (1)

Highest childcare/education qualification information was available for 133 managers. Table 3 reveals that the most frequent childcare/education qualification was the Nursery Nursing Education Board (NNEB – now the Diploma in Childcare Education awarded by Council for Awards in Childcare and Education- CACHE). Only a small percent (4.5% or 6) of managers reported they had no qualifications at all.

A six-point scale is used nationally for qualifications and training. In EPPE Technical Paper 5 we adapted the QCA framework. A summary of the six-point scale is shown in Table 4. Note that Level 1 cannot apply to childcare qualifications as it requires constant supervision by a supervisor, i.e. Level 1 does not apply nationally to child care.

Table 4 – Childcare /education qualification six-point rating scale

Level	Description	Example
Level 0	Unqualified	-
Level 1	<i>(No childcare qualification equivalent)</i>	
Level 2	Childcare certificates	BTEC Certificate in Childcare
Level 3	Childcare diplomas	NNEB
Level 4	Childcare advanced diplomas	Advanced NNEB
Level 5	Professional teaching qualification	BA (QTS), PGCE

Due to the small numbers of level 4 qualified managers, levels 3 and 4 were combined in our sample (Table 5). Manager's level of childcare qualifications differed significantly by pre-school type ($H(5)=73.9, p<.001$) as shown in the table overleaf.

Table 5 – Managers’ highest childcare/education qualifications (by pre-school type)

	Nursery class	Playgroup	Private day nursery	LA	Nursery school	Combined ctr
Level 0		11.4%	3.6%	4.2%		
Level 2		40.0%	10.7%	4.2%		
Level 3/4	18.2%	48.6%	64.3%	66.7%		33.3%
Level 5	81.8%		21.4%	25.0%	100.0%	66.7%
n	22	35	28	24	16	6

The centre managers with the highest childcare/education qualifications were found predominately in the ‘education’ rather than ‘care’ sector i.e. nursery schools and nursery classes. A third type of maintained provision, combined centres also had high levels of staff with Level 5 childcare qualifications. Playgroups had the least qualified centre managers with over 50 per cent with Level 2 or below. One in ten playgroup managers had no childcare qualifications at all. As might be expected, given the link with type, the centre manager’s qualification level was also associated with ratio category. For example, 60 per cent of centre managers had qualifications at Level 2 in centres which had the lowest observed ratios, including volunteers (under 5). By contrast only 28 per cent of managers had Level 2 qualifications in centres with ratios of over 8. Moreover, only 24 per cent of managers in centres with ratios of under 5 had Level 5 qualifications compared with 61 per cent of managers in centres with observed ratios of above 8.

Qualifications - staff

Of the 961 staff, childcare/education courses and qualification data were available for 870. As seen in Table 6, by far the most commonly held childcare/education qualification was the NNEB, and interestingly the second most common category was ‘no qualifications’. When staff courses and qualifications were compared across pre-school type using the 4 point scheme differences were found ($H(5)=104.0$, $p<.001$). The distribution across pre-school type is shown in Table 7.

Table 6– Staff highest childcare/education qualification and training (whole sample)

High frequency qualifications		Mid-frequency qualifications		Low frequency qualifications	
NNEB	42.9% (373)	ADCE	1.3% (11)	MA	0.2% (2)
No qualifications	11.0% (96)	Montessori	1.3% (11)	Other CC qualification	0.2% (2)
BTEC Certificate	7.0% (61)	PLA Learning Through Play	1.1% (10)	Modular Course in CC	0.2% (2)
NVQ Level 2	5.1% (44)	City and Guilds II	0.9% (8)	CSE	0.1% (1)
NVQ Level 3	3.8% (33)	BTEC Certificate	0.8% (7)	NVQ Level 1	0.1% (1)
DPP Level III	3.7% (32)	First aid	0.8% (7)	DCC	0.1% (1)
Cert. Ed	3.1% (27)	NNEB with Portage	0.6% (5)	Overseas CC qualification	0.1% (1)
B. Ed	3.0% (26)	HN Diploma	0.5% (4)	British Sign Language	0.1% (1)
PGCE	2.9% (25)	BA	0.5% (4)	State Registered Nurse	0.1% (1)
PPA Foundation Level	2.9% (25)	HN Certificate	0.2% (2)	Classroom assistant	0.1% (1)
BTEC Diploma	2.8% (24)	Dip. Ed	0.2% (2)	Registered Child Minder	0.1% (1)
PA Level II	1.8% (16)	Overseas	0.2% (2)	Other miscellaneous	0.1% (1)

Table 7 – Staff childcare/education qualifications (by pre-school type)

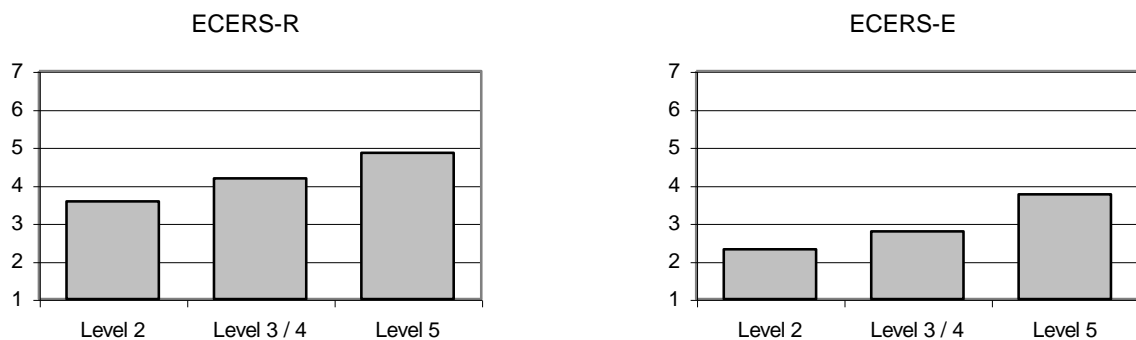
	Nursery class	Playgroup	Private day nursery	LA	Nursery school	Combined ctr
Unqualified	9.6%	20.6%	11.7%	8.7%	5.0%	12.0%
Level 2	5.8%	43.3%	25.8%	21.3%	7.6%	9.6%
Level 3/4	67.3%	35.1%	58.9%	65.2%	59.7%	61.4%
Level 5	17.3%	1.0%	3.6%	4.7%	27.7%	16.9%
n	52	9	248	253	119	83

Overall, there is a descending order of high / low childcare qualifications amongst managers and staff across the different forms of provision. Nursery classes and nursery schools have very similar profiles in terms of staff qualifications and are thus the most highly qualified, followed by combined centres, then private day nurseries and local authority centres together, and finally, playgroups who have the lowest proportion of qualified staff. One in five playgroup staff had no childcare qualifications at all.

Relationship between childcare/education qualification and environmental profile

We examined the relationship between the Early Childhood Environment Rating Scales (ECERS-E and ECERS-R), an observational assessment of pedagogy, facilities and programmes, and centre managers childcare/education qualifications. Figure 3 below shows the mean ECERS-R and ECERS-E scores grouped according to manager’s childcare qualification level. A clear trend is shown in which the quality of the environment increases with childcare qualification. Analysis of variance reveals that this trend is statistically significant on both ECERS measures ($p < 0.01$). Further, Tukey post hoc analysis reveals that in addition to the significant overall effect, significant differences exist between each qualification subgroup also. That is, Level 5 performance is significantly higher than that of Level 3 / 4 ($p < 0.01$) and Level 2 ($p < 0.01$), and Level 3 / 4 performance is significantly higher than Level 2 ($p < 0.05$). This is true for both ECERS-R and ECERS-E.

Figure 3 - ECERS-R and ECERS-E means by manager qualification



Ratios and academic qualifications

Further analyses are planned which will explore associations between academic qualifications, and ratios in relation to children’s outcomes. This will enable us to find whether academic ‘level’ rather than child care training is a better predictor of children’s developmental progress. These data will be reported in a later paper.

Ratios and quality characteristics

We examined the relationship between the Early Childhood Environment Rating Scales (ECERS-E and ECERS-R), an observational assessment of pedagogy, facilities and programmes, and ratios. There is little evidence of associations between centre ratios and quality characteristics as measured by ECERS-R. However, the ECERS-E which has a more educational focus showed a significant though weak positive correlation between observed ratio including volunteers and average total score on ECERS-E ($r=0.21$, $p<0.02$, $n = 141$). This indicates a tendency for quality scores on this measure to be higher in centres with higher ratios. This may reflect the higher ECERS scores to be found in the Local Education Authority sector (with ratios of 1:13, see Technical paper 6 and 6a). The relationship between ratios and the ECERS quality measures are notably weaker than those found between quality and centre manager's childcare/education qualifications levels.

Part Two : The effects of ratios

Ratios varied in the EPPE study in systematic ways; centres where staff had higher qualifications tended to have higher statutory ratios while centres with lower qualified staff had what used to be called 'more favourable' ratios (using the assumption that 'lower' may be 'better' for children). Moreover, some centres with high quality scores on the ECERS observational profiles also had high ratios; especially nursery classes (see Tables 1 and 2). The important exception to this was the combined centres which had high quality scores on ECERS but had low ratios. Some centres with the 'least favourable' ratios offer the highest quality of pedagogy and facilities especially nursery classes. They also have the most highly qualified staff and better facilities. We will attempt to disentangle these variables in the analyses on child outcomes.

The design of EPPE allows us to investigate the effects on children's developmental progress (the 'value added') which can be attributed to ratio. The next section describes the results of the statistical analyses using multilevel modelling which seek to identify the effects of both statutory and observed ratios on children's cognitive and developmental progress across the pre-school period.

The relationship between ratios and cognitive progress

The EPPE study has explored the impact of pre-school on children's progress during the pre-school period using four outcome measures of cognitive development at entry to school (taking account of earlier cognitive attainment at entry to the study):

Language skills – assessed by the British Ability Scales

Pre-reading skills - assessed by letter recognition and phonological awareness

Early number concepts – assessed by the British Ability Scales

Non-verbal skills – assessed by the British Ability Scales

Given earlier findings on the relationship between centre type and quality characteristics (as measured by ECERS) and of variation between individual centres in effects on children's cognitive progress, it was decided to explore a range of models. In testing the impact of ratios full control was included for children's prior cognitive attainment at entry to the EPPE study, and measures of child, parent and home learning environment found to show a statistically significant relationship with cognitive skills at school entry (see Measuring the Impact of Pre-School on Children's Cognitive Attainment at School Entry: Preliminary Report to DfEE, January 2000).

The possible impact of ratios was tested while measuring ratios in five different ways :

- i) Observed ratio of children to adults not including unpaid staff i.e. volunteers (centered around mean)
- ii) Observed ratio of children to adults including volunteers (centered around mean)
- iii) Observed ratio categories (under 5, 5-under 8, 8-12, over 12) without volunteers
- iv) Observed ratio categories (under 5, 5-under 8, 8-12, over 12) with volunteers
- v) Statutory ratio (under 8, versus 8-13)

The first two measures treat ratios as a continuous measure. The others treat ratios as a categorical measure. The impact of ratios was then tested using four separate models, each one using different amounts or type of control:

Ratios (no control for pre-school type or ECERS-E)

Ratios (control for ECERS-E)

Ratios (control for type)

Ratios (control for type and ECERS-E)

The inclusion of pre-school type and ECERS-E scores was deemed appropriate in testing ratios because previous analyses (Measuring the Impact of Pre-School on Children's Cognitive Attainment at School Entry: Preliminary Report to DfEE January, 2000) have already revealed the existence of statistically significant associations between these two measures and children's cognitive progress across the pre-school period. The qualifications measures for staff and centre managers however had not shown such links. For these reasons additional models including qualifications are not included in the ratio testing. We believe that the influence of qualifications may operate indirectly through the ECERS-E quality assessments.

The final model considers the effect of ratios controlling for type and ECERS.

Each of the four models was tested using the five different measures of ratios (providing 20 separate sets of results) for each outcome. In addition, a simple measure of volunteers present or not was tested, giving a total set of 24 models for each of the four cognitive outcomes (96 models in total). The results for children's cognitive outcomes are summarised in tabular form in Appendix 1.

Overall, the multilevel results provide no clear cut interpretation of the impact of ratios on children's educational outcomes at entry to school. For each outcome the main findings are listed below.

Language

The results indicate that higher ratios are significantly associated with better language attainment at school entry, when ratios are treated as a continuous measure. These results are evident even after controlling for prior attainment, type and ECERS-E scores. When ratios are considered as a grouped variable, the ratio 8-12 was found to be associated with a positive impact in comparison with the lowest ratio group under 5. These results suggest that children's language development may be greater in centres where child adult ratios are higher, possibly because of increased child - child interaction. It should be noted that the inclusion of ratios does not alter the findings related to ECERS-E and pre-school type on language outcomes. However this effect is primarily present in the nursery classes and schools sector of our sample. This result suggests that this ratio effect may be due to one or both of the following reasons:-

- a) more child-child interactions in centres with higher ratios could benefit language development

- b) settings with lower ratios often were found in disadvantaged areas which had been allocated additional help and/or peripatetic teachers. These children themselves will be likely to have poorer language development, although it should be noted that the multilevel analyses controls for children's prior cognitive attainment and child, parent and family characteristics.

Additional analyses were conducted excluding children who have English as an additional language. These produced broadly similar findings on the impact of ratios. Therefore we can conclude that the results on children's progress in language, over the pre-school period, are not affected by differential distribution of children who have English as a second language amongst pre-school types.

Pre-reading

In contrast to language progress, none of the ratio measures tested showed a significant association with children's pre-reading skills at school entry. By contrast the ECERS-E measure (literacy sub-scale) and pre-school type remained significant for all ratio measures tested, indicating that these findings are not confounded by ratio.

When the measure of volunteers present or not was tested in the model with and without controlling for the ECERS-E measure, the category 'no volunteers' was found to be associated with a positive impact in comparison with the category 'volunteers present'. This finding is probably confounded with level of qualification as qualified staff have the relevant training to teach pre-reading skills. However, this finding is no longer significant when the measure volunteers present or not is tested in combination with pre-school type, showing that the apparent disadvantage of having volunteers disappears after controlling for pre-school type.

Non-verbal skills

For non-verbal skills the majority of ratio measures tested were not statistically significant.² As with pre-reading the findings concerning pre-school type and ECERS-E quality remained significant when ratio is controlled. (Interestingly, controlling for ratio category with volunteers also suggested that for pre-school type, as well as private, the category LA showed significant positive effects on non-verbal skills compared with nursery class. This was not found when ratio is not included in the multilevel model).

Early Number Concepts

Our measure of mathematical skills focuses on early number concepts. Results of testing the ratios measures show that, tested in isolation (without type and ECERS-E) higher ratios have a negative association with progress. This finding is not significant when ratio with volunteers is tested and pre-school type and ECERS-E included. Treated as a categorical variable, and controlling for type and ECERS-E no significant results are found for different ratio categories. In line with results for the other cognitive outcomes, the ECERS-E and type results remain fairly stable. It should be noted that as well as private day nurseries the categories playgroup and combined centres were significant and positive (compared with nursery class). It appears that this finding emerges only after control for ECERS-E (on which of course playgroups and private day nurseries tend to score less well). Again these results point to difficulties in attempts to study the impact of type of pre-school without reference to other characteristics, such as quality or ratio because pre-school is experienced as a 'package' of inter-related features.

² There was some indication that the ratio category 5-8 was negative compared with the category under 5 when volunteers were not included, but no evidence that higher ratio groups were less favourable than the under 5 group. This finding about the 5-8 group was not confirmed when the ratio measures with volunteers was tested.

Overall for the cognitive outcomes studied results show that there is no clear cut link between ratios and children's cognitive progress. There are suggestions that higher ratios may relate to better language outcomes, but this should be interpreted with caution. The multilevel analyses clearly demonstrate the need for very careful control of confounding factors such as type and quality characteristics. Any studies which seek to examine the impact of ratios without reference to these factors are likely to provide potentially very misleading results. Again it needs to be stressed that the EPPE research design is intended to examine the impact of *packages of provision* delivered at the centre level, and also to explore the influence of pre-school type.

It should also be noted that because no significant links were found in earlier multilevel models testing staff or centre managers' qualifications these measures have not been included in the present analysis (to reduce the very large number of models compared). Earlier in this paper it has been shown that there is a link between ECERS scores and centre managers qualification levels and we believe that the effect of qualifications, may operate indirectly through the ECERS.

The relationship between ratio and children's progress in social and behavioural development

Four outcomes were studied at entry to school, after controlling for appropriate measures at entry to the EPPE study:

- i) Independence/Concentration
- ii) Co-operation/Conformity
- iii) Anti-social/Worried/Upset
- iv) Peer Sociability.

The multilevel strategy adopted for the analysis of the impact of ratios on these outcomes followed the pattern for cognitive outcomes. The possible impact of ratios was assessed with and without control for other relevant measures (namely type of pre-school provision and ECERS-R where these measures had been shown to be significant for a particular social behavioural sub-scale). The results are summarised in tabular form in Appendix 2.

Co-operation/conformity

If statutory ratios are considered in isolation it appears that positive child outcomes are found in provisions with higher ratios (i.e. 1-13 rather than 1-8). However, ratios are likely to be confounded with type and ECERS-R (sub-scale interaction) effects. The results indicate that when type is included the effect for ratios is removed (the type findings indicate better outcomes for nursery classes and poorer for playgroup, private and local authority). Controlling for these measures no significant difference is found according to statutory ratios.

Considering observed ratios³ with volunteers in the same model as type and ECERS-R (interaction) no significant differences in children's co-operation/conformity were identified in relation to ratio category. This result shows how important it is to consider ratio in combination with pre-school type. It seems that apparent effects related to statutory ratios may disappear if more sensitive data about observed ratios are used.

Independence/concentration

Testing the impact of the five different ratio measures provided little indication of any statistically significant link with this social behavioural sub-scale when control for pre-school type and ECERS-R is made.

³ For the observed measure without volunteers there is some indication that the ratio categories 5-8, and 8-12 show a significant negative impact in comparison with the category under 5.

Peer Sociability

Testing the impact of the five different ratio measures provided little indication of any statistically significant link for the Peer Sociability sub-scale. If statutory ratios are considered in isolation it appears that positive child outcomes are found in provisions with higher ratios (i.e. 1-13 rather than 1-8) although it is important to note that statutory ratios are confounded with type effects.

Neither observed nor statutory ratios were tested in combination with ECERS-R. This is because none of the ECERS-R sub-scales were found to be significant for this factor.

Anti social/worried/upset

Neither observed nor statutory ratios were tested in combination with either type or ECERS as these variables are not significant for this sub-scale. There was no evidence that the various ratio categories were related to children's outcomes on the social, behavioural sub-scale.

Overall the results of the analyses of children's social, behavioural development over the pre-school period provide no clear cut evidence concerning the impact of adult-child ratios and children's social, behavioural outcomes at school entry. This is in line with the results for cognitive outcomes and again points to the complexity in studying this area and need for detailed models to explore different influences.

Ratios and quality of provision

During the period of the EPPE research policy in early years practice moved from the introduction of the Desirable Learning Outcomes (DLOs) to the implementation of the Early Learning Goals (ELGs). During our data collection period pedagogical practices in pre-school reflected this shift. Methodologically EPPE was never designed to measure directly the impact of DLOs. However, the qualitative case-studies will illuminate aspects of the pedagogical practices in more effective centres. We have, however, measured aspects of the DLOs such as phonological awareness in the pre-reading measure (results reported above showed no significant link with ratios measures).

The ECERS E scale provides a measure of environmental quality related to the DLOs. The results of multilevel models in Appendix 1 show clear links between centres' ECERS-E scores and children's cognitive progress over the pre-school period for all four cognitive outcomes.

Ratios and children from socially and culturally mixed backgrounds

About 23 per cent of EPPE children came from minority ethnic groups. A larger percentage of children from ethnically diverse background were represented in the group of 'home' children (those who had no pre-school experience). In order to establish whether ratios are significant for children from different ethnic groups we first need to establish whether these children made less progress than their majority ethnic peers who had pre-school experience, after controlling for intake (child, family and centres variables). If this is the case, we could explore whether the minority children who fared better came from centres with higher ratios. These analyses can only be fully completed when our entire sample has passed from pre-school into school. Our analyses may shed some 'light on the real world' but only an experimentally designed study (with all its ethical implications) will be able to give more conclusive evidence of the possible impact of ratios associated with specific ethnic groups. Such a study would be very difficult to design and implement successfully.

Summary

The EPPE research on 141 pre-school centres drawn from 6 local authorities in England has shown great variation in observed ratios. Playgroups managed to reach their statutory ratios of 1:8 only through the contribution of volunteer staff, whereas many nursery schools consistently operated well below their permitted ratio of 1:13. This demonstrated the advantage of observed measures rather than relying on statutory numbers in any study of the impact of ratios. We found an apparent paradox: some centres with the least favourable ratios tended to have high quality ratings on ECERS-R and ECERS-E. This might be explained in part by the higher qualifications found amongst the staff in the LEA settings with 'official' ratios of 1:13.

The EPPE research indicates that the study of ratios is far from straightforward. In a non-experimental study influences will be confounded by other factors including pre-school type itself (related to staff qualification levels) and quality characteristics.

In addition, ratios can be defined in different ways. In this paper we argue that observed ratios including unpaid staff, i.e. with volunteers are likely to be the most appropriate. Moreover, the EPPE data illustrate that statutory ratios can bear little relationship to actual ratios experienced by children on the ground. In order to test for the influence of ratios on children's outcomes it is also important to use appropriate statistical models that control for the influence of child characteristics such as age, gender, and prior attainment as well as family and home learning environment characteristics. Only by studying children's progress and development over the pre-school period using adequate statistical controls for intake differences can the influence of other factors related to pre-school experience (such as ratio), be explored.

The present analyses are based on over 2,000 children and between 138 and 141 centres. The results suggest there is little clear cut evidence of an influence of ratios on children's cognitive or their social and behavioural development over the pre-school period. There are some indications that higher ratios may be associated with better progress in the area of language, but these results must be treated with caution. For example, there is reason to believe that the apparent benefits of higher ratios on language progress may be in part a consequence of the better pedagogical practices (measure by the ECERS-E) in LEA provision.

There is no clear evidence of benefits from lower ratios on child social, behavioural outcomes, but this again is likely to reflect the influence of other factors such as type of pre-school and quality characteristics.

The main conclusions are:-

- Variation in ratios within the pre-school is confounded with a range of potentially important variables such as staff qualifications/training, pre-school type and quality characteristics.
- The observations indicate that statutory ratios do not adequately reflect 'on the ground' ratios experienced by children in pre-school centres.
- Statistical analyses of children's cognitive and social behavioural outcomes reveal no clear association between ratio levels and better outcomes at entry to school which are independent of other variables.
- In one part of the cognitive domain, children's language progress across the pre-school period, the research suggests that higher observed ratios are associated with better progress. However, this relationship may reflect the influence of confounding factors.

The positive relationship between an observed ratio category of 1 adult to 8-12 children and language development is associated with the education sector (in some nursery classes and schools).

- In the social behavioural domain, the factor of co-operation/conformity at first appears to be associated with lower ratios but further analyses reveal that this apparent association is accounted for by variation in type of pre-school. The results suggest there is no independent effect of ratio on social, behavioural measures over the pre-school period.

Appendix 1 **Effective Pre-school, Primary and Secondary Education (EPPSE) Project**
(1997 – 2013)

Additional sources of information

The EPPSE website: <http://eppe.ioe.ac.uk> contains information on the sample, methodology, and many other aspects of the project. The website also contains links to the information listed below (see the 'Publications' sections of each phase of the study). For further information contact Brenda Taggart, Principal Investigator/Research Co-ordinator, 0207 612 6219, b.taggart@ioe.ac.uk

The Pre-school phase:

End of pre-school phase report and research brief

Final report of the pre-school phase:

<http://www.education.gov.uk/publications/eOrderingDownload/SSU-FR-2004-01.pdf>

Research brief on the pre-school phase:

<http://www.education.gov.uk/publications/eOrderingDownload/SSU-SF-2004-01.pdf>

There are twelve technical papers associated with this phase of the research - see <http://eppe.ioe.ac.uk>

Technical Paper 1 (1999)

An Introduction to the Effective Provision of Pre-School Education (EPPE) Project.

Technical Paper 2 (1999)

Characteristics of the Effective Provision of Pre-School (EPPE Project sample at entry to the study.

Technical Paper 3 (1999)

Contextualising EPPE: Interviews with local authority co-ordinators and manager.

Technical Paper 4 (1999)

Parent, family and child characteristics in relation to type of pre-school and socio-economic differences.

Technical Paper 5 (2000)

Characteristics of the centres in the EPPE sample: Interviews.

Technical Paper 6 (1999)

Characteristics of the centres in the EPPE sample: Observation profiles.

Technical Paper 6A (1999)

Characteristics of pre-school environments.

Technical Paper 7 (2001)

Social/Behavioural and cognitive development at 3-4 years in relation to family background.

Technical Paper 8a (2002)

Measuring the impact of pre-school on children's cognitive progress over the pre-school period.

Technical Paper 8b (2003)

Measuring the impact of pre-school on children's social/behavioural development over the pre-school period.

Technical Paper 9 (2004)

Report on age 6 assessments.

Technical Paper 10 (2003)

Intensive case studies of practice across the Foundation Stage.

Intensive case studies of practice across the Foundation Stage. Research Brief No RBX16-03

Technical Paper 11 (2004)

Report on the continuing effects of pre-school education at age 7

Technical Paper 12 (2004)

The final report

Sammons, P., Elliot, K., Sylva, K., Melhuish, E., Siraj-Blatchford, I. and Taggart, B. (2004). 'The impact of pre-school on young children's cognitive attainments at entry to reception'. *British Education Research Journal*, 30 (5), 691-712.

Pre-school pedagogy

Researching Effective Pedagogy in the Early Years (REPEY - 2002): Research Report 356

<http://www.education.gov.uk/publications/eOrderingDownload/RR356.pdf>

The Primary Phase:

End of primary school phase report and research brief

Final report from the primary phase: Pre-school, school and family influences on children's development during Key Stage 2 (2008). Research Report RR061

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RR061.pdf>

Final Report from the Primary Phase: Pre-school, School, and Family Influences on Children's development during Key Stage 2 (Age 7-11 (2008). Research Brief RB061

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RB061.pdf>

Cognitive/Academic outcomes:

Year 5

Influences on children's attainment and progress in Key Stage 2 (2007) Cognitive outcomes in Year 5. Full Report

<http://eppe.ioe.ac.uk/eppe3-11/eppe3-11%20pdfs/eppepapers/DCSF-RR048.pdf>

Summary Report (2007): Influences on children's attainment and progress in Key Stage 2 Cognitive outcomes in Year 5. Research Report RR828

<http://www.education.gov.uk/publications/eOrderingDownload/RR828.pdf>

Influences on children's attainment and progress in Key Stage 2 (2007) Cognitive outcomes in Year 5. Research Brief RB828

<http://www.education.gov.uk/publications/eOrderingDownload/RB828.pdf>

Year 6

Influences on children's attainment and progress in Key Stage 2 (2008) Cognitive outcomes in Year 6. Research Report RR048

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RR048.pdf>

Influences on children's cognitive and social development in Year 6 (2008). Research Brief RB048-049

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RB048-049.pdf>

Social- behavioural outcomes:

Year 5

Influences on children's development and progress in Key Stage 2 (2007) Social/behavioural outcomes in Year 5. Research Report RR007

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RR007.pdf>

Influences on children's development and progress in Key Stage 2 Social/behavioural outcomes in Year 5 (2007). Research Brief RB007

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RB007.pdf>

Year 6

Influences on children's development and progress in Key Stage 2 (2008) Social/behavioural outcomes in Year 6. Research Report RR049.

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RR049.pdf>

Influences on children's cognitive and social development in Year 6 (2008). Research Brief RB048-049

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RB048-049.pdf>

Affective attributes and outcomes

Year 5 only

Relationships between pupils' self-perceptions, views of primary school and their development in Year 5 (2008)

<http://eppe.ioe.ac.uk/eppe3-11/eppe3-11%20pdfs/eppepapers/RelationshipSelfPercpViewSchool16Sept08.pdf>

Pupils' self-perceptions and views of primary school in Year 5 (2008). Research Brief RBX-15-08.

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RBX-15-08.pdf>

Influences on pupils' self-perceptions in primary school: Enjoyment of school, Anxiety and Isolation, and Self-image in Year 5 (2008)

<http://eppe.ioe.ac.uk/eppe3-11/eppe3-11%20pdfs/eppepapers/Influences16Sept08.pdf>

Exploring pupils' views of primary school in Year 5 (2008)

<http://eppe.ioe.ac.uk/eppe3-11/eppe3-11%20pdfs/eppepapers/PupilsViewsYr5.pdf>

Study of Year 5 classrooms/schools

Variations in Teacher and Pupil Behaviours in Year 5 Classes. Full Report (2006).

<http://eppe.ioe.ac.uk/eppe3-11/eppe3-11%20pdfs/eppepapers/Tier%203%20full%20report%20-%20Final.pdf>

Summary Report: Variations in Teacher and Pupil Behaviours in Year 5 Classes (2006). Research Report RR817

<http://www.education.gov.uk/publications/eOrderingDownload/RR817.pdf>

Variations in Teacher and Pupil Behaviours in Year 5 Classes (2006), Research Brief RB817.

<http://www.education.gov.uk/publications/eOrderingDownload/RB817.pdf>

The Influence of School and Teaching Quality on Children's Progress in Primary School. (2008) Research Report RR028

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RR028.pdf>

The Influence of School and Teaching Quality on Children's Progress in Primary School. (2008) Research Brief RB028

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RB028.pdf>

Effective Primary Pedagogical Strategies in English and Mathematics in Key Stage 2: A study of Year 5 classroom practice drawn from the EPPSE 3-16 longitudinal study (2011)

Research Report:

<https://www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-RR129>

Research Brief (2011)

<https://www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-RB129>

The Secondary Phase:

End of secondary school phase report and research brief

Effective Pre-school, Primary and Secondary Education 3-14 Project (EPPSE 3-14) - Final Report from the Key Stage 3 Phase: Influences on Students' Development from age 11-14 (2012) Research Report RR202

<https://www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-RR202>

Effective Pre-school, Primary and Secondary Education 3-14 Project (EPPSE 3-14) - Final Report from the Key Stage 3 Phase: Influences on Students' Development from age 11-14 (2012) Research Brief RB202

<https://www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-RB202>

Academic outcomes in Year 9

Influences on students' attainment and progress in Key Stage 3: Academic outcomes in English, maths and science in Year 9.

(2011) Research Report

<http://eppe.ioe.ac.uk/eppse3-14/eppse14pdfs/Final%20EPPSE%20cogs%2026March2012.pdf>

(2012) Research Brief DfE RB184a

<https://www.education.gov.uk/publications/eOrderingDownload/DFE-RB184a.pdf>

Social-behavioural outcomes in Year 9

Influences on students' development in Key Stage 3: Social-behavioural outcomes in Year 9.

(2011) Research Report

<http://eppe.ioe.ac.uk/eppse3-14/eppse3-14pdfs/Final%20EPPSE%203%2014%20socs%20%2027march2012.pdf>

(2012) Research Brief DfE RB 184b

<https://www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-RB184B>

Affective attributes and outcomes in Year 9

Influences on students' dispositions in Key Stage 3: Exploring enjoyment of school, popularity, anxiety, citizenship values and academic self-concepts in Year 9

(2011) Research Report <http://eppe.ioe.ac.uk/eppse3-14/eppse3-14pdfs/Final%20EPPSE%203-14%20Dispositions%2025%20Jan%202012.pdf>

(2012) Research Brief DfE RB 184c

<https://www.education.gov.uk/publications/eOrderingDownload/DFE-RB184c.pdf>

Views of School in Year 9

Students' Reports of Their Experiences of School in Year 9.

(2011) Research Report <http://eppe.ioe.ac.uk/eppse3-14/eppse3-14pdfs/Final%20EPPSE%203-14%20Reports%20of%20school%20exp%2025Jan2012.pdf>

EPPSE as a programme of research

Effective pre-school provision in Northern Ireland (EPPNI Study)

See Department of Education, Northern Ireland (DENI) http://www.deni.gov.uk/rb_3_2006-2.pdf

Effectiveness of primary schools in England (Reading and Maths)

The Effectiveness of Primary Schools in England in Key Stage 2 for 2002, 2003 and 2004. Full Report (2006)

<http://eppe.ioe.ac.uk/eppe3-11/eppe3-11%20pdfs/eppepapers/Tier%201%20full%20report%20-%20Final.pdf>

The Effectiveness of Primary Schools in England in Key Stage 2 for 2002, 2003 and 2004, (2006) Research Brief RBX06-06

<http://www.education.gov.uk/publications/eOrderingDownload/RBX06-06.pdf>

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The Equalities Review. (2007), Fairness and Freedom: The Final Report of the Equalities Review

http://www.theequalitiesreview.org.uk/upload/assets/www.theequalitiesreview.org.uk/equality_review.pdf

Promoting Equality in the Early Years: Report to The Equalities Review

<http://www.equalitiesreview.org.uk>

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Mobility

Tracking pupil mobility over the pre-school and primary school period (2008): Evidence from EPPE 3-11. <http://eppe.ioe.ac.uk/eppe3-11/eppe3-11%20pdfs/eppepapers/TrackingMobility16Sept08.pdf>

Pedagogy

Researching Effective Pedagogy in the Early Years (REPEY - 2002): Research Report 356 <http://www.education.gov.uk/publications/eOrderingDownload/RR356.pdf>

Effective Primary Pedagogical Strategies in English and Mathematics in Key Stage 2: A study of Year 5 classroom practice drawn from the EPPSE 3-16 longitudinal study

Research Report:

<https://www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-RR129>

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Transitions from primary to secondary school

What makes a successful transition from primary to secondary school? (2008) Research Report RR019

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RR019.pdf>

What makes a successful transition from primary to secondary school? (2008) Research Brief
RB019

<http://www.education.gov.uk/publications/eOrderingDownload/DCSF-RB019.pdf>

Special educational needs

Early Transitions and Special Educational Needs Study

This sub-study produced 3 technical reports See <http://eppe.ioe.ac.uk>

Technical Paper 1 (2002)

Special needs across the pre-School period

Technical Paper 2 (2004)

Special educational needs in the early primary years: Primary school entry to the end of Year 1

Technical Paper 3 (2004)

Special educational needs: The parents' perspective

The Early Years Transition and Special Educational Needs (EYTSEN) Project (2003) Research Report 431

<http://www.education.gov.uk/publications/eOrderingDownload/RR431.pdf>

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