Summary

This project built on and extended an ESRC TLRP project (Group Work Scotland - ScotSPRinG) on effective collaborative group work in primary schools, particularly in science. It also investigated knowledge and motivation transfer across contexts, between primary and secondary education. Pupils who participated in the previous primary project on the development of high quality cooperative learning through group work were followed into secondary school. The conditions fostering such desiderata were identified, in the context of support for secondary teachers through continuing professional development and specially developed materials. It explored transfer to the secondary school environment of pupil domain-specific knowledge and skills and general social, communication and teamwork skills. The extent to which successful transfer was a function of the quality of group work in primary school and the quality of opportunities within the secondary school was explored.

Background

Previous Related Research

A Phase II TLRP project: 'Improving Effectiveness of Pupil Groups in Classrooms', involved the universities of London (Institute of Education), Cambridge, and Brighton, (the SPRinG project - www.tlrp.org/proj/phase11/phase2a.html). It sought to establish the conditions necessary for group activities to produce definite educational benefits (in terms of learning and quality of classroom relationships), and to design ways of helping teachers to introduce effective group work into their classes at Key Stages 1-3 of the National Curriculum in England. The Group Work Scotland (ScotSPRinG) project was an extension and development of this project into the Scottish context, also wholly funded by the ESRC TLRP programme.

The full title of this project was "Supporting Group Work in Scottish Schools: Age and Urban/Rural Divide" (web sites at www.tlrp.org/proj/phase11/Scot_extb.html and www.groupworkscotland.org). The project extended group work support to science teaching with 10-12 year olds in four types of primary school in Scotland:

- Small rural schools with composite classes and cross-age group work;
- Rural schools with same-age classes and group work;
- Urban schools with composite classes and cross-age group work;
- Urban schools with same-age classes and group work.

A brief list of main conclusions is offered here:

1. Experimental pupils engaged in group work in science gained in science tests significantly more than control pupils;
2. There was some evidence of gains in mathematics, suggesting some spontaneous transfer;
3 In achievement gains, the differences between urban and rural, composite and single-age classes were not large – all types gained, although single-age urban tended to gain most;
4 In the social domain, single-age classes showed gains in in-class relationships, rural classes showed gains in out-of-class relationships from a higher baseline;
5 Urban single-age classes showed gains in self-esteem;
6 Positive changes over time in quality of process interaction in the classroom (evidence of higher implementation integrity) were associated with better outcomes – urban single-age classes started low and made the biggest gains;
7 There was some evidence of different “types” of group work in practice – one more cognitive-discourse focused which resulted in higher achievement gains, and one more socio-emotionally focused which resulted in higher social gains;
8 Interaction was mostly cooperative learning in all class types – but where peer tutoring did occur it seemed very effective.

Rationale

Sustaining effective progression and transfer of learning between primary and secondary school has been a cause for concern for some time. Research suggests schools are relatively effective in "smoothing" transition with regard to socio-emotional aspects, but relatively ineffective in terms of students' learning progress (e.g., Galton, Gray, & Ruddock, 2003). In parallel, the teaching of science in secondary schools (especially in the first two years) has been a cause for concern for some time. Small-group discussions have been advocated in secondary school science for a number of years. However, a recent systematic review found that whether and how such discussions were structured was crucial for effectiveness (Bennett, Lubben, Hogarth, & Campbell, 2004).

Beyond such specifics, the concept of "transition" has rarely been clearly defined, let alone been embodied in an over-arching theoretical model. Research into the 'transition' of pupils from primary to secondary schools has tended to focus on the organisational structures and processes surrounding the progression of pupils from one part of the education system to another. By contrast, the theoretical concept of 'transfer' of learning has been explored very thoroughly in the cognitive science literature. However, the link between these has not often been made explicit.

From a theoretical perspective, the issue of transfer of learning across time and space has been a subject of sometimes polarised debate. The proposers took the (evidence-based) view that transfer of learning is possible but not automatic, and especially for “far” rather than “near” transfer the process requires scaffolding to ensure that it happens for all children. From the research literature, 16 factors important in promoting transfer have been identified:
1. Realisation that transfer is required
2. Motivation (including perceptions of utility)
3. Self-confidence
4. Teaching of generalisable principles & concepts
5. Social construction/communication of knowledge + skills + meta-cognition
6. Meta-cognitive/rule-induction strategy instruction
7. Meta-cognitive questioning
8. Meta-cognitive prompting
9. Fostering abstraction of principles from many examples
10. Emphasis on structural similarities of diverse problems
11. Control information-processing demands by reducing distracters
12. Student self-monitoring of process strategies used
13. Student self-monitoring of strategy effectiveness
14. Student personal goal-setting
15. Scaffolded self-regulation

In the original Group Work Scotland intervention, experimental group primary teachers were encouraged to have pupils engage in activities likely to enhance some of these (particularly 1-5, 10, 12-13, 15). The activity cycle for each session included Briefing and Planning prior to activity and Debriefing after it, the latter giving ideal opportunity for transfer-enhancing discussion. However, it was evident from the classroom observations that different teachers were able to use these opportunities more or less well. The new investigation presents the opportunity to address issues of considerable significance concerning the role that might be played by group work in smoothing the transfer from primary to secondary school. The Scottish system encompasses a wide variety of primary school sizes and methods of organisation. Such variation is lessened at secondary level, however, where schools tend to be larger, and there might be greater emphasis on whole class teaching and less use of exploratory group work.

Two points that merit examination arise from this shift. The first is how far it is the case, in general terms, that support for increased provision of group work at secondary school level helps bridge the transition from primary school activity, by connecting back to pupils' previous experiences of educational practices, and restoring a sense of engagement in familiar tasks. The second is how far any such effect is moderated by the exact nature of children's primary school experience. For instance, the transition to secondary school represents a substantially bigger shift for rural children than for urban, since it is likely to involve them in being bussed out of their immediate community, and being required to interact for the first time with others who are largely unfamiliar to them. This jump being larger, there is some reason to expect them to experience greater difficulty over the transition, and thus to benefit more from the provision of connections back to prior practices. At the same time, however, this may present greater difficulties, since secondary school organisation might typically preclude cross-age group work, so even where joint activity does occur it may tend to have a less familiar dynamic, and thus to be less effective in smoothing the primary-secondary transition. Gathering hard data on these points not only addressed the issue of transition itself, but served to test further the generalisability of the project intervention methodology at secondary level across different types of circumstance, and in consequence added further to the elaboration of the social pedagogy aimed at by the original project.

Objectives

To explore whether gains accruing from the development of high quality cooperative learning through group work (in attainment in science, transferable skills and socio-emotional aspects of learning):

- Transfer at follow-up after transition from primary into secondary,
- Can be supported by Continuing Professional Development and resources for secondary teachers,
- Transfer more or less as a function of quality of primary school group work experiences,
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- Transfer more or less as a function of quality of secondary school group work experiences.

At this stage in time, the data analysis has not proceeded far enough to enable us to be fully definitive with regard to the third and fourth of these items. However, we have been able to explore some hypotheses, and the data awaits further investigation. This has been handicapped by the appointment of our principal analyst Andrew Tolmie to a chair at the Institute of Education, following an extended visit to Australia. However, we are confident that upon his return data analysis will continue. A further difficulty is the entry to hospital of the principal investigator Keith Topping on December 11, requiring the early submission of this report.

Methods

The project would be partly a follow-up study (P7 pupils involved in the schools in the previous project would be followed into S1) and partly an intervention study (pupils followed-up or not would be subject to group work in the secondary school). Some of these pupils would be engaged in no group work, and some would be engaged in group work initiated by project intervention. Of course, P7 pupils from one primary school do not all attend the same secondary school. The secondary school recruiting the majority of P7 pupils from each primary was the focus for intervention (and control follow-up).

Target Secondary schools were those to which the primary project pupils had transferred. A total of 10 relevant secondary schools were identified in the West of Scotland, and a further 11 in the East. Recruitment efforts were focused on the ScotSPRinG project participants who were now attending year 1 of the Secondary school, and some of their classmates for comparison purposes. One science class from each year was targeted in each school. Where possible, this class contained the largest numbers of follow-up pupils in the original sample. Assessment included follow-up and non-follow-up pupils (within-school controls) within this class, and follow-up pupils from other classes.

The intervention was implemented in those classes where science teachers had expressed their willingness to participate. The sampling situation in the East is that of 11 possible schools, there are 4 intervention schools yielding 9 intervention classes (n=128 pupils of which 21 are primary follow-ups, 107 are newly intervened), plus 4 control schools and in addition one control class in one of the intervention schools (yielding 140 control pupils of which 80 are follow-up controls plus 38 other follow-up controls in the intervention schools = total 118 follow-up controls). Three schools declined to participate. Of the 11 schools in the East, four agreed to be intervention schools, four were control schools (yielding follow-up and non-follow-up on-intervention between-school control groups), and three had refused to participate. In the West, out of a total of 10 schools, four agreed to be intervention schools, and four agreed to be control schools, while two schools refused to take part.

The project experienced sampling difficulties. These had been anticipated, but their scale was perhaps unexpected. In both East and West the numbers of high schools wishing to participate was not large. In the East the high schools more or less kept to the plan, although there was some demand for additional materials which had not been anticipated. However, there was considerable variation in the quality of implementation of the project. In the West the high schools were more likely to want to depart from the plan, varying what they did more considerably, and this resulted not only in
customisation of materials, but also some changes in materials. This project did launch
upon the participating high schools without a great deal of advance notice (given the
short time scale), and a longer project with more developmental time to cultivate schools
would probably have resulted in greater take-up of a somewhat more orderly nature.

Key teachers from the receiving secondary schools who agreed to participate as
intervention schools were identified as leaders in the development of group work
methods in their schools. They attended the project in-service days and received
materials and consultation. Around this, outcome measurement occurred at two main
points: Middle of Autumn Term 2006 and End of Spring Term 2006-7. Data collection
in the middle of the Autumn term 2004 explored whether any loss of relevant capabilities
had begun to occur, as well as providing a baseline for the post-test.

Intervening teachers were provided with packages of materials and classroom resources
and be invited to take part in a total of three CPD days: (1) general group work strategies
and activities, pupil training in the skills necessary for effective group work, with
emphasis on social and communication skills; (2) specific and structured group work in
science in the topics of Materials and Earth in Space; (3) a final debriefing and evaluation
session. In the last session, teachers took part in a brief interview session and completed
a questionnaire concerning their experiences and perceptions of the group work initiative
or any further issues they feel are relevant.

Measures included some but not all measures from the original ScotSPRinG project, or
adaptations thereof, together with some new measures. Particularly important were tests
of science attainment in the two areas of science taught through group work, and the
sociometric measure, which had already shown substantial pre-post gains in the original
project. Wider attainment measures in science using a broad test based on the AAP
materials was included. Self-esteem measures used in the previous project (Harter) would
be used together with measure of attitudes to cooperative learning and group work used
previously (STOP). An additional measure of motivation in science which has recently
become available was. Pupil self-assessment of transferable skills in cooperative
teamwork was used.

In the cognitive domain, a 21 item AAP assessment in general science has been derived
from the full standard AAP test. Specific science tests have been developed for the
purposes of the current study, which tap into the targeted group work topics, one on
_Earth and Space_ (30 items) and one on _States of Matter_ (30 items). Finally, the _Forces
science_ test, comprising of 16 items, will be administered at the pre-test stage only, to assess
enduring knowledge on this topic continuing from the primary project. In the affective
domain, _Attitudes to Science_, a 31-item questionnaire, will be used to explore pupils’
attitudes towards the school subject of science. A modified version of Harter’s (1985)
“Self-Perception Profile for Children” will be used; the _What I am like_ questionnaire,
which contains a total of 20 items designed to assess Global Self-worth as well as a total
of 3 domain-specific judgements of competence or adequacy (Scholastic Competence,
Social Acceptance, and Close Friendships). Attitudes to group work will be measured by
a 6 item questionnaire, namely the _My Feelings About Group Work (MFAGW)_ , the
development of which was based on the ScotSPRinG project. Based on the CLEF
(Cooperative Learning Evaluation Form) measure used previously, two CLEF
questionnaires were used, one for pupils (_CLEFP-lite_), and one for their teachers
(_CLEFT-lite_); each comprises 17 items and is designed to assess the development of
transferable skills in group work. Finally, as in the ScotSPRinG project, a (modified)
Sociometric measure will be employed in order to investigate pupils' social relationships and patterns of interaction in and outside school. *People in your Class*, presented in the form of a matrix, will ask adolescents to consider four key context questions (columns) regarding their relationships with all other members of their science class (rows).

Researchers visited secondary schools at intermediate points throughout the experimental period to offer consultative support and assay implementation quality of group work. This involved direct observation in classrooms. The researchers used an adaptation of the observation schedule utilised in the original project. The ecology of each classroom was mapped. Group work interactions were characterised as collaborative, cooperative learning, peer tutoring or a mixture.

Analysis subsequently explored experimental/control differences, and whether primary experience in rural or urban schools or in single-age or composite classes advantages or disadvantages pupils on transition to secondary. Previous data on quality of interaction in group work in the primary school was related to outcomes in the secondary school, as was new data on quality of interaction in group work in the secondary school.

The original Group Work Scotland project obtained ethical approval within the respective universities. No ethical problems subsequently arose. Informed consent for involvement was obtained without difficulty from all local authorities, schools, teachers, pupils and parents. As the pupil participants were followed up in the current project, it proved straightforward to obtain extension of existing permissions. We ensured that all children taking part in the study did so with full informed consent, the necessary procedures for obtaining this consent being subject to scrutiny by the relevant Ethics Committee of each of the two Universities and in conformity with the ethical guidelines of the relevant professional associations. Secondary school teachers participating did so voluntarily. Feedback and debriefing was provided to participants. All data is held in confidence and anonymously in accordance with the requirements of the Data Protection Act.

**Results**

Comparison of follow-ups with non-follow-ups at pre-test indicated significant differences. A one-way Anova on Forces yielded a higher score for follow-ups than for non-follow-ups: F(1,595) = 12.18, p = .001, ES = .02; Follow-ups = 23.07, Non = 21.40. This suggests that the primary intervention did indeed have a continuing effect. However, there is some evidence that non-follow-up pupils might have some advantage in other aspects of general science: F(1,560) = 0.61, ns; Follow-ups = 27.11, Non = 27.76. This difference is however small.

No significant difference was evident on attitudes to science: alpha = .69, F(1,524) = .80, ns; Follow-ups = 29.68, Non = 30.17. However, this begs the question of whether respondents were considering science as it was in primary school or science as it was in secondary school. Surprisingly, Feelings about group work showed no significant difference: alpha = .82, F(1,574) = 0.30, ns; Follow-ups = 23.45, Non = 23.24. Also surprisingly, the cooperative learning skill s checklist CLEFP showed no significant difference: alpha = .85, F(1,562) = 0.00, ns; Follow-ups = 38.93, Non = 38.93. On self-esteem, there was no significant difference: alpha = .86, F(1,462) = 0.16, ns; Follow-ups = 71.98, Non = 71.64.
Sociometric tests were explored with respect to Pre-relations. Of the six items, only two were significant, and in these cases the non-follow-up pupils scored higher. Work with, class $F(1,248) = 4.69, p = .031$; Follow-ups = 24.12, Non = 29.88. Work with, group $F(1,247) = 0.71, \text{ns}$; Follow-ups = 58.27, Non = 62.87. Break with, class $F(1,248) = 2.60, \text{ns}$; Follow-ups = 16.86, Non = 20.02. Break with, group $F(1,247) = 0.77, \text{ns}$; Follow-ups = 43.75, Non = 48.47. Outside with, class $F(1,248) = 5.48, p = .020$; Follow-ups = 10.58, Non = 14.27. Outside with, group $F(1,247) = 0.55, \text{ns}$; Follow-ups = 34.33, Non = 37.11.

Thus in general, the follow-up pupils and the non-follow-up pupils appeared to be similar at pre-test in this project (which was good for the next stage of the intervention), with the exception of performance in the Forces test, where the follow-up pupils showed a sustained advantage.

Turning to the interactions between intervention and control in relation to follow-up and non follow-up while considering the pre vs. post test scores, on Specific Topic 1 Pre vs. post $F(1,348) = 39.04, p < .001, 0.04 \text{ vs. } 0.50$; follow-up vs. non $F(1,348) = 4.66, p = .032$, effect as at pre-test. In other words, the pre-post differences were significant, but the non-follow-ups did better than the follow-ups: an unexpected result. On Specific Topic 2, Pre vs. post $F(1,296) = 9.02, p = .003, 0.10 \text{ vs. } 0.36$; pre/post x condition x follow-up $F(1,296) = 6.99, p = .009$, intervention gain more than controls, but only if non follow-up. In other words, again a significant difference, with intervention pupils doing better, but only if they were non-follow-up.

On General science Pre vs post $F(1,355) = 92.28, p < .001, 27.73 \text{ vs. } 32.73$; pre/post x condition $F(1,355) = 5.51, p = .019$, intervention start higher, controls show greater progress. In other words, again a significant difference, with some evidence that the controls show a tendency to catch up with the intervention pupils. On condition x follow-up $F(1,355) = 5.43, p = .020$, intervention non-follow-up do better. In other words, the non-follow-up pupils again scored better than the follow-ups.

In general, considering all the results together, there is evidence here that the intervention results in a gain in science attainment, but the non-follow-ups seem to advance significantly more than the follow-ups. Thus there is little evidence of any enduring impact of the primary school intervention when the pupils come through into the world of secondary school.

However, this is considering the data as a whole, in a way which masks the variation between intervention schools. Additionally, there is a question about the control schools, since these were somewhat self-selected, and might have been schools of higher socio-economic status or offering alternative programmes of equal effectiveness.

For instance, comparing intervention teacher 1 with intervention teacher 5 (in different schools), we find a significant difference between the pupils they did group work with for both science topics ($p=.004, .046$), despite these pupils being in more than one class. Indeed, on Specific Science Topic 1, a one-way Anova indicated a significant difference between teachers $F (13, 268) = 10.026, p<.001$. On Specific Science Topic 2, $F (13, 257) = 5.715, p<.001$. It seems that quality of implementation was very varied within the intervention schools.
However, we found little evidence that the quality of secondary experience as indicated by observations consistently influenced the outcomes for pupils. All the correlations between observed factors and results on Specific Science Topics 1 and 2 were insignificant. This was the case in East and West analysed separately.

However, there might be a differentiation here between those follow-up pupils from rural locations and those from urban locations. One-way Anovas on pre-test (in high school) scores on Forces, Specific Science Topic 1, Specific Science Topic 2 and General Science all indicated that rural pupils performed more highly than urban pupils. F(1, 137) = 2.045 (p=.155), 6.100 (p=.015), 2.771 (p=.098) and 9.610 (p=.015). Not all of these comparisons were significant, but two of them were.

There was some indication from the sociometric data that the follow-up pupils tended to focus upon group relations rather than relations with the whole class at pre-test. By post-test, the non-follow-up pupils also tended to have shifted in the same direction. This was particularly marked with the East pupils.

Summary

There was evidence that follow-ups were significantly advantaged on the Forces pre-test, suggesting the primary intervention had a continuing effect into the early stages of the secondary school. On other measures there were few consistent differences at pre-test.

On the pre-post specific science tests, both groups increased, but the non-follow-ups increased more than the follow-ups. On the pre-post general science test, non-follow-ups increased more than follow-ups. In general, considering all the results together, there is evidence here that the intervention results in a gain in science attainment, but the non-follow-ups seem to advance significantly more than the follow-ups. Thus there is little evidence of any enduring impact of the primary school intervention when the pupils come through into the world of secondary school. It seems that transition eliminates these. The implications here for any transfer of other forms of learning are considerable.

However, there is considerable difference in the quality of implementation of the intervention between schools, so these overall results might be misleading. Further analysis of schools on a case by case basis is warranted. Nonetheless, there was little evidence that observations of quality of implementation were correlated with outcomes in attainment.

However, there might be a differentiation here between those follow-up pupils from rural locations and those from urban locations; rural pupils doing better. This is in contrast to the expectation that rural pupils will have greater difficulty adapting to secondary school.

On sociometric measures at pre-test, the non-follow-up pupils scored significantly higher on Work With In Class and Outside With Class, indicating greater orientation to the whole class. Follow-up pupils tended to focus upon group relations rather than relations with the whole class, and by post-test the non-follow-up pupils also tended to have shifted in the same direction.

Further analysis will concentrate on investigating schools and teachers on an individual basis.
REFERENCE No.

Activities and Outputs

The ESRC project prior to this one (ScotSPRinG) has so far yielded 1 publication accepted, one submitted in revision, two submitted and one in preparation, with reporting at several conferences. Something similar is anticipated for the current project once data analysis is complete. Already a paper has been presented to the TLRP conference in Glasgow 20-22nd November 2006 and a paper has been submitted to the EARLI conference in Budapest in August 2007. Presentations at BERA and SERA are anticipated in 2007. The data will be lodged in the ESRC data archive. However, for the moment dissemination is pending further analysis of the data.

Impacts

No commercial exploitation is being discussed at the moment. However, the Enjoying Science Together materials by Topping and Thurston suitable for peer tutoring and cooperative learning in science (noted as an output to the ScotSPRinG project) have been digitised and will be made available to all teachers in Scotland via Glow, the Scottish Schools Digital Network. The adaptations to the ScotSPRinG CPD materials made for secondary teachers might lend themselves to further dissemination, but we are waiting for the full data analysis before that.

Future Research Priorities

The Group Work Transition project has already had an influence on other projects. A large randomised controlled trial largely funded by ESRC has been developed in Scotland, involving 125 primary schools in peer learning in reading and mathematics, with exploration of differences between light and intensive application and between cross-age and same-age working. A further bid to ESRC on peer learning with ICT under the Technology Enhanced Learning call is in submission. A bid to ESRC under the Science and Mathematics call is pending, involving peer learning in science and mathematics in primary and secondary schools.

References
