Title Page

TITLE: Effects of Group Work Training on Science Attainment in Rural and Urban Schools.

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Abstract

This study investigated the effects of collaborative group work skills training on pupil attainment in science. Twenty-four experimental classes were drawn from schools in rural and urban settings. Pupils in experimental classrooms engaged in general group work skills training and two structured group work activities in science. Attainment was assessed using the Performance Indicators in Primary Schools (PIPS) instrument. Significant gains in science attainment were observed in the experimental urban and rural classes. Significant changes in observed group work behaviours were observed in both urban and rural classes. Changes in group work behaviour were correlated to increased science attainment. The implications for practice, policy and future research are explored.

Acknowledgement

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The project researched the effects of collaborative group work on attainment in primary science. To achieve this, the aims of the project were as follows:

- To identify representative samples of teachers in rural and urban schools and recruit these teachers to continuing professional development (CPD) programmes which supported them in planning and implementing group work training activities for children. The teachers were provided with science curriculum materials to facilitate the introduction of effective group work practices within the context of their classroom.
- To collect data on attainment in primary science and assess the impact that training pupils in collaborative group work skills could have on cognitive development in this area.
- To establish whether there were differences in outcomes associated with the intervention in terms of classes located in rural and urban settings.

Theoretical overview

Vygotsky (1978) placed emphasis on the role of social interaction, language and discourse in the development of understanding,

particularly interaction with more advanced learners, but at an appropriate level of challenge. This has been termed social constructivism. Vygotsky's views on peer assisted learning suggested that in peer interactive contexts children could scaffold each other's learning and engage in co-construction (Baines, Blatchford & Kutnick, 2003).

Slavin (1996) reviewed four major theoretical perspectives on co-operative learning.

- Motivational,
- Social cohesion,
- Cognitive elaboration,
- Cognitive developmental.

The motivational perspective was described as co-operative approaches that enhanced learning when group members helped others to succeed and encouraged them to exert maximum efforts. The social cohesion perspective suggested that the effects of cooperative learning on achievement were strongly mediated by the cohesiveness of the group. Students helped one another learn because they cared about one another and wanted one another to succeed. Both the cognitive elaboration and cognitive developmental

perspectives asserted that students required training to advance intellectually through working in groups. This training required learning how to give explanations to each other, and how to present, comment on and critically discuss each other's viewpoints. Slavin concluded that the opportunity for students to discuss, argue, present and hear one another's' viewpoints were critical elements of cooperative learning with respect to student attainment.

Previous research on group work

Co-operation through talk enabled learners to reconstruct and elaborate their ideas through peer dialogue (Bereiter, 2002). Talk was also reported to have stimulated students to ascertain and resolve, for themselves, what was confusing or problematic (Brophy, 2002). Talk is the primary tool for the joint construction of knowledge by teachers and learners in learning contexts (Mercer, 1996). Groups composed of students who gave more explanations were found to be most effective at promoting attainment in cooperative learning contexts (Slavin, 1996). Group learning contexts characterized by giving or receiving answers without explanation showed reduced attainment (Webb, 1989). The importance of ideas being explored, the development of joint conceptions (Barnes & Todd, 1977) and learners having shared

responsibility for the task (Ogden, 2000) have each been found to be important for effective group work to take place.

Group work has been reported to have enhanced self-esteem and motivation (Slavin, 1991; Galton & Williamson, 1992), increased social interaction between pupils (Slavin, 1991) and developed exploratory talk (Tough, 1977). A number of factors influence the effectiveness of group work. These included the age and ability of children (Dean, 1992), and the effectiveness of the management of the classroom environment (Doyle, 1986). The effectiveness of group work is influenced by the size and number of groups in a classroom setting. Groups that are too large result in splintering and the beneficial effects of the group activity may be lost (Galton & Williamson, 1992). To promote effective group work, teachers must take account of the social, cognitive and communication developmental levels of the children (Baines, Blatchford & Kutnick, 2003). Whilst teachers often reported that they utilised group work as a teaching and learning strategy in the classroom, this ‘group work’ often actually involved working alone or listening to teacher instruction (Tizzard, Blatchford, Burke, Farquhar & Plewis, 1988; Galton & Williamson, 1992; Galton, Hargreaves, Comber & Pell, 1999; Wilson, Andrew and Sourikova, 2001). In such learning contexts, talk did not enhance learning and children did not get the benefits of the social aspects of learning in a group (Galton &

Williamson, 1992; Galton, Gray & Ruddock, 1999). In settings where teachers did not plan effectively and ensured that tasks required group collaboration, then the result was individualised working with little group activity (Kutnick & Rogers, 1994).

The choice of group composition can be important for learners. Groupings that combined high and middle, and middle and low attaining pupils in groups were reported to be most effective (Webb, 1989). The type of curricular task being undertaken has also been reported to be influential to the successful implementation of group work in primary classrooms. Science is reported to lead itself to classroom activities that can create effective contexts for undertaking group work (Howe, Tolmie, Duchak-Tanner & Rattray, 2000). CPD was reported to be vital to the implementation of co-operative learning. In order to employ co-operative learning strategies teachers needed access to training that included: (1) the theory and philosophy of co-operative learning; (2) demonstrations of co-operative learning methods; and (3) ongoing and collegial support at the classroom level (Slavin, 1996). With such a complex and disparate set of issues influencing the effectiveness of group work in the classroom, further work in this area is essential to fully expand our understanding of the pedagogy of effective practice when using group work.

The attainment of pupils has been demonstrated to be raised through the use of group work learning contexts (Slavin, 1987; Lou, Abrami, Spence, Poulsen, Chambers & D'Apolonia, 1996). Increased attainment in mathematics as a result of adopting effective group work strategies have also been reported (Topping, 2002). In a survey of 804 schools, 34 % of schools reported that they utilised group work as a strategy to promote increased attainment. (Hallam, Ireson & Davis, 2004). Providing structure to group work activities resulted in more effective group learning contexts and increased attainment in a sample of 223, 13-14 year old pupils in a study in an Australian school setting (Gillies, 2004). This study also concluded that teaching of group work skills to students allowed them to perform better in unstructured group settings and promoted attainment across curriculum areas. Ninnes (2002) reported that there was little opportunity for group discussion in structured science schemes of work produced by commercial publishers. It was concluded that there was a need for effective group work that promoted talk and prompted children to think about science curriculum related issues.

The implementation effects of groupwork training may differ dependent on the geographical location and school setting. It was reported that teacher behaviour was different in large and small classes in Norwegian rural schools. Teachers in larger classes exhibited greater

control on individual behaviour. This led towards the development of classroom environments dominated by teaching and mediation of knowledge. Smaller rural classrooms tended towards individual and collective freedom. This allowed social constructivist approaches to develop more effectively (Kvalsund, 2004). It was reported that pupils in rural schools in Northern Ireland had more extensive cross age and cross sex peer relationships that pupils in urban schools (Gallacher, 2005).

Research questions

The research project aimed to answer the following research questions:

1. What were the effects on attainment in science of teacher intervention designed to enhance group work skills in pupils?
2. Were there significant observable differences in the effectiveness of the intervention between classes from urban and rural schools?
3. Do differences in interactive behaviour during group work help explain differences in outcomes?

Methodology

Design

A pre-post design was coupled with gathering process data regarding implementation integrity. The intervention took place during the period of one academic school year between August and June. Initial contact was made with the schools in August. Schools were selected for the experimental groups by September. Data was collected on the attainment tests from 24 study classes. Twelve classes were from a rural location and twelve classes were from an urban location. The main dependent variable measured was attainment in science. In addition, observations regarding the extent to which group work was being utilised in science learning contexts were undertaken. Teachers from the experimental classes were recruited to a CPD programme that focused on enhancing group work practices in the classroom setting. The first CPD day took place for teachers in October. Pre-intervention data was collected in October. Teachers trained pupils from their class in group work skills between October and December. The second day of CPD for teachers took place in February. The teachers taught the two science group work topics in their classes between February and May. A final CPD day for teachers was held in May. Post-intervention data was collected in June.

Sample

Questionnaires were distributed to schools in eight local authority regions in central Scotland. The local authority regions were selected on the basis of similarity in socio-economic conditions and population demography. From a pool of interested schools, 24 sample classes were selected. The selected schools provided an even balance of 12 urban and 12 rural classes. The description of the Scottish Executive 2001 Census (General Register Office for Scotland, 2004) was used to classify schools as urban/rural. The postcode of the school was used to determine whether it had it was associated with a local population of more than 10000 people (urban) or less than 10000 people (rural). School roll, associated residential population and numbers of free school meals were used as indicators of school profile. The classes were chosen on the basis of fitness for purpose. It was not the intention of this study to produce a randomised controlled sample, but rather to look for implementation effects in rural and urban experimental conditions. The number of pupils in each condition in the sample who completed pre and post test instruments was n=148 (rural), n=184 (urban). The percentage free school meals in the urban and rural classes were 20.72 (sd 10.43) and 13.69 (sd 10.14). One-way ANOVA indicted that free school meals were significantly higher in the urban than rural sample ($F=66.28$, df (1,573), $p<0.001$).

Intervention

Continuing professional development for teachers

The CPD took place over three days spaced out pre, during and post intervention. The cost of employing supply/substitute cover to allow classroom teachers to attend these CPD days was recovered by participating schools. The main aim of the CPD was to enhance pedagogical approaches to group work adopted by the teachers in the experimental sample. In order to achieve this, the CPD programme focussed on a number of issues that highlighted how the effectiveness of group work could be influenced. These issues included the size and number of groups (Galton & Williamson, 1992), working arrangements put in place by the teacher (Kutnick & Rogers, 1994), the nature of adult support afforded to the learners (Blatchford, Kutnick, Baines & Galton, 2003), the choice of group composition (Webb, 1989). Teachers were provided with advice on troubleshooting if the learning contexts that they established did not function effectively. Materials were adapted for use in a Scottish context from those developed by the team looking at social pedagogical research into grouping (SPRinG) (Baines, Blatchford & Kutnick, 2003). In addition to developing the pedagogical awareness about effective group work teaching skills, the CPD had a number of aims:

- To train teachers in techniques of how to develop generic group work skills in children. The teachers were provided with a manual that included about 20 hours of classroom based group work training activities for children.
- To exemplify how generic group work skills could be incorporated into the science curriculum (particularly two science topics - states of matter and forces and friction). The science curriculum packs included lesson plans and teaching materials for approximately 40 hours of classroom based activities.
- To ensure the teachers had subject content knowledge and confidence to deliver two science units.
- To familiarise the teachers with instruments and measures that would be utilised.

Instrumentation

Attainment measures

Measures of standard attainment in science were completed utilising the PIPS instrument for 11 and 12 year old pupils (Curriculum, Evaluation and Management Centre, 2002a). The PIPS test was only administered to 11 and 12 year old pupils from these classes at both pre- and post- intervention. The PIPS instruments are tests of

curriculum attainment developed by the Curriculum, Evaluation and Management Centre at the University of Durham. The tests are annually reviewed for validity and reliability. They are widely used (thousands of schools in over 25 countries). The PIPS instruments has been developed such that the average standardised score for the Primary 7 aged children that composed the sample for this study (11 and 12 year olds) was 50. This necessitates a conversion from the raw score to a standardised score. The PIPS instrument was administered by the teachers in their own classrooms in accordance with the Teacher Administration Instructions (Curriculum, Evaluation and Management Centre, 2002b). Standardised scores are presented in the data set. The PIPS instrument assessed science attainment by means of a 43 item test, each item having 4 multiple choice options. The PIPS instruments had high figures for reliability and validity. Reliability (Chronbach's alpha) scores previously reported of the PIPS assessments used in this study were α=0.89. These reliability scores were reported for a study involving 642 Primary 7 pupils in Scottish schools (Merrell, 2005).

Observational analysis

The observation schedule used was developed from one previously utilised by the SPRinG team (Blatchford, Kutnick, Baines & Galton,

2003). This schedule was supplemented with other behaviours reported to promote interactive cognitive activity (King, 2000). Two observations of group work lessons were undertaken. One observation was conducted pre intervention and one observation was conducted post intervention. Prior to the first observation, 6 children were randomly identified from the class list. Observations were based on a 40-second window –12 to focus in, 16 to observe, 12 to record. The observations started with the first of the preselected target children. Eight successive windows were observed and recorded for that child before moving onto the second target. The second child observed was another child from the same base or group as the first, of the opposite gender. Eight successive windows were observed and recorded for this child before again moving onto the third target. The next preselected child was the third target. Observation now cycled between preselected children with the same pattern of gender target change between observations. For each target eight windows were observed and recorded before moving on. Scores are presented as the total observed behaviour in each category (min=0, max=8). The teachers were asked to provide a lesson that had a problem solving context for the first group observations. The same six children were observed during the second observation session, so that longitudinal data on interactions was obtained. The second observation took place during one of the science lessons provided to the teachers as part of the intervention.

This meant that in both the pre and post test observation lessons, children were only observed when they are actually supposed to be doing group work. Observations were only recorded during the groupwork sections of the lessons (not during briefing or debriefing). Multiple codes were used where appropriate for all dialogue elements falling within the same observation period. For example if the target child gave an instruction and then asked an open-ended question, both were recorded. An example of the observation schedule is contained in Appendix I. For simplicity, each interactant was recorded once only during a given window no matter how many times the target child engaged with an interactant. For example if the child started by talking with another child in the same group, then asked the teacher a question, and then returned to talking with the first child, this would be recorded just as the child talking to someone in the same group, and with the teacher. Only data from children who were present in the initial observations and the second observation visit in addition to completing both the pre and post test PIPS tests is presented in the paper. The number of children observed from each sample for whom pre and post test attainment data was also available was n=37 (urban) and n=40 (rural).

Observations were undertaken by two research assistants employed for data gathering purposes for this project. Training was given to each

research assistant. Reliability trials were undertaken prior to the first observation being undertaken. Each research assistant independently coded 8 successive windows for each of 8 different target children, noting the interactants and the frequencies of each type of dialogue (giving 64 separate sets of coding each). Data indicated agreement at the following percentage levels for the main dialogue codes recorded:

- Proposition: child suggests an idea or course of action, or otherwise makes some form of statement that someone else could disagree with (88%)
- Disagreement: child explicitly disagrees with a suggestion or explanation offered by another (97%)
- Explanation: child offers an explanation of a proposition (98%)
- Reference back: child explicitly refers back to a previous suggestion or explanation, irrespective of originator (98%)
- Resolution/compromise: child acknowledges previous statement of other and adjusts own to include content (98%)
- Instruction: child tells someone to say something or carry out some action (89%)
- Question: child asks open-ended question (or gives other form of prompt) that directs attention to something not yet considered (97%)

Data handling and statistical analysis

One way ANOVAs were utilised to analyse changes in attainment within each experimental condition in the sample. Two-way ANOVAs were also utilised to examine pre-post test science attainment gains in respect of the effect of urban-rural condition. Linear regression analyses were utilised to look for relationships between changes in attainment with class size and percentage of free school meals per class. Changes within conditions in categories of observed behaviour were analysed using one-way ANOVA. Differences in observed behaviour between conditions were explored using two-way ANOVA. Pearson Correlations were used to determine relationships between changes in observed behaviours and gains in science attainment. Attrition rates were low and similar in each condition and there was no evidence that attrition significantly biased the samples.

Results

Attainment measures

Table 1 reports the average pre- and post- intervention PIPS instrument test scores obtained from the rural and urban experimental classes. Average changes between pre and post test scores are reported. Only participants for whom pre-post data was complete were included in the analyses.

Insert Table 1 here

Gains in science attainment that could be attributed to the intervention were modest. Statistically significant gains were observed in attainment in science in both the urban ($F=5646.75$, df (1,183), $p<0.001$) and rural ($F=4363.8$, df (1,147), $p<0.001$) experimental conditions. The gains were equivalent to a 5.3% and 6.3% increases in science attainment in the rural and urban conditions respectively. There were significant effects of rural/urban location on differences in the pre-post test attainment scores when the urban was compared to the rural condition with two-way ANOVA. Attainment in urban schools, being significantly lower ($F=16.74$, df (1,330), $p<0.001$).

Linear regression analyses were conducted to investigate the relationship of changes in attainment within individual classes to the number of free school meals and the number of pupils in each class. No statistically significant relationships were observed between science attainment at pre test and the number of free school meals (urban $F=2.82$, df 1, 201, $p=0.92$; rural $F=0.197$, df 1, 151, $p=0.658$) or between class size and gains in science for rural schools ($F=0.015$, df (1, 147), $p=0.92$) or for urban schools ($F=0.025$, df (1, 183), $p=0.87$).

Observational data

Results of observations are presented in Table 2. Pre-intervention observations indicated that there were not significant differences in the observed results from urban and rural contexts. One-way ANOVAs indicated that the only significant difference was that urban children offered more explanations to propositions at pre-intervention. However, there were differences in the effect of the group work intervention on observed behaviours. Two-way ANOVA indicated significant increases in the number of ideas suggested by urban children as compared to rural condition ($F=4.33$, df (1,74), $p>0.05$). The increase was significant from pre to post observation in the urban condition ($F=78.3$, df (1,36), $p<0.001$). The increases in the number of ideas suggested by children were significantly correlated to increases in science attainment in the

urban condition ($r=0.557$, $n=37$, $p<0.001$). This pattern was not repeated in the rural condition ($r=0.236$, $n=40$, $p=0.142$). In the rural condition there were significant pre to post test gains in the number of ideas suggested by children ($F=5.126$, df (1,39), $p<0.05$), the number of explanations to propositions offered ($F=34.5$, df (1,39), $p<0.001$) and the number of time a child told someone to say something or carry out an action ($F=9.11$, df (1,39), $p<0.01$). Changes in offering explanations were correlated to increases in science attainment in the rural condition ($r=0.465$, $n=40$, $p<0.01$), but not in the urban condition ($r=0.295$, $n=37$, $p=0.076$).

Regression analyses were also conducted at the class level. These analyses explored the relationships between average science attainment and the number of observed behaviours recorded for making propositions and offering explanations to propositions by pupils in the sample, and in the urban and rural conditions. This analysis was conducted to establish whether correlations observed at the individual level persisted at the class level. Average attainment and observation scores were generated for each class (using only pupils for whom each set of data was available) for the pre and post tests and observations. Attainment at class level for the urban classes was found to be statistically significantly linked to greater instances of the making of propositions ($F (1,18)=4.71$, $p<0.05$). For the sample there was a

significant relationship between the giving of explanations and science attainment at the class level ($F(1,34)=5.16$, $p<0.05$).

Insert Table 2 here

Discussion

The section will focus on discussion of how successful group work was at promoting attainment and explain the nature and pattern of results. It will also discuss action implications for the design of CPD programmes for teachers and curriculum materials to support teaching and learning in primary classrooms. Finally it will critically reflect on aspects of the research design and methodology.

Gains reported in science attainment in the rural and urban settings may have been expected. Children in these classes worked through two units that had a focus on the science curriculum. The reported increases have to be viewed in the light that classes were not randomly assigned to the experimental conditions and that comparable control data was not gathered. None-the-less, the sample of twenty-four classroom contexts should at least present data robust enough to allow

reflection on the meaning of results (even if generalisation may be problematic). The materials and training provided for pupils as part of this study were effective at promoting modest (yet statistically significant) increases in academic attainment in general science.

The gains were correlated to increases in observed group behaviour and therefore may have been attributable to changes in both the pupil's interactional styles and the pedagogy underpinning the classroom organisation and management styles being employed by the teachers. Significant relationships were also observed between increased making of propositions (urban classes) and offering explanations to propositions (all classes in sample) made by pupils and higher science attainment. These results (and the fact that they persist at both the individual and the class level) provide good evidence that increased cognitive ability is linked to interaction style in the classroom. More effective group work in urban and rural classrooms was observed as the group work training started to take effect. Pupils were more likely to exhibit discourse behaviour that was identifiable with effective group work such as giving statements, making suggestions, and most importantly, offering explanations to group members. One conclusion for this was that it occurred because the pupils were able to work more effectively as a group due to the group work training. This may have given rise to more effective peer learning in the classrooms. The

proliferation of peer learning in this manner may be a possible explanation as to why increases in general attainment were observed in science. These changes led to the development of classrooms where pupil talk became more effective for co-construction.

However, why should enhancement to the quality of peer assisted learning lead to increased cognitive performance in the classroom *per se*? Peer assisted learning is a complex process. Topping and Ehly (2001) proposed a theoretical model of peer assisted learning which went beyond simple notions of cognitive conflict. In this model, cognitively demanding peer interactions should include the following structural elements: individualising goals and plans to optimise interactivity, variety, time on task and time engaged with task; cognitive conflict to help liquefy primitive cognitions and beliefs; scaffolding and error management through peer modelling (an essential component of this process being the language skills to allow this modelling to take place including listening, explaining, questioning, clarifying, simplifying, prompting, rehearsing, revising, summarizing, speculating and hypothesizing); affective development including motivational aspects of learning, self-disclosure, accountability and a developing ownership of learning. These elements embedded in a process of co-construction had potential to enhance metacognition, self-monitoring and self-regulation of learning, with consequential self-attribution of learning

success and thereby enhancement of self-esteem of a learner. Central to the theoretical model were processes involving intersubjectivity, particularly making suggestions and giving explanations with reinforcement from peers. The immediate corrective feedback offered through effective peer learning in the event of error, or confirmatory or corroborative feedback to reinforce correct models are both important aspects of peer feedback. Where these feedback elements are both present Topping and Ehly reported that there could be effective co-construction. Data indicated that the intervention promoted the establishment and enhancement of these structural elements of peer learning and discourse (as data showed significant correlations between gains in science attainment and with making suggestions in the urban condition and offering explanations in the rural condition). This could be interpreted as evidence that the nature of the intervention contributed to observed cognitive development. One important feature of the Topping-Ehly model was that before cognitive development through peer learning could take place, then the correct organisation and engagement structures had to be in place in the classroom. The continuing professional development and training in peer learning for children, helped develop these organisation and engagement structures during this intervention.

There may have been other minor contributors to the effects observed. Pre-intervention measures of attainment in the urban condition were lower than the classes from the rural condition. It is also of note that average attainment of children in the urban condition was below 'average' as measured and defined by the PIPS instrument. The role that urban deprivation may have played in the below average performance of children in this study is unclear. Urban classes had the highest rate of free school meals in the sample. Previous research had found direct correlations between higher pupil attainment and social class of occupation. In a study from a large sample of children drawn from 141 pre-school centres, researchers reported that social class of parental occupation was the most important factor in determining academic success of pupils in a longitudinal study (Sammons, Elliot, Sylva, Melhuish, Siraj-Blatchford & Taggart, 2004). However, no effects were found at the class level in respect of the impact of free school meals on average changes in pre- post- intervention attainment for this study. Future work would need to record data on socio-economic status at the individual, rather than class level, to allow the detailed analysis required. The effects of the intervention appeared to be to raise attainment in urban classes to be closer to the standardised average (as defined by PIPS). The urban children started at a lower point and therefore, an intervention that could make them learn more effectively could have had potential to have a greater impact.

Larger class size has been reported to generate more peer-peer talk, but more time off task (Blatchford, Bassett, Goldstein & Martin, 2003). The training that the pupils had in group work skills should have made their use of peer interactions more effective. It has been reported that as class size increases then the quantity of pupil to teacher talk decreases. It is therefore imperative that peer to peer interaction is made more efficient in larger classes. Adults are only reported to be present in one third of classroom interactions (Kutnick, Blatchford & Baines, 2002). These results may have demonstrated the benefit of training pupils to make effective use of peer-peer interaction in classes of larger size. However, linear regression analyses on data recorded by this study did not reveal any statistically significant relationship between class size and changes in attainment at the class level. Data appeared to support a conclusion that it was the quality and nature of teaching and learning that was the strongest indicator of academic success.

Gains reported in the study need to be judged against the background that control groups did not form part of the design of the resaerch. It was never the intention to develop full control group samples for the rural and urban studies. Recent meta-analyses have been undertaken on peer learning interventions with elementary school students.

Rohrbeck et al (2003) reviewed 90 peer learning interventions and concluded that positive increases in attainment for the sample (unweighted effect size=0.59 (sd 0.90); weighted effect size *d*=0.33, p<0.0001, 95% confidence interval = 0.29-0.37). The meta-analysis demonstrated that peer learning interventions were effective at raising attainment. However, the meta-analyses also indicated that peer learning interventions were disparate in their inception, design and implementation. The paper identified a need to look at variables that may affect the implementation integrity of peer learning interventions and analyse each in a systematic manner. One of the variables identified as being of interest in the research field was the effect of peer learning interventions in urban and rural school settings. It was the intention of this research to investigate implementation effects in rural and urban conditions, with this variable being the main focus of the current research.

The structure of the observations also requires some exploration. The decision to only record each observation within a time window once was a pragmatic decision. It was taken as the observation window was limited to 16 seconds. This left little time for extended discourse. There would also have been the problem for the observer that they may have to record multiple instances of multiple behaviours. The reliability of the observations undertaken by each observer, and the inter-rater reliability

between the two observers may have been compromised. Therefore, the decision was taken to record behaviours once. It was still felt that this decision allowed the nature of discourse to be captured and quantified, whilst not compromising the integrity and reliability of the data. The inter-rater reliability obtained for the two researchers during training to some extent justified this choice.

Conclusions

In conclusion data indicated that as more effective group work pedagogies were applied in the urban classroom settings that the levels of general attainment in science of children in these settings moved towards the 'norm' for their age. This may indicate that formal group work skills training could be an important factor in raising attainment in these education settings. If appropriate group work training is given to children who exhibit poor group work skills then it may help them realise their educational potential more effectively. With poverty and low attainment being major issues for Scottish education (Thurston & Topping, 2005) the techniques of training pupils in group work skills may be an effective tool in combating the perpetuation of a knowledge underclass in urban schools in Scotland. Data may indicate that the effects of poverty and urban deprivation may be counteracted through the use of effective pedagogical approaches (although it

should be noted that poverty in Scotland is by no means limited to urban settings (Hobbs, 2003)).

Gains in general attainment reported in this paper were modest. Therefore, it may be reasonable to conclude that generic group work training for pupils and CPD for teachers may not be enough to maximise gains at the classroom level. There is also a need to develop contextualised curriculum materials that are designed to promote effective use of social pedagogy and group work skills at the classroom level. The research team have developed such materials for the science curriculum (Topping & Thurston, 2004). Despite the relatively modest gains in general attainment, the study none-the-less indicated that group work could be an effective method of promoting attainment. These finding appear to add support to conclusions of Ennis and McCauley (2002) regarding effective pedagogy in urban school settings. They reported that in a sample drawn from 18 urban classrooms in the USA the most effective classrooms were those that were characterised by more effective group work (displayed through more trust and positive interactions with individual needs being discussed and met). MacNab (2003) reported that in a sample drawn from 170 Local Education Authority and school representatives, 46% of Scottish schools reported less group work since the introduction of curriculum initiatives. The drop in reported group work may be

indicative of teachers losing the ability to apply an effective pedagogical tool in the classroom. This was emphasised by Hutchison (2003) who reported there was a need to ensure that group work was effective in classroom contexts, and concluded that education was not just an activity that takes place in a group, but was a group activity. To have maximum impact it is clear that group work needs to be embedded into the pedagogy and planning in individual curriculum areas.

The research highlighted a number of important issues. The implications for educational policy and practice are that group work has the potential to provide an effective method of learning and teaching. However, it must be supported by carefully structured CPD for teachers and curriculum materials that are designed with effective pedagogical group work approaches embedded into them. The potential impact of group work needs to be understood in terms of a much finer grained analysis set against the background of other factors that may also be exert an influence. Future work may focus on changes at the individual, rather than the sample or classroom level. It was also intended that pupils would have skills that would perpetuate through time. This aspect of the work will be explored in future research. Follow up work will report on the progress of pupils from the experimental sample as they make the transition from primary to secondary school. The potential influence that group work skills may have on the success of

this transition for pupils will be examined. In addition a similar group work in science intervention will be attempted in secondary school. This work will include the development of control groups. The use of collaborative group work strategies in secondary school science is less widespread than in primary school. Control groups will be required for this work as there is a need to explore the potential of collaborative group work in secondary schools as compared to existing practice.

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Appendix I: Observational Analysis Record Sheet

Date: School: Target:
Start time:

	Interactants				Dialogue								
	I	T	Cog	Cdg	Prop	Dis	Exp	Rfbk	Inst	Ques	Res	Oth	UC
1													
2													
3													
4													
5													
6													
7													
8													

Key/Definitions

Interactants

Tick each of these that applies within a given window:

I child is working on own
T child is engaged with (i.e. talking or listening to) teacher or classroom assistant etc
Cog child is engaged with another child in same group or in close proximity in an ordinary lesson
Cdg child is talking with another child in a different group or further away from them in an ordinary lesson

Dialogue

The unit of coding is a verbally explicit ‘idea unit’ (i.e. a single thematically coherent utterance). Code for each of the following each time they occur within a window:

Collaborative codes

Prop proposition: child suggests an idea or course of action (whether low or high level), or otherwise makes some form of statement that someone else could disagree with

Dis disagreement: child explicitly disagrees with a suggestion or explanation offered by another

Exp explanation: child offers an explanation of a proposition

Rfbk reference back: child explicitly refers back to a previous suggestion or explanation, irrespective of originator (i.e. they must refer to the content of the previous statement and point to the fact that this is something that has been said before – saying e.g. “I think the same” is not sufficient)

Res resolution/compromise: child acknowledges previous statement of other and adjusts own to include content (i.e. there must be some explicit fusion of ideas)

Tutoring codes

Inst instruction: child tells someone to say something or carry out some action

Ques question: child asks open-ended question (or gives other form of prompt) that directs attention to something not yet considered (e.g. “what about keeping weight the same?” “do you think it would make any difference if we used something solid?”); NB the key marker here is that this is a question that the asker does not want to know the answer to (they already know it)

Residual codes

Oth other dialogue not covered by above categories (e.g. descriptions etc)

UC uncodable or inaudible

Table 1: Mean pre-post PIPS standardised scores [(b)] of general attainment in science (sd)

	Rural n=148	Urban n=184
Experimental Pre-test	51.05 *(10.89)*	46.35 *(9.50)*
Experimental Post-test	53.77 *(10.15)*	49.29 *(9.29)*
Average change	+2.72	+2.94

[(b)] Mean pre-post PIPS standardised scores of general attainment for pupils in age range of sample=50, max=100, min=0.

Table 2: Number of observed groupwork behaviours from rural [n=40] and urban [n=37] experimental classrooms samples (Minimum score =0, maximum score =8 for each observation)

	Child was engaged with another child in same group or in close proximity in an ordinary lesson		Child was talking with another child in a different group or further away from them in an ordinary lesson		Child suggested an idea or course of action (whether low or high level), or otherwise made some form of statement that someone else could have disagreed with		Child explicitly disagreed with a suggestion or explanation offered by another		Child offered an explanation to a proposition		Child referenced back to another child (child explicitly referred back to a previous suggestion or explanation, irrespective of originator)		Child told somebody to say something or carry out some action		Child asked an open-ended question that directed attention to something that had not previously been considered	
	rural	urban	rural	urban	rural	urban	rural	urban	rural	urban	rural	urban	rural	urban	rural	urban
Pre-intervention observation	6.95 *(1.34)*	6.65 *(1.97)*	0.48 *(1.28)*	*0.26 (0.97)*	2.45 *(1.93)*	2.75 *(2.15)*	0.51 *(0.7)*	0.37 *(0.81)*	0.65 *(1.22)*	1.3 *(1.18)*	0.07 *(0.35)*	.07 *(0.35)*	0.55 *(0.98)*	0.57 *(0.75)*	0.07 (0.27)	0.10 *(0.38)*
Post-intervention observation	7.04 *(1.23)*	7.11 *(2.11)*	0.23 *(0.53)*	0.13 *(0.40)*	3.04 *(2.54)*	3.66 *(2.71)*	0.56 *(0.7)*	0.54 *(0.82)*	1.40 *(1.51)*	1.27 *(1.58)*	0.09 *(0.29)*	0.13 *(0.34)*	1.26 *(1.32)*	1.04 *(0.07)*	0.05 *(0.21)*	0.07 (0.27)
Change	+0.09	+0.46	-0.25	-0.13	+0.49	+0.91	+0.05	+0.17	+0.75	-0.03	+0.02	+0.06	+0.71	+0.47	-0.02	-0.03