

# Junior Aged Children as Reflective Practitioners

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## Abstract

This paper sets out to discuss aspects of my recently completed EdD (Open) research into junior aged children operating as “reflective practitioners”.

The study focused on the extent to which children are provided with sufficient opportunities to take responsibility for achieving “optimised design solutions”, through reasoned decision making and how this position can be supported or hindered by related elements of teachers’ classroom practice and inter group dynamics. In the context of this paper I shall focus on one of three key findings: that the encouragement of young children as reflective practitioners is related to an effective interplay between metacognitive questioning, clear task structuring (see also the notion of action patterns, below) and well organised collaborative endeavour, based on the establishment of sound ground rules. Whilst some evidence was found, during some twenty four classroom observation sessions of teacher-pupil interactions promoting effective reflective practice, such evidence was limited. Moreover, even when these key elements of effective classroom practice were appropriately employed to support children when working as a team, other factors seem to impact upon pupils’ ability to reach a shared and suitably justified/agreed understanding of how to make proficient progress; in short, to “reason together”. These factors, which tend to undermine a group’s ability to work towards optimised solutions to the problem(s) they are faced with, were linked to the notion of “cognitive dissonance”. This includes, for example:

- Children’s concerns about their personal levels of uncertainty.
- Their perception of their place within the group: not least how they view their own and others designing and manufacturing skills.
- Combined and overriding positions based on friendship rather than reasoned argument, in the most critically constructive sense.
- The need for reward or a simple desire to be getting on with the “doing” rather than engaging in further “thinking”.

Whatever the cause, the outcome of children’s collaborative endeavours in the context of practical problem solving activities can be seen to be part of the complex make up of children asked to interact in group settings.

## Key Words

metacognitive questioning, collaborative endeavour, task setting, action patterns, cognitive dissonance and reflective practitioners.

## Methodology

The approach used was qualitative and interpretive. It was based on evidence drawn from:

- Audio and video taped observations of groups of children involved in either the designing and or making phase of a design and technology project, including teacher-pupil and pupil-pupil interactions. (The video sequences were recorded to help me complete accurate transcriptions of pupil – pupil and teacher – pupil(s) verbal interaction).
- Audio recordings of teacher inputs at the start of a teaching session.
- Audio recordings of follow up semi-structured interviews with the groups observed (usually one week after the observation).
- Audio recordings of follow up semi-structured interviews with the group’s class teacher (usually one week after the observation).

My place within the process can best be described as one of partial participant observer, positioned at a distance from any group being observed/recorded, with no direct input in terms of their progress, but cognisant of the fact that I may still have impacted on their performance and was in any case predetermining, to a large extent, the aspects to be considered as relevant. In that sense, of course, the research is to some degree partial and theory laden.

The analysis of data based on the observation of initial teacher inputs, group work and the associated teacher-pupil/pupil-pupil interactions, was centred on the development of a system of categorising forms of recorded dialogue rising from the operational definitions of “metacognitive questioning” and young children as “reflective practitioners” (see below). Moreover, given that the operational definitions changed over the time of the study, so too did

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my interpretations of these interactions. This is to be seen as a strength of the qualitative approach adopted, not least because it allowed for a refinement of analysis as theory and practice were more successfully merged.

The analysis itself was managed on what might be termed an "instantaneous basis", by this I mean that a colour coding system, which I adopted to aid the process, was added to transcriptions as they evolved; interpretation was ongoing rather than end-on. As audio recordings were transcribed (observation sessions were normally thirty minutes in length, sometimes longer) I identified what I deemed to be relevant aspects of metacognitive questioning, noted in red text and or reflective practice, noted in blue text. I found this to be a more insightful means of analysing data than attempting to transcribe the whole recording with analysis carried out retrospectively.

In addition, this form of analysis assisted my identification of other themes/areas of interest, leading to the formation of the key questions used as the basis of follow up semi-structured interviews with pupils (the focus group) and then their class teacher. Here, the questions that were prompted were noted at the time of their conception in green text. The follow up, post observational interviews were also audio-taped and transcribed as part of further data analysis.

The colour coding also helped greatly in extracting pertinent elements of the data from the volumes of paper that were created. I would like to think that this systematic line of attack has lent weight to the notion of procedural objectivity though I recognise that, along with Craft (2000), because others may wish to interpret the data differently, no guarantee of inter-judge reliability can be provided. In the same manner, the analysis of transcripts, as they unfolded, also allowed for issues to be identified in relation to the other aspects of this study: task structuring, ground-rules for collaborative endeavour and, in a less direct sense, cognitive dissonance. Any associated questions were also colour coded green and referenced for consideration by pupils, the teacher or, in some cases, both parties.

### Introduction

On the final page of my EdD dissertation, *Issues of interaction: A consideration of factors that impact upon children operating, in junior classrooms, as reflective practitioners in the context of group-based practical problem solving activities*, I draw the reader back to a key quotation first established in the introductory section of the thesis:

If you cannot increase reflective power in people, you might as well not teach, because reflection is the only thing in the long run that changes anybody. (Howe, A. 1997 p.12)

For me, reflection has to be seen as a key component of design and technology capability, not least because without a willingness on the part of pupils to think in a critically constructive manner, products cannot develop as effectively as they might during the design and make process. Moreover, central to the development of optimised products must be a classroom ethos in which children feel confident about taking and making their own independent decisions and secure in their use of effective reasoning skills.

It should be noted here that the study evolved over time. This is shown in Figure 1, which illustrates, by way of a conceptual framework, how the study moved chronologically from its initial attention on teacher questioning to include the interrelated issues of task structuring, ground rules for collaborative endeavour and cognitive dissonance.

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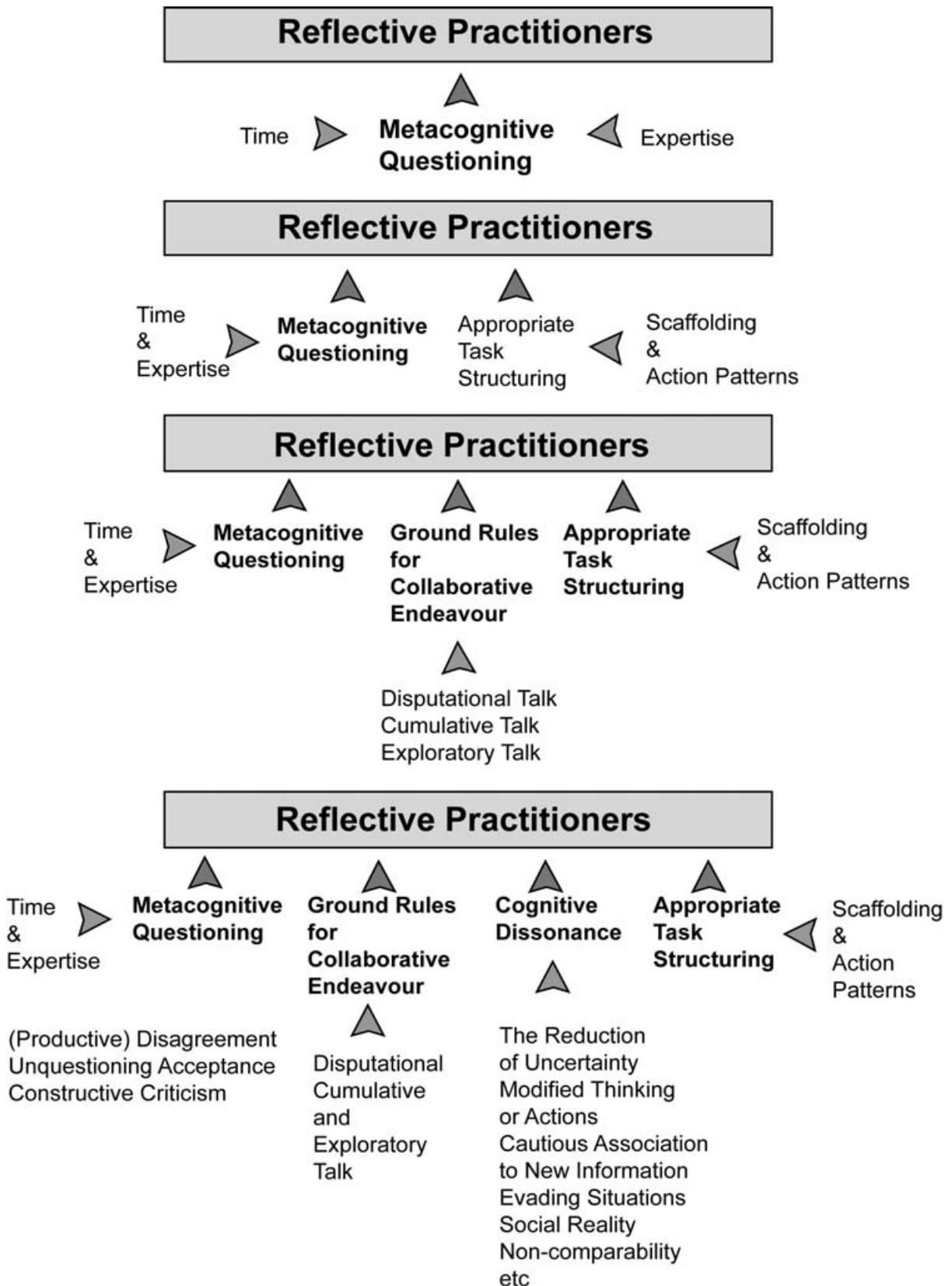


Figure 1: The Development of the Study Over Time

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These key issues are now discussed in some detail:

### Metacognitive Questioning and Reflective Practice

Dominowski (1998) suggests that the encouragement of individuals to provide reasons for their choices and actions often results in improved task performance. Moreover, he suggests that verbalization is most effective when it is centred on the use of what he called “metacognitive questioning”. That is, questions that direct problem-solvers to reflect not simply on their intentions but why such intentions form part of the strategies they adopt as a means of securing a resolution to a particular problem. From the teacher’s point of view, forms of questioning that encourage children to identify, clarify and justify lines of thought or action, including alternatives, based on reasoned argument that is either self or other-oriented. Put simply, questions that prompt pupils to engage in a critical evaluation of either their own current position/intentions, or those of their peers. This might include them, for example, being asked to evaluate, in terms of judging one line of thought or action against another, including the monitoring of suggestions or progress involving cross checking, demonstrating aspects of doubt, a willingness to challenge the views etc.

An example drawn from transcribed audio recordings illustrates this effectively, in that the teacher can be seen to move the group’s thought processes forward in a considered manner:

Teacher     How are you going to attach this...  
                  this body bit to the head box?  
(Seeking clarification of intentions and promoting planning ahead)

Samantha   Em ... we can use those string  
                  things and you can join them on.  
(Part clarifying solution and planning ahead)

David       How?  
(Monitoring others suggestion – seeking clarification/justification)

Teacher     But if you think of the end of the  
                  tube though ... would that be  
                  easy?  
(Promoting evaluation of intentions)

Samantha   No ...  
(Challenging but not offering reasoned argument)

Teacher     How else could you do it?  
(Seeking alternative, promoting planning ahead)

Samantha   Em ...

David       Ah ...

Teacher     Think of the legs that you saw in  
                  there.  
(Prompting them to relate current work to prior experiences)

Claire       Ah ... you could cut little bits ...  
                  and then spread those out and  
                  then you could stick the head on  
                  top.  
(Justifying alternative)

As such, metacognitive questioning was seen to be a form of questioning that encourages children to:

- Identify, clarify and justify lines of thought or action, including alternatives – based on reasoned argument that is either self or other-oriented.  
For example: “Why have you decided, as a group, to use PVA rather than the glue gun?”
- Evaluate in terms of judging one line of thought or action against another, including the monitoring of suggestions or progress involving cross checking, demonstrating aspects of doubt, a willingness to challenge views. based on reasoned argument that is either self or other oriented.  
For example: “Rhiannon has suggested that you use a smaller gear wheel on the input shaft, than the output shaft; but David thinks they should be the same size. What do you think the difference will be if you decided to go along with Rhiannon’s suggestion? And why might it be more appropriate?”
- Plan ahead, based on reasoned argument that is either self or other oriented.  
For example: “You now need to think about finishing the product, so what do you need to do now?”  
Here, a teacher’s use of metacognitive questioning is seen to be of significant importance as part of a repertoire of mechanisms that will support effective

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collaborative endeavour. Moreover, if used regularly and supported by relevant modelling of reasoned decision-making, pupils will hopefully see the relevance of engaging in reflective practice as a means of supporting progress towards optimised solutions, when resolving practical problems.

Pupils were judged, as a mirror image of metacognitive questioning, to operate as reflective practitioners if they could be observed to utilise decisions and actions that stemmed from measured deliberation. That is, to reflect purposefully on their own or other's current position and, thereafter, demonstrating the metacognitive skills of:

- Identifying, clarifying and justifying lines of thought or action, including alternatives – based on reasoned argument that is either self or other-oriented.  
For example: "We've decided to use PVA because it doesn't set straight away. It takes a bit of time to dry and gives you a chance to change positions of things if you need to."
- Evaluating in terms of judging one line of thought or action against another, including the monitoring of suggestions or progress involving cross checking, demonstrating aspects of doubt, a willingness to challenge views etc. based on reasoned argument that is either self or other oriented.  
For example: "I think that we should use Rhiannon's idea because when you turn the handle to make the smaller gear go round, the bigger one will go slower and that will make the fairground ride work better because it needs to go quite slowly, like the real ones."
- Planning ahead, based on reasoned argument that is either self or other oriented.  
For example: "We need to decide as a group on what we would like to use, say, paint or felt-tip pens. Then, once we've agreed, we should make a list so that we don't forget anything."

### Ground Rules for Collaborative Endeavour

Lovelock and Dawes (2001) indicated that many children can find group based activities a difficult experience with few of them able to effectively pool their mental resources, combine ideas, negotiate compromises or ask

for/provide justifications for suggestions made. Furthermore, a number of authors (Hardman and Beverton, 1998; Lyle, 1996 and Gokhale, 2002) recognise that effective interaction in group settings has to be supported by teachers making the purpose and desired outcomes of a task, and the roles that children are to undertake, clear. Indeed for Lyle, the roles include those of leadership, negotiation and support of others. Moreover, she suggested that:

Successful educational activity through group work depends on learners (a) sharing the same ideas about what is relevant to the discussion, and (b) having a joint conception of what they are trying to achieve by it.  
(Lyle, 1996:362)

In this context Mercer (2000) has suggested a need for teachers to encourage children, whilst in group-based activities, to engage in "exploratory talk", whereby pupils connect critically but constructively with each other's ideas. That is, where information is offered for joint consideration, where proposals may be challenged, where alternatives are articulated and justified and concurrence is sought as the basis for jointly agreed progress. In all of this, knowledge is made publicly accountable and reasoning is visible in the talk. In this respect Mercer et al (1999) suggested that as a basis for effective collaborative endeavour, and for me the reflective practice that can stem from such approaches, teachers need to firmly establish ground rules based upon pupils:

- Sharing all relevant information.
- Seeking to reach agreement about what line(s) of thought to follow/action(s) to take.
- Accepting that the group (rather than individual members) takes responsibility for decisions and actions and for any success and failures that ensue.
- Recognising the need to provide reasons to back up assertions, opinions and suggestions.
- Recognising that challenges are acceptable.
- Recognising that alternatives should be discussed before a decision is taken.
- Understanding that all in the group should be encouraged to speak by the other group members.

### Effective Task Setting

In a number of instances noted during classroom observation, it was seen that too much was being asked of young people at any one moment in time. As a result, groups were seen to fail to focus collaboratively on the essential requirements of the task in hand. Evidence from the study therefore, suggests that children need to be encouraged when working as a team to think about only one, or at least a limited number of key elements, as an aid to a more collegial approach to the sequential progression of a problem resolution and hopefully, through critically constructive interaction, this would lend weight to children developing as reflective practitioners.

As such, teachers need to give sufficient attention to the way in which group based, practical problem-solving activities are managed, and in essence, the appropriate setting of effective ground rules for group work, whilst important, has to be buttressed by a structured approach to task setting. In essence, the need to break “global problems” down into manageable, bite sized chunks.

Not least, as a means of supporting the development of pupils’ procedural and conditional knowledge. That is, pupils’ growing appreciation of the “what”, “how”, “why” and “when” relevant designing and manufacturing strategies (thoughts and actions) should be utilised. As Mercer (1996: 365) notes, when appraising his own approach to understanding the quality of talk and collaboration:

We needed to look at the ways activities were set up by the teacher, and what the teacher expected the children to achieve from doing the work.

In this context Edwards and Mercer (1987: 23) citing Bruner, saw “scaffolding” as a means of aiding a pupil to “internalise external knowledge and convert it into a tool for conscious control” and it is the scaffolding of the development of pupils’ procedural and conditional knowledge that is critical here. Moreover, where such scaffolding is aided by teachers’ use of metacognitive questioning to encourage reflective practice, I would argue that such approaches will assist children’s

understanding of when, how and why to do things in a particularly ordered sequence as a means of optimising their solutions to practical problems.

Mabin, Mercer and Stierer (1992: 188) extend this issue. If, as they suggest, “scaffolding” is about more knowledgeable others, “reducing the scope for failure in the task a learner is attempting” then I would argue that teachers’ metacognitive questioning is a means by which children, if responding in an appropriately reflective manner, can be helped to make proficient progress when managing a practical problem solving activity. There are also clear links here to the notion of children operating effectively within their zones of proximal development; that is, at points that just exceed their problem solving abilities as individuals in the context of assisted performance. Moreover this would further accord with Mabin et al’s view that scaffolding:

Is not just any assistance which might help a learner accomplish a task. It is help which will enable learners to accomplish a task which they would not have been quite able to manage on their own, and it is help which is intended to bring learners closer to a state of competence which will enable them eventually to complete such a task on their own.

(Mabin et al, 1992: 188)

This brings me back to the view that what “reflective practice” encourages is competence to work towards “optimal solutions”. In similar vein, Rogoff and Wertsch (1984) note that mental functions, including thinking, reasoning and problem solving can be aided by collaboration during social interaction.

Whilst in many primary classrooms all participants (teachers and pupils) may lack some relevant declarative, procedural and or conditional knowledge and skills, this need not prevent teachers, during verbal interactions, encouraging children to “reflect”, to “think before doing”. In this sense it is the process of reasoning, rather than the distinctive content of the discussion per se that is to be valued. Of course, even where levels of expertise/confidence are higher this may not guarantee either effective task structuring or the use of appropriate metacognitive

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questioning. Rather, this expertise could be used ineffectually by way of offering more in the way of answers, rather than continually challenging pupils to think for and by themselves. What the study hoped to lend weight to, is a growing appreciation by teachers that where they are willing to encourage reflective practice this will result in children operating in a more measured way. For Rogoff and Wertsch (1984), it's about children's notion of how things can best be done, about going beyond their current internalised position to more closely mirror that of a more expert other. In this case, teachers who value reasoned decision-making as a means of encouraging children to focus on relevant aspects of the task in hand.

Meadows (1993), reflecting on the work of Voss, notes that dealing with problems involves the gradual build up of both subject-based and procedural knowledge and skills. In relation to the latter, she references the importance of an ability to analyse problems into a sequence of appropriate sub-problems and notes the need to teach such problem-solving strategies in contexts where they are useful. In a similar vein, Stephenson (1997) suggests that children need a structure for the way they undertake investigative and problem solving activities; whilst Hennessy and McCormick (1994) argue that teachers will need to plan carefully to provide opportunities for children to be able to engage with and to value sub-processes in order that they begin to build up their own understanding of how such sub-processes might best be used. Fisher (1990) offers a more direct overview, suggesting that it may not always be possible for children to break problems down into manageable steps and that they will sometimes need clues to support their approach to a problem solving task. He also recommends that children need to be:

Encouraged to verbalise what they are doing, to exercise their linguistic intelligence in monitoring their actions and explain to themselves (or others) what they are doing. In gaining more control over intellectually challenging tasks a child is learning how to learn.  
(Fisher, 1990:121)

However,

Left to themselves children are not very good at bringing their previous experience to bear on solving related problems. Both structural factors (the extent to which an appropriate pathway through the problem has been considered) and psychological factors (how clearly the problem is expressed and understood) are important.  
(Fisher, 1990:129)

For Lyle (1996), collaborative group work needs both to be supported, in terms of developing pupils' cognitive and social skills, and explicitly valued in terms of pupil performance. Not surprisingly, therefore, the role of the teacher, not least in terms of task setting, is seen to be one of the important factors alluded to above. Citing Galton and Williamson, she recognises how important it is for teachers to:

Reduce uncertainty for children and ensure that they know what they are doing and why in order to increase the chances of full participation, to enable them to generate ideas and to retain ownership of these ideas.  
(Lyle, 1996:19).

I would argue here, that if children are encouraged to focus on the most relevant aspects of a problem, then this will support their engagement in what Mercer et al (1999) have termed "exploratory talk" (see above), a critical aspect of "reflective practice". Indeed, if pupils can be assisted in breaking down a "global problem" into stages which, for them, are more readily managed, then this should reduce the tendency, noted during field-work, for groups to fragment, with individuals or pairs essentially operating independently of each other. In this respect, the following example should help to illustrate a general finding from the study, that teachers either failed to afford such foci or explicitly encouraged children to think about too many aspects at any one time. Here, when pupils needed to be concentrating on the size and shape of a Jink framework (relatively simple structures based on one centimetre square section timber joined using paper/card based triangles to attain rigidity) as the basis for a Tudor house, the teacher, at the end of her initial input, suggested the following wide range of concerns:

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Teacher So what we want is the research, and a picture, and a resources list, and a plan of the cuboids, with their measurements, equipment - and I want the measurement of that equipment, the pieces of wood. And when you say how many you're going to have I want you to add up the prices (they had been told that each piece of timber had a value) and I want you to design a net of the roof and, this is for you to think about on your own, are there any safety issues to think about? We will have a discussion about that at the end of the lesson.

(Ongoing reference was left on the blackboard)

This certainly left the children confused and led to individuals in the group concentrating on what they felt was the key activity for the session. In the follow up interview they could not reach agreement on whether a more focused input from the teacher would have helped them to work more collaboratively and this lack of agreement seemed to stem from their lack of familiarity in working as a group on practical problem solving tasks. However, one of the group suggested that it might well, "take the pressure off", a tacit acknowledgement that a more concerted team effort would aid them in making more proficient progress. The teacher also felt, on reflection, that concentration on a single theme may have helped the children to work more effectively as a team. On similar occasions, in different classrooms, other teachers aligned themselves with the view that a sharper focus, when task setting, would assist the children in appropriately sequencing their work and allow more time for them to evaluate their current position/intentions, through reasoned decision making, as they move their designing and or making, forward.

For me, if teachers' initial inputs were more securely framed, then I would contend that groups would be able to more readily reach what has been termed, "intersubjectivity", based on the willingness of individuals to give up a currently held position (situation definition) in favour of another (situation redefinition), as they realign themselves towards an agreed "action pattern" – a logically structured approach to problems in

hand. This is not to suggest that teachers provide answers to such problems, nor a predetermined framework for the way in which children approach them. Rather, its about keeping the focus manageable – the bite sized chunks referred to above.

### Action Patterns

Given that I would wish to see peer interaction as an integral component of assisted performance, I would suggest that what adults can provide, as part of a supporting mechanism to aid the development of children's procedural and conditional knowledge (efficient engagement with the design and make process – practical problem solving), is guidance that promotes a clear understanding, at the outset of a task, of the need for individuals, working as part of a group, to reach joint agreement on how to sequence their approach to goal-directed activities as a means of securing an optimised final product. As such, one would hope that all participants become more capable as a result of developing a willingness to reach agreement on the basis of reasoned decision-making. However, as noted above, this guidance needs to be placed, at any one time, in the context of children focusing on relevant aspects of a global problem, appropriately broken down into manageable sub-units of work. Thereafter, a teacher's role should, I would contend, be linked to three theoretical constructs, identified by Wertsch (1984), in his attempt to clarify the notion of the Zone of Proximal Development (ZPD). These are: "situation definition", "action patterns" and "intersubjectivity".

With regard to the former, Wertsch argued that within the ZPD, adults and children, in the context of collaborative endeavour, might tend to represent objects and events in different ways. Here the author refers to objects in a concrete sense, for example, the construction of a replica model using a range of interlocking pieces. In the context of the focus for this study (practical problem solving), I would argue that the "objects" referred to by Wertsch need to be viewed as the "products of reasoned-thinking leading to efficient action". For teachers then, there is a need to promote, through careful task structuring and the considered use of metacognitive questioning, a willingness, on the part of pupils to reflect, to think before doing, to come to understand the need for

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them when operating collaboratively, to reach a joint understanding of how best to move forward. That is, individuals coming to agree the strategic steps that are required to support efficient problem resolution by way of demonstrating their ability to effectively apply what they currently know and can do. Evidence from the study, drawn from analysis of transcriptions, has indicated some recognition on the part of pupils of the benefits that might accrue from agreeing on an appropriate, group-based action pattern. However, pupils often failed to secure this position and post observational interviews tended to suggest that the limited opportunities for creative activities, currently afforded within the primary curriculum, undermine the development of "shared agreement" because "action" rather than "reflection" is valued/prioritised by pupils: "doing" rather than "thinking".

As such, I would argue that children will be supported by tasks being clearly structured as this will help them to secure a unified perspective on what is involved, as a sound foundation for how they should sequence their approaches to it. Without the former, the latter becomes more problematic.

Indeed, Wertsch (1984) contends that when, at the outset of problem solving tasks, children come to define the purpose of a task differently from a supportive adult, the consequence will be a variation in perceived "action patterns". That is, the way in which the development of a solution might be logically and efficiently structured. Such variations may, moreover, differ at a personal level such that individual pupils within a group fail to share an aligned perspective on a best way forward. To avoid the likely consequence of an impasse, scenarios where pupils drift into standoff positions that undermine progress, one or more of the participants will have to give up their current situation definition (perspective on expected outcomes) and its associated action pattern (preferred sequence of events, including strategy choices) in favour of a revised and agreed position, hopefully based upon critically constructive dialogue as a means of securing thoughtful decisions. For Wertsch, (1984:11) it is this relinquishing of an existing situation definition, and its associated action pattern, in favour of a new one (situation redefinition) that is a fundamental quality of movement within the

zone of proximal development; a "qualitative transformation" that, as I understand it, augments pupils' cognitive development.

In this way, pupils hopefully come to recognise the relative appropriateness of their thinking and associated lines of action, as does the teacher, as facilitator of "reflective practice", through the medium of communication. Indeed, I would argue that it is the role of communication during teacher-pupil interaction that in effect causes each, as an aspect of verbal reasoning, to evaluate the outcome of their own and others intentions. Participants (teacher and pupils) in such interaction may begin at different or comparatively similar starting points, but what is important to the development of an optimal solution is that, where necessary, modifications to currently held positions, on the basis of reasoned judgement, secure intersubjectivity. That is, functioning on what Vygotsky termed the "interpsychological plane", needs to be supported by all participants in the context of social interaction such that they come to both share the same situation definition and know this to be the case. For, as Wertsch notes:

Intersubjectivity is often created through the use of language.  
(Wertsch 1984: 13)

### Cognitive Dissonance

However, pupils' readiness to engage in this type of interactive exchange may well be adversely affected by factors that reduce their willingness to reach a shared understanding that would be of benefit to the group as a whole. This is in keeping with Lyle's (1997), suggestion that among other things, pupils expectations, status, prior achievement and communication skills will differ and impact upon the notion of "meaning making". Such factors, in the context of my study, were related to the concept of "cognitive dissonance"; and though this paper does not permit a full coverage of the term, evidence suggested that, for example:

A pupil's failure to engage critically with their own or others' intentions may stem from perceptions of the relative levels of personal expertise (status) within a group and an unwillingness to expose associated personal limitations. A useful example is provided below:

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Pupil We (he and another boy) could discuss what we think is better and see if she agrees, but if she doesn't then we could find a way that we all agree on. But, she is really good at sketching so I thought that it wouldn't matter what she did because I thought that she would do something that was good anyway.

A reluctance on the part of a pupil to give up a current line of thought or action may often have been a function of their wish to minimise the level of personal uncertainty, leading, in many cases to the entrenchment of existing positions.

Friendships often led to a collective view, held by weight of numbers within the group, even though the supported line of thought or action was not, in reality, secure.

Simple agreement was often reached to obtain the reward of moving quickly from reflection to action, from thinking to doing. The following comment, based on a Year 6 pupil being asked about the limited interaction during the designing phase of a project, illustrates this well:

Pupil We're busy getting the work done and also, I don't think that we should challenge one another because then we'll just end up getting into a fight or something.

In summary, when a clear framework of interaction is established, through effective task structuring, a framework in which teacher and pupils are clear about expected outcomes, then I would contend that children should be more readily positioned to use elements of reflective practice to secure jointly agreed action patterns supportive of efficient problem resolution. Moreover, it should support the ability of children to ultimately retain ownership of related tasks and secure progress through a joint agreement on strategy usage based on reasoned decision-making. Lastly, such interaction can also be linked to the notion of "contingent teaching". Roy Corden (1992) draws out the connection between a teacher's willingness to operate contingently and a teacher's ability to use interactional dialogue appropriately. Of the many ways in which a teacher can interact, Corden notes that

in prompting children to clarify their own understanding a teacher is "scaffolding" their learning. In the context of pupils' design and technology experiences, such scaffolding should, therefore, support pupils' developing knowledge and understanding of related procedural and conditional knowledge. Furthermore, as Wood contends:

...contingent control helps to ensure that the demands placed on the child are likely neither to be too complex, producing defeat, nor too simple, generating boredom or distraction. (Wood, 1991:108)

In essence, what is being suggested here is that when teachers and children interact in the ways outlined above, new schemata, or versions of progress, can be developed as a result of the shared interaction. If one assumes that children will be approaching problem-solving activities with a degree of doubt about how best to move forward efficiently then any encouragement to "think" before "doing" must, I would argue, be beneficial. Indeed, as Wood notes:

Without help in organising their attention and activity, children may be overwhelmed by uncertainty. (Wood, 1991:106)

### Conclusions

First, and most positively, where children were seen to be working in contexts that supported them operating, at least to some extent, as reflective practitioners, the resulting interaction between members of the observed team led to progress (problem resolution) based on reasoned decision making. As such, designing or manufacturing strategies were developed on a clearer, co-constructed understanding of how to move work on in an optimised manner. However, evidence also suggests that such favourable situations are not a key feature of collaborative group work during practical problem solving activities and in the majority of cases interaction (teacher – pupil(s), pupil – pupil) did not afford the same benefits.

Rather, observed classroom interaction often indicated what one might describe as "half-way house" positions. By this, I mean sessions during which teachers failed to encourage pupils to justify their intentions, thereby leaving

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them in positions where they were willing to identify, champion or challenge alternative perspectives, during dialogic exchanges, but without engaging as critically and constructively with each others' ideas as they might have done. In Mercer's (1996) terms, interaction exhibited limited evidence of "exploratory talk".

It was also noted that children often operated somewhat inconsistently in terms of their willingness to engage in key aspects of reflective practice, for example, clarifying and justifying intentions; constructively considering alternative means; evaluating their own or others' lines of thought and action, including a willingness to challenge views and planning ahead. Such inconsistencies were certainly noted in relation to the extent to which children often operated in a more reasoned manner during teacher-pupil interaction than in their associated pupil-pupil interaction, not least, perhaps due to some of the intuitive beliefs that individuals held about the level of expertise of their peers.

Finally, during the study it became clear that a teacher's use of "metacognitive questioning", their ability to structure tasks effectively and the setting of appropriate ground-rules for collaborative endeavour are key interrelated elements in facilitating young children to operate as reflective practitioners. However, a number of factors appear to impact upon this interrelationship, including, in addition to "cognitive dissonance", time limitations and a teacher's perception of their subject (design and technology) based expertise (see below).

On the basis of the issues discussed above the following key findings and associated recommendations were identified:

- The role of the teacher is both central to the aim of promoting young children as reflective practitioners and complex.
- The encouragement of young children as reflective practitioners is related to an effective interplay between metacognitive questioning, clear task structuring and well organised collaborative endeavour based on sound ground rules.

However, even when these key elements of effective classroom practice are appropriately employed to support children when working as a team, other factors seem to impact upon their

ability to reach a shared and suitably justified/agreed understanding of how to make proficient progress. In short, to "reason together". These factors, which tend to undermine a group's ability to work towards optimised solutions to the problem(s) they are faced with, have been linked to the notion of "cognitive dissonance". This includes children's concerns about their personal levels of uncertainty; their perception of their place within the group: not least how they view their own and others designing and manufacturing skills; combined and overriding positions based on friendship rather than reasoned argument; in the most critically constructive sense, the need for reward or a simple desire to be getting on with the "doing" rather than engaging in further "thinking". Whatever the cause, the outcome can be seen to be part of the complex make up of children asked to interact in group settings.

Moreover, one also needs to recognise teacher limitations, particularly time and their own levels of perceived expertise, that may further undermine the important part that design and technology can play in developing what McCormick (1999) has referred to as children's "qualitative reasoning" – seen by Mercer (2003) as explicit, rationale, collaborative problem-solving. As such, group work in design and technology does not seem to be affording the real opportunities that it should offer, not least because children will not be effectively engaged, as reflective practitioners in prudent collaborative endeavour.

As one teacher in the study noted:

Group work has got tremendous benefits, particularly in a classroom situation for resourcing and yes, practice is important. It's social skills, social skills that they don't necessarily use, some of them, and less and less at the moment.

If this statement can be accepted as representative of a common picture of current primary practice, then design and technology, when managed well, should be seen by all primary teachers as an excellent vehicle for developing children as reasoned decision makers; willing, able and, most importantly, encouraged to operate as "reflective practitioners". Moreover, in the context of group-based problem-solving, it can very

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effectively support the enhancement of social (teamwork) and related communication skills. As Ritchie (2001:10) notes:

Design and technology activities can foster personal qualities and attitudes such as curiosity, creativity, originality, self-reliance, co-operation, tolerance for others' views, respect for evidence and perseverance. Design and technology is not the only curriculum area to foster these, but it is one in which attitudes and personal qualities are particularly important and in some ways necessary for success.

Here, "success" has to be seen to relate to the development of optimised solutions, based on children's acceptance of the need to reason together; to operate in a more measured way; to reach a shared/joint agreement, as a basis for proficient progress.

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