Metacognition in Primary Classrooms
A pro-ACTive learning effect for children

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1. Purpose of the paper

The purpose of this short paper is to briefly present some of the findings on children’s learning from the TLRP Phase 2 project, ACTS II Sustainable Thinking Classrooms. Quantitative data will be presented graphically and statistical details are not dealt with in this paper. In the specific context of the TLRP mini-conference for the school sector, the second purpose is to identify some cross-cutting themes relating to images of learners and learning, the characteristics of the ‘new pedagogies’ (dialogic pedagogy?), their focus on individual and social learning, their power and reach (inclusion), and their sustainability for both children and teachers.

2. Objectives and Structure of the project (a reminder)

The main purpose of the ACTS II\(^1\) project was to create and develop a pedagogy to improve learning in primary schools, through enhancing children’s thinking skills across the curriculum.

ACTS adopted an infusion methodology where the goals of enhancing thinking and subject/topic understanding were simultaneously pursued. The theoretical perspective with regard to children’s learning focused on the development of their metacognitive capacities - on their ability to become proactive about their learning in terms of planning, monitoring and appraising their thinking.

Three strands of investigation were pursued within this framework. The first strand comprised the main study: it evaluated an intervention process to enhance children’s thinking and learning, and the effects on both pupils’ and teachers’ learning were appraised. In a second study, thinking lessons were video recorded to identify features of classroom dialogue likely to mediate the development of metacognition. The final strand aimed to design a professional development programme for teachers, to write curriculum materials, and to create longer term strategies for sustaining thinking classrooms.

A flow diagram that outlines how the outcomes of each strand are related to one another and the predicted causal links is shown in the appendix to this paper (Appendix Figure 1).

3. Metacognition as a core concept: Meanings related to individual and social learning

In terms of theoretical development and knowledge building, the concept of metacognition became more central to ACTS II as the project progressed. The

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\(^1\)This version of the project was called ACTS II to distinguish it from an earlier version which was labelled ACTS I. The current project was co-funded by the Department of Education in Northern Ireland and all five Education and Library Boards.
relationship between cognition and metacognition was more clearly articulated within the ACTS thinking framework and as a potential lever for cognitive development and change. A metacognitively rich pedagogy was conceptualised, resulting in the framework for analysing metacognition in classroom dialogue and practices. The impact of the ACTS intervention on children’s self-evaluations of their cognitive and metacognitive strategies and how they changed over the course of three years became a primary focus in terms of pupil learning outcomes. Figure 1 below shows the different meanings of metacognition that have emerged.

**Figure 1. Metacognition as a core concept: Individual and social learning**

The initial ACTS Thinking Framework (Appendix Figure 2) was derived from a cognitive perspective and included a range of different kinds of thinking (pattern-making, reasoning about cause/effect, problem-solving, decision-making), with metacognition at its core. The framework acknowledged the importance of metacognition for cognitive development - not only as a product of development but also as potential means for fostering development. Within the cognitive developmental tradition, Kuhn (1999) has most recently articulated that position but it can be traced back to Flavell’s original writings.
How can the ACTS Thinking Framework be harnessed pedagogically? In our work this required two theoretical turns. The first was from considering metacognition as ‘revealing’ cognitive development, to a more constructivist perspective on metacognition as fostering or ‘creating’ development. The second turn acknowledged the power of social learning as a mediator for metacognition and the perspective shifted to social-constructivism, particularly to the role of classroom dialogue. Hence language and dialogue were of primary interest in the video study. Nevertheless, identifying mediators for metacognition went beyond dialogue and identified other psychological tools that might serve the same purpose in the classroom (e.g., diagrams, wall displays, prompts, icons, cartoons). Appendix Figure 3 outlines the framework we have created for analysing metacognition. For a more extended discussion on the centrality of metacognition for teaching thinking, see McGuinness (2005).

Finally, as our ultimate goal was that the ACTS intervention should have an impact on children’s capacity to manage their own thinking – to think independently - we linked the concept of metacognition within a broader conceptual framework of self-regulation (e.g., Boekaerts, Pintrich). The concern with fostering self-regulation represents a convergence of many different theoretical perspectives (Piagetian, information-processing, Vygotskian, motivational and self theorists).

In terms of evaluating the impact of the ACTS intervention on children’s learning, we positioned our analyses within a more learner-centred framework, that included both cognitive and motivational constructs. We used a suite of self-assessment inventories, Assessment of Learner-Centred Practices, ALCPs (McCombs, 1997) developed from the American Psychological Association’s learner-centred principles (www.apa.org/ed/lcp.html). Seven scales enabled pupils to evaluate their learning (rated on a four-point likert scale) with regard to a range of cognitive and motivational constructs called - Active Learning Strategies (cognitive and metacognitive), Knowledge Seeking Curiosity, Task Mastery, Performance-Oriented Goals, Effort Avoidance Strategies, Work Avoidance Goals, and Self-Efficacy.


One of the most important findings to date relates to the pattern of change over three years in children’s self-ratings on three ALCPS scales – Active Learning Strategies, Effort Avoidance Strategies, and Work Avoidance Goals – identified through latent growth modelling.²

For the purposes of this paper, only the data from the Active Learning Strategies scale will be presented in detail. Sample items from the scale are

² Latent growth modelling is a statistical technique used to detect change over time in longitudinal data. The model on which the results are based combines both latent growth modelling with latent class analysis and is called Latent Growth Mixture Model. The program used was MplusVersion 3.13 statistical modelling program (Muthen & Muthen, 2004).
“I try to figure out how new work fits with what I have learned before in this class” (prior knowledge activation)

“I ask myself questions while I do my work to make sure I understand” (self-monitoring)

“When we have difficult work to do in the class, I try to figure out the hard parts on my own” (independence)

“I go back over work I don’t understand” (self-monitoring)

“I spend some time thinking about how to do my work before I begin it” (planning)

“When I make mistakes, I try to figure out why” (evaluating)

Figures 2, 3, 4 and 5 show the adjusted estimated means at four points in time for the Active Learning Strategies scale. A higher score on this variable indicates more active learning.

Figures 2 and 3 show the pattern for the control group of children who were not participating in the ACTS intervention. The children are grouped into three levels of ability (using latent class analysis) and the data are plotted separately for girls and boys. Figures 4 and 5 show findings for both the control and ACTS intervention groups. The reason for viewing the control data separately is simply to identify patterns in the data and for ease of comparison with the ACTS intervention sample in subsequent figures. This control group is a representative sample of Northern Ireland children in the last three years of their primary schooling (N=548). Blue lines represent High Ability, red lines represent Moderate Ability and green lines represent Low Ability.

Figure 2 shows the data for girls and Figure 3 for boys. The first point to notice is that all ability groups reported that they use active learning strategies less often as they progress through school – there was a general downward trajectory. Reported use was related to levels of ability. For the lowest ability children, the drop off was the most severe especially in the penultimate year of primary school (the year Northern Ireland schools prepare for the selective transfer test to grammar schools). Comparing the girls’ data (Figure 2) with the boys’ data (Figure 3), it is clear that the patterns are very similar, but that the scores for boys are generally lower and the downward trajectory is more pronounced.

If this is the norm in primary classrooms in Northern Ireland, then what can we expect from an intervention such as ACTS whose goal is to promote more active thinking and metacognitive strategies? If the intervention is having the desired effect, then the least we can expect is that it will halt the downward slope and perhaps even reverse the trend.

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3 See Footnote 2
Figures 4 and 5 show the data for both the control sample and for the ACTS intervention sample who participated for three years (for a variety of reasons, not all classes remained in the intervention for the full three years, resulting in sub-samples that participated for one, two and three years).

Figure 2

![Figure 2: Mean ratings: Active Learning Strategies, Girls, Hi, Mod, Low Ability Groups. Control Group ONLY.]

Figure 3

![Figure 3: Mean ratings: Active Learning Strategies, Boys, Hi, Mod, Low Ability Groups. Control Group ONLY.]

Figure 4

Mean ratings: *Active Learning Strategies*,
Girls, Hi, Mod, Low Ability Groups
Control vs ACTS 3 Years

Figure 5

Mean ratings: *Active Learning Strategies*,
Boys Hi, Mod, Low Ability Groups
Control vs ACTS 3 Years
The colours show the ability groups, as in the previous figures. Small circles indicate the ACTS sample and the triangles represent the control sample.

Analysis of the slope measures show that, controlling for the effects of other variables (sex, age, free school meals), participating in the ACTS intervention for 3 years had a positive effect on children’s ratings of their use of cognitive and metacognitive strategies, in the sense that it moderated decreases that were evident in the control group. By the end of three years, the ACTS children reported more frequent use of the cognitive and metacognitive strategies than do the controls (see the changing trajectory over time). The statistically significant effect was confined to the moderate ability group, but the pattern was evident for high ability children. Indeed, the high ability girls are the only group that show an upward trajectory in reported use of active strategies.

In contrast, there was no effect of ACTS on how low ability groups evaluated their cognitive strategies. Both ACTS and control low ability groups showed substantial decreases as they progressed through their school years. Overall, girls rated themselves higher than boys but the pattern of change was virtually identical in both groups.

The impact of ACTS on the pattern of change for two other ALCPS scales, the Work Avoidance Goals, and to a lesser extent, Effort Avoidance Strategies, mirrored the changes shown on the Active Learning Strategies scale.

We have labelled these changing patterns in children’s self-perceptions as a pro-ACTive learning effect, as they are associated with more active use of cognitive and metacognitive strategies, with working harder and putting in more effort. The learning effect is confined to those children who have participated in ACTS for three years; participating for one or two years does not seem to be sufficient. In addition, the positive effects were not the same for all children. Moderate to high ability children (who represented 80% of the sample) benefited most. No positive outcomes were identified for low ability children. Establishing this effect is an important outcome of the study as it demonstrates that engaging with the metacognitively-rich ACTS pedagogy over an extended period in classrooms can have an accumulating positive impact on children’s cognitive self-regulation and motivation – at least for children in the moderate to high ability range.

4. Emerging cross-cutting themes

Images of learners and learning: In contrast to the passive images of learning that can dominate a knowledge-based curriculum, the image of learners and learning that underpinned this project is one where learners were viewed as active, and expectations were set for high quality thinking and learning, learners were considered as capable of
being mindful and resourceful about their learning, of participating in joint meaning making and having the capacity to be an agent in their own learning. This image drew on a range of theoretical viewpoints related to metacognition and learning but is certainly not confined to those viewpoints. In terms of the findings, the image was not fully realised in all the children’s experiences, yet it did prove possible to ‘turn around’ a large number of children to be more proactive about their learning and thinking. Although not reported in this paper, we also found that teachers experienced important changes in their images of themselves as teachers. They described an increased awareness of the importance and value of teaching thinking, of being more open to alternative approaches and allowing children to be more independent in their learning.

**Characteristics of the ‘new’ pedagogies:** Several pedagogical approaches are being researched in the TLRP programme - those that foster metacognition and thinking, assessment for learning, collaborative learning, explicit awareness about learning, ICT as psychological tools for learning and so on. Teachers will be asked to incorporate these new approaches into their classrooms. Theoretical commonalities and differences need to be identified.

From our video study, both practices and dialogue seem to be important. ACTS teachers arranged their classrooms in ways that supported opportunities for children’s talk and created conditions for mediating metacognition. They shifted between teacher-led and pupil-led activities and gave pupils time both to talk to one another in pairs and groups, and to talk to the whole class. They engaged children in cognitively demanding tasks and made thinking more explicit by developing a vocabulary for talking about thinking and for modelling thinking in more concrete situations. What made good thinking lessons distinctive was that learners were given opportunities to talk about their thinking, to jointly construct meaning, to evaluate their thinking and to make connections to contexts both within and outside the curriculum. Nevertheless, there were individual differences between teachers in how well they achieved this. There were some occasions when practices became rituals.

**The impact of the new pedagogies:** An important question will be to evaluate how powerful the new pedagogies are – relative to other influences on learning. What is it reasonable to expect from classroom processes (teacher effects, school effects, social-economic circumstances, ‘ability’ however conceived)? Sustaining the project over time proved to be an important factor in having an influence on the children’s learning. Also, from our project it will be important to understand why lower ability children did not benefit from the intervention and to make links with other studies with similar (or different) findings, in an effort to ensure that the ‘rich do not get richer and the poor get poorer’.

In terms of evaluating the power of the ‘impact’ of this intervention, it should be noted that what teachers achieved was from just one year’s involvement with the ACTS intervention. Although some children participated for almost three years, they were taught each year by teachers who were new to the methodology. In addition, there were differences between schools (rather than individual teachers), in the degree to which they
embraced the ACTS pedagogical practices. A limitation of the current project was that it did not extend to examining the school processes by which ACTS became more embedded in some schools compared to others.

**Becoming and remaining pro-learning:** The title of the project was Sustainable Thinking Classrooms. The potential for sustainability was designed into the project at several levels. The infusion methodology demanded that teachers create, design and redesign lessons and schemes of work from topics across-the-curriculum rather than from pre-designed thinking lessons, thus creating opportunities for teachers to consider more deeply their own lesson intentions with regard to higher-order thinking and task/activity design. Evidence from the project shows that teachers designed and taught infusion lessons across all areas of the curriculum and the lessons were integrated into schemes of work.

The focus on the relationship between cognition and metacognition as the primary construct for enhancement was related to fostering a more general self-regulatory orientation to learning that would permit children to transfer their newly learned active thinking strategies to contexts both within and outside the curriculum. The pro-ACTive learning effect has already been described and the limits identified. In terms of transfer to more traditional indices of achievement, the impact of changes in children’s self-ratings had only weak effects on attainment tests; although they were statistically significant for reading attainment (effects were very small). The reasons for this are beyond the scope of this paper, and may be related to the insensitivity of the attainment tests to the higher order thinking that was the focus for enhancement.

On a more systemic scale, several strategies were adopted to enhance the sustainability of the project, for example, extending the longitudinal design of the project enabled more teachers from the same school to participate. With few exceptions, schools had 2/3 teachers who participated and some had considerably more. All teachers reported that they were continuing with the methodology although differences emerged in the self-reported level of involvement.

In addition, a link officer from each of the five Education and Library Boards in Northern Ireland was attached to the project to continue the work when the funding ended in June 2004. This proved to be successful in 3/5 Education and Library Boards where ACTS methodologies have been either extended to Key Stage 1, linked with Assessment for Learning projects, or rolled into Teaching and Learning developments more generally. Restructuring and retirements have interrupted the process in the other two Boards. Nevertheless, the potential for sustainability at a systems level has been considerably enhanced by the introduction of a Framework for Thinking Skills and Personal Capabilities into the Revised Curriculum for Northern Ireland (CCEA, 2003)\(^4\) which draws substantially on the ACTS thinking framework and an infusion methodology.

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\(^4\) Revised Curriculum to be rolled out from 2007.
5. References


Appendix  Figure 1 shows the hypothesised causal links between the different activities and data in ACTS II Sustainable Thinking Classrooms
(* small scale studies conducted in addition to the main studies funded by the grant)

ACTS intervention
5-day out-of-school Professional Development Programme
distributed throughout school year
Teachers (N=134)

Changes to classroom practices in schools
Infusion lesson planning (evidence from lesson plans)
Pedagogical changes (see below)

Video analyses of ACTS lessons with P5
Teachers (N=21)
Metacognitive Framework developed

Small scale study*
comparing ACTS children’s thinking strategies with control children on two tasks
(N=24)

End-of year structured questionnaires with P5, P6 and P7 teachers (N=94)
• Teachers’ reports on changes in classroom practices
• Teachers’ reports on changes in perceptions of self-as-teacher
• Teachers’ perceptions of changes in children’s thinking

Children’s self-evaluations of cognitive/metacognitive strategies and motivations (ALCPS scales)
at four time points
(N=704 ACTS sample, N=548 comparison sample)

Children’s attainments in reading and mathematics at four time points
(N=704 ACTS sample, N=548 comparison sample)

School principals* perceptions of ACTS in schools (N=33)
Appendix Figure 2. ACTS Framework for Thinking

What Kinds of Thinking?

**Critical thinking**
- Making predictions & formulating hypotheses.
- Drawing conclusions, giving reasons.
- Distinguishing fact from opinion.
- Determining bias, reliability of evidence.
- Relating causes & effects, designing a fair test.

**Metacognition**
- Planning
- Monitoring
- Redirecting
- Evaluating

**Decision making**
- Identifying why a decision is necessary.
- Generating options.
- Predicting the likely consequences.
- Weighing up the pros and cons.
- Deciding on a course of action.
- Reviewing the consequences.

**Problem solving**
- Identifying & clarifying situations.
- Generating alternative solutions.
- Selecting & implementing a solution strategy.
- Evaluating & checking how well a solution solves problem.

**Creative thinking**
- Generating ideas & possibilities.
- Building & combining ideas.
- Formulating own points of view.
- Taking multiple perspectives & seeing other points of view.

**Searching for meaning**
- Sequencing, ordering, ranking.
- Sorting, grouping, classifying.
- Analysing, identifying parts & wholes.
- Noting similarities & differences.
- Finding patterns & relationships.
- Comparing & contrasting.

## Critical thinking
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### Appendix Figure 3 A Framework for Analysing Metacognition in Primary Classrooms

<table>
<thead>
<tr>
<th>Outline of Typical Lesson</th>
<th>ACTS-type Lessons Detailed Structure</th>
<th>Focus for Mediating Metacognition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launching the Lesson</td>
<td>Introducing learning intentions</td>
<td>Making thinking processes explicit</td>
</tr>
<tr>
<td></td>
<td>Topic/Activity</td>
<td>Using vocabulary for talking about thinking</td>
</tr>
<tr>
<td></td>
<td>Type of Thinking</td>
<td>Modeling the thinking process</td>
</tr>
<tr>
<td></td>
<td>Linking to prior experiences</td>
<td>Linking backwards (transfer)</td>
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<tr>
<td></td>
<td>Teacher-whole class</td>
<td>Scaffolding visually (thinking diagrams, word banks, wall charts)</td>
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<tr>
<td></td>
<td>Teacher-pupil</td>
<td></td>
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<tr>
<td></td>
<td>Mostly teacher talk</td>
<td></td>
</tr>
<tr>
<td>Engaging With the Main Activity</td>
<td>Completing challenging task</td>
<td>Engaging with the thinking process</td>
</tr>
<tr>
<td></td>
<td>Pair or group work</td>
<td>Appropriating the language</td>
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<td></td>
<td>Pupil-pupil</td>
<td>Asking and responding to questions about thinking and learning while on-task</td>
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<tr>
<td></td>
<td>Pupil-group</td>
<td>Jointly constructing meaning (combining, disputing)</td>
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<tr>
<td></td>
<td>Pupil-whole class</td>
<td>Planning and monitoring progress</td>
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<tr>
<td></td>
<td>Teacher-group</td>
<td>Explaining and justifying thinking</td>
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<tr>
<td></td>
<td>Teacher-whole class</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Several iterations of group work/reporting depending on activity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mostly pupil talk</td>
<td></td>
</tr>
<tr>
<td>Review</td>
<td>Reviewing and making connections across contexts</td>
<td>Reviewing the process of thinking</td>
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<tr>
<td></td>
<td>Teacher-whole class</td>
<td>Reviewing the quality of collaboration and the quality of talk</td>
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<tr>
<td></td>
<td>Teacher-pupil</td>
<td>Evaluating what has been learned</td>
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<tr>
<td></td>
<td>Pupil-whole class</td>
<td>Making connections at the level of process to other contexts both within and outside the curriculum</td>
</tr>
<tr>
<td></td>
<td>Teacher-led but mostly pupil talk</td>
<td></td>
</tr>
</tbody>
</table>