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Self-regulation and learning: evidence from meta-analysis and from classrooms

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Self regulation and learning: evidence from meta-analysis and from classrooms

Background.

Research indicates that supporting self-regulation and metacognition in learners improves their attainment and wider learning capabilities. However, using this knowledge effectively is challenging.

Aims.

This paper has two main aims. The first is to make a case for the *relative* benefits of metacognitive and self-regulatory approaches for improving learning. Comparative data from over 50 meta-analyses of interventions in schools indicates such approaches are more beneficial than other interventions. The second aim is to present data about different kinds of metacognitive thinking in classrooms which was elicited with cartoon templates.

Sample and methods.

Data about thinking in classrooms is drawn from a sample of 355 pupils, aged 4-15, in 12 schools who were involved in a project which promoted meta-cognition and self-regulation. The completed templates were coded for different kinds of thinking, including metacognitive knowledge and metacognitive skillfulness. A two way ANOVA (gender and age) was conducted to examine the development of thinking across age groups (4-7 year olds; 7-11 year olds; 11-15 year olds).

Results.

There was an increase in all kinds of thinking recorded on the templates with younger children (4 -11 year olds), but contrary to expectation more complex kinds of thinking were identified less frequently with the 11-15 year olds.

Conclusion.

There is strong evidence from meta-analysis that metacognition and selfregulation are key dimensions in supporting learning, but there are also indications from classrooms that such approaches are not routinely embedded in schools in a way which takes advantage of learners' developing capabilities.

Introduction

There is increasing evidence that supporting meta-cognition and the selfregulation of school-age learners is effective in improving their attainment and their wider learning capabilities. The aims of this paper are to strengthen the case for the development and use of such approaches by identifying the relative benefits of metacognitive and self-regulatory approaches, using data from a number of meta-analyses. Not only are meta-cognitive and self-regulatory approaches beneficial, but they are also amongst the most effective of the interventions in education which have been researched with experimental designs.

Section 1: the importance of self-regulation and metacognition for learning

Drawing on constructivist theories of learning, the idea of self-regulation is that students should take active responsibility for aspects of their own learning (Zimmerman, 2001). Although there is a wide range of theoretical perspectives about self-regulation (Zeidner, Boekaerts & Pintrich, 2000), definitions tend to focus on a combination of metacognitive and motivational strategies (Zimmerman, 1986) and a more pro-active approach by learners (Winne, 2011).

Boekaerts (1999) identifies three aspects of self-regulated learning in terms of cognition, metacognition, and motivation/affect. Cognition relates to the range of cognitive strategies that learners use, with metacognitive strategies used to manage, control and regulate this cognition, such as through planning,

monitoring and evaluating specific cognitive strategies and the motivational and volitional components supporting affective and conative aspects of behaviour such as resilience and perseverance (Boekaerts & Corno 2005). As Winne (2005) observes, all learners in academic contexts must to some extent self-regulate. The question is how to ensure that this is optimal, with the challenge for practice being whether teachers can change their classrooms to encourage in self-regulated learning among their students (Zimmerman, 2008).

These ideas are also related to contemporary ideas from policy and practice about 'learning to learn' (Higgins, Wall et al., 2007) and also reflect a shift in policy, particularly in Europe, where the documents such as the 'Framework of Life-long Learning' (EU Council 2002), argues that we need students who can learn in a self-regulated way during school, and even more importantly after schooling and throughout their working life.

A number of meta-analytic reviews have consistently indicated the effectiveness of meta-cognitive and self-regulation approaches (Abrami, Bernard et al., 2008; Chiu 1998; Dignath, Buettner & Langfeldt, 2008; Haller, Child & Walberg, 1988; Higgins, Baumfield & Moseley, 2005; Klauer & Phye 2008). There is also growing evidence that not only are they effective, but that they are relatively more promising than other approaches. This idea builds on the work of researchers such as Fraser, Walberg, Welch and Hattie (1987), Sipe and Curlette (1997), Marzano (1998) and Hattie (2008) who have argued that one of the benefits of meta-analysis is that we can draw comparative inferences between meta-

analyses across different areas of research.

Meta-analysis aggregates data across research studies by using a common metric, effect size, to compare studies. As a statistical technique to look at similar studies on a particular topic it is relatively uncontroversial. However it is also tempting to look at results across different kinds of studies with a common population, so to provide more general or more comparative inferences. This approach is, of course, even more vulnerable to the classic "apples and oranges" criticism of meta-analysis which claims you can't really make a sensible comparison between different kinds of things. However, as Gene Glass (2000, p. 6) said, "Of course it mixes apples and oranges; in the study of fruit nothing else is sensible; comparing apples and oranges is the only endeavor worthy of true scientists; comparing apples to apples is trivial."

A number of studies have attempted to take meta-analysis to this further stage, by synthesising the results from a number of existing meta-analyses and producing what has been called a 'meta-meta-analysis' (Kazrin, Durac & Agteros, 1979), a 'mega-analysis' (Smith 1982), 'super-analysis' (Dillon, 1982) or 'supersynthesis' (e.g. Sipe & Curlette, 1997). There are some differences apparent in researchers' intentions in this further aggregation. Some use each meta-analysis as the unit of analysis in order to say something about the process of conducting a quantitative synthesis and identifying statistical commonalities which may be of importance (e.g. Bloom, Hill, Black & Lipsey, 2008; Ioannidis & Trikalinos, 2007; Lipsey & Wilson, 2001), particularly in terms of the effect of factors such as

research design or effect of the choice of different outcome measures. Others, however, attempt to combine different meta-analyses into a single message about a more general topic than each individual meta-analysis can achieve. Even here, there appear to be some differences. Some retain a clear focus, either by using meta-analyses as the source for identifying original studies (e.g. Marzano, 1998) in effect producing something that might best be considered as a larger meta-analysis rather than a meta-meta-analysis. Others, though, make claims about broad and quite distinct educational areas by directly combining results from different meta-analyses (e.g. Fraser et al. 1987; Sipe & Curlette, 1997).

The most ambitious of these 'super-syntheses' to date is a collation of more than 800 meta-analyses (Hattie, 2008) which produces some interesting conclusions. First of all, it identifies that most things in education 'work', as the average effect size is about 0.4. Hattie then uses this to provide a benchmark for what works above this 'hinge' point as particularly beneficial approaches. There are, of course, some reservations about this 'hinge' as small effects may be valuable if they are either cheap or easy to obtain, to tackle an otherwise intractable problem. Similarly large effect sizes may be less important if they are unrealistic and if they cannot be replicated easily in classrooms by teachers. Further reservations about combining effect sizes of different kinds suggest that intervention effects sizes. The distributions in these studies may be of different kinds, so that unlike comparing fruit, it is more like comparing an apple with a chair (Higgins & Simpson, 2011): the effect size of the difference between the

performance of girls and boys (0.12) is of a different kind from the impact of approaches to individualise instruction (0.2). With a narrower focus on approaches to improving learning, however, approaches like reciprocal teaching (0.74), feedback (0.72) and meta-cognitive strategies (0.67) are all identified as particularly valuable in Hattie's (2008) analysis.

A report (Higgins, Kokotsaki & Coe, 2011a) for the Sutton Trust, a UK charity which focuses on underachievement in education, has developed this approach in order to identify 'best bets' for schools based on the evidence from metaanalysis. The policy context for this was the allocation of the Pupil Premium in England for each of their disadvantaged pupils allocated as part of their funding. These pupils were identified as those who were eligible to receive free school meals or who had previously received free school meals in the past six years. The inclusion criteria for the review aimed to produce a set of meta-analyses sufficiently similar for comparison to enable the cost-effectiveness to be estimated across the different interventions and approaches. These criteria included similar research designs and broadly similar intervention fields (i.e. interventions in schools with similar outcome measures: Hill, Bloom, Black & Lipsey, 2007) with the population clearly specified, as effect sizes are likely to differ for various sub-populations and to reduce with age (Bloom et al., 2008). The intervention approaches selected were those identified by the government, such as one-to-one tutoring or reducing class sizes or the adoption of school uniforms. Initially the review focused on the cost-benefit of these suggestions, and further areas were added in response to teachers' ideas about how they

would be likely to spend the Pupil Premium, such as the appointment of additional teaching assistants, and additional categories were drawn from research summaries of effective approaches (e.g. Hattie, 2008; Sipe & Curlette, 1997).

The analysis therefore tried to identify which approaches were more likely to be beneficial than others and looked at over 50 meta-analyses as a source of comparative data. Our conclusions were, similar to Hattie's (2008), that the most successful interventions focus on the *process* of teaching and learning and the *quality* of teaching and learning interactions either involving the teacher (particularly when providing feedback) or supporting the learner to monitor themselves (metacognition and self-regulation) or each other (peer tutoring and peer-assisted learning). All of these also involve the learner in working harder at learning, often requiring increased cognitive effort. By contrast structural or organizational approaches (such as forms of grouping or individualized instruction) tended to have smaller effects (see Figure 1). For each area an indicative effect size was selected from the meta-analyses or other studies available. For full details of the studies, methodology and distribution of effects see Higgins, Kokotsaki and Coe (2011b).

Figure 1: About here

There are, of course, some limitations and caveats to this approach. Effect size is a standardized metric, usually the difference between two groups divided by the pooled standard of these groups. As such it is vulnerable to a number of issues related to the methods of calculation and in particular the standard deviation chosen. The basic concept is a powerful one as it focuses on improvement, relative to the distribution or spread of scores. However, the underlying comparability is crucial to the meaningfulness of the result. So, if you are looking at similar populations of school pupils with similar underlying circumstances then such comparisons may be valid. Comparing approaches in other contexts such as approaches which work with young children compared with which those which work with older pupils may not be reasonable as the distribution of scores changes with age (Bloom et al. 2008). Studies of interventions with younger children tend to have higher effect sizes as the standard deviations tend to be smaller.

Another issue with meta-analysis is that it looks at averages. All of the approaches have a range of effects which are combined into a pooled average. Some examples of the technique or approaches will have been extremely successful, others less so. What meta-analyses tells you is how effective an approach is on average, indicating which interventions are more or less likely to be productive in other settings and contexts. However there are no guarantees that the findings will transfer to a new context.

There is also a problem in terms of the changing nature of the context, such as with information and communications technology (ICT). Technology has advanced rapidly over the last 30 years so the findings of the effects of technology supported learning from the 1980s may well not apply in 2013. Also although ICT is easily identifiable as an approach, the type of technology and they way that it is used may make a difference. Averaging technology effects over time may therefore be misleading.

Overall the approach has a number of strengths, particularly as it is the only way to compare effects across areas of research using quantitative data. Considerable caution is needed in interpreting the differences without understanding the limitations of the technique. Whilst some tentativeness is clearly needed in drawing conclusions, metacognitive and self-regulatory approaches are at the high end of the distribution of effects suggesting that their use is likely to be productive for improving learning in schools.

Another strength of meta-analysis is that it can identify features associated with greater or smaller improvement by looking at factors (or 'moderator variables') associated with the pattern of effects across a comparable set of studies, so the final part of this section looks at what the messages are from meta-analysis of intervention research in education about self-regulation and metacognition.

Dignath et al. (2008) summarise the most effective characteristics of interventions and suggest (p. 121) that programmes should be based on social-cognitive theories, should focus on strategy training: particularly elaboration and problem solving strategies at the cognitive level, planning strategies at the metacognitive level, and planning and feedback strategies at the motivational level, with a focus on providing knowledge to learners about use of strategies and about their benefits. Group work is challenging and primary school pupils in

particular will need support to develop their skills in this area. Haller et al.'s (1988) early work on reading comprehension indicated that teaching selfquestioning strategies are particularly important.

Chiu's (1998) analysis of reading interventions suggests that meta-cognitive approaches are more effective with low attainers, work better with slightly older students (9-11 year olds) in small groups (rather than individual or class teaching) and that less intensive programmes are more effective than more intensive. Two of these findings are counter-intuitive. Usually what works well for low attaining students works as well or even better for higher attaining pupils and usually more intensive programmes of short duration are more effective than longer ones with less intensity (Hattie, 2008). Perhaps what works for low attainers is that meta-cognitive approaches make aspects of learning more explicit, while high performing learners can work out strategies for themselves. Perhaps time is also needed for all young learners to transfer or apply newly acquired skills for them to have a lasting effect.

Findings from Abrami et al. (2008) and Higgins et al. (2005) indicate that direct teaching of thinking is more effective with a meta-cognitive component than a purely cognitive approach. A mixed approach is beneficial which allows for direct teaching combined with an infused approach (Effect size (ES) = 0.94 compared with 0.38 for general thinking skills and 0.54 for infusion: Abrami et al., 2008, p. 1118). Again the evidence seems to indicate the effectiveness of explicit teaching of strategies with an emphasis on conscious application and use.

Section 2: Meta-cognition and self-regulation in schools: older pupils can but don't

This section of the paper turns to look at some evidence about what kinds of thinking learners in school typically tend to show in class when given the opportunity to think about their learning. Some aspects of self-regulation can be thought of as part "doing school", learning to behave in accordance with school expectations and norms, such as lining up, conforming to routines and routines. For young children this may be a more implicit introduction to the culture of formal schooling than for older learners where it tends to be more explicit (Campbell & Ramey, 1995). There is also evidence that maturation is more important than direct experience of school (Skibbe, Connor, Morrison & Jewkes 2011) though approaches which focus on teaching self-regulation explicitly show potential for boosting young children's skills in this area (Bodrova & Leong, 2005; Winne, 2011).

As part of the Learning to Learn in Schools (Phase 4) project, teachers administered pupil views templates (Wall & Higgins, 2006; Wall, Higgins & Packard, 2007) to pupils in their classes (see Figure 2 for an example of a completed template). These have been shown to elicit children and young people's thinking about their learning (Wall & Higgins, 2006). In total, templates from 355 pupils from the first year of this project were analysed. The completed templates were from a total of 12 schools comprising both primary and secondary age pupils from a variety of geographical and socio-economic regions

across England (see Wall, Hall et al., 2009 for further details). The age range of pupils who completed templates was from 4 to 15 years old. The teachers administered the templates as part of their professional enquiries into learning (Baumfield, Hall, Higgins & Wall 2009), and they received support in their use through the professional development and research support strand of the research project (Wall et al. 2009).

Figure 2: About here

The written content of each template was transcribed and imported into NVivo8 for analysis using a deductive coding procedure (described below). A code was applied based on the sense and meaning of a pupil's response with a judgment made by the researchers as to the intended meaning, and a category code applied accordingly. A category could therefore be applied to a single word, to a sentence fragment, a full sentence or a paragraph. Results are presented in terms of total words coded as the most sensitive output of NVivo (both proportionally and in relation to the research aims).

In the first stage of analysis, documents were coded according to the following variables: school, length of school's involvement in the project, gender, age and which year of Phase 4 the templates were collected in. We were restricted to gender and age as variables about the pupils in terms of the permissions for use of the data across all of the schools involved. Ideally further areas such as current level of attainment or socio-economic status would have been interesting to explore. The text units were also tagged at this stage with whether they were

written in the speech bubble or thought bubble. In the second stage of the analysis the statements were categorised using Moseley and colleagues model of thinking (Moseley, Elliot, Gregson & Higgins, 2005; Moseley, Baumfield et al. 2005: see Figure 3).

Figure 3: About here

This model of thinking was chosen as it is based on an inclusive synthesis of 42 taxonomies and frameworks of thinking (Moseley, Baumfield et al. 2005), and has been used to create categories with a high reliability across different coders (Wall, Higgins et al, 2012). The statements were categorised as to whether they were predominantly evidence of cognitive skills (information gathering, building understanding, or productive thinking); and/or whether they were evidence of metacognitive thought (strategic and reflective thinking in Moseley, Baumfield et al.'s 2005 model). The following definitions based on this analysis were used. Information gathering is characterised by recall of ideas and processes and recognition or basic comprehension of information they have been told or have read. Building understanding requires some organisation of ideas and recollections, some idea of relationships or connections, with some development of meaning about implications and/or patterns which could be applied or interpreted. Productive thinking comments tended to show more complex thinking such as reasoning, problem solving and some movement of understanding beyond the concrete and towards the abstract. Ideas that were more clearly generalisable or creative were placed also in this category. Strategic

and reflective thinking comments represented an awareness of the process of learning, including a reflective or strategic element to the statement or explicit thinking about learning (metacognitive awareness of learning).

The statements which were labeled as strategic and reflective, and therefore indicative of metacognition, were then further analysed for evidence of metacognitive knowledge and metacognitive skillfulness (Veenman, Kok & Blöte, 2005). These categories were characterised in the following ways. Metacognitive knowledge comments showed an understanding that the learner could think about learning, and could talk about some of the processes which supported their own learning (declarative knowledge). Metacognitive skillfulness comments involved the procedural application and translation of thinking and learning skills across different contexts or for different purposes (for definitions and further clarification see also Veenman & Spaans (2005), p 160).

This coding system was checked for inter-rater reliability with an agreement of 82%. Exemplification of the coding can be seen in Table 1 where examples of each coding category are given. All the examples were taken from the same school where teachers were focusing their professional enquiry on how Circle Time (a classroom strategy to support children's reflections on their learning) could support children in talking about their learning experiences. These templates come from a class including Year 1 and 2 pupils (age 5, 6 and 7 years old). It should be noted that the categories used were not necessarily mutually exclusive and a single text unit could be classified as fitting under more than one

heading so percentages in the following graphs do not necessarily total to 100%.

Table 1: About here

Statistical analysis was conducted using a fully between-subjects 3 (age) x 2 (gender) two-way factorial ANOVA. Sample sizes are shown in Table 2.

Table 2: About here

The purpose of the analysis was to find out whether there would be differences in five dependent variables based on rater's scores of pupils' ability to use different cognitive skills in their descriptions of their learning. These skills were Information gathering (IG), Building understanding (BU), Productive thinking (PT), Metacognitive knowledge (MK) and Meta-cognitive skillfulness (MS). These five dependent variables were mapped against two factors, age (three levels: age 4-7 years, age 7-11 years and age 11-15 years (these age bands correspond with the 'Key Stages' of schooling in England) and against gender (male and female). The hypothesis was that more complex, productive and meta-cognitive thinking would be more evident in older learners (Skibbe et al., 2011, p 47) and that young children would show limited meta-cognitive knowledge and skillfulness (Veenman, Kok & Blöte 2005, p 197). Veenman and Spaans (2005, p 162) argue that metacognitive awareness may start at the age of 4–6 years as an inclination that something is wrong and that metacognitive knowledge grows gradually thereafter, but the suggest development of metacognitive skills does not usually appear until the age of 11–12 years. By contrast, Whitebread and colleagues

argue that meta-cognitive knowledge and meta-cognitive regulation are observable in 3-5 year old children (Whitebread et al., 2008) and Wall (2012) describes both meta-cognitive knowledge and skillfulness reported by 4-5 children. The existing literature does not provide any clear expectations regarding different developmental trajectories of meta-cognition by gender. In terms of cognitive development, gender differences are typically small, accounting for only 1-3% of the variance in performance (Ardila, Rosselli, Matute & Inozemtseva, 2011), though there is also some evidence that girls tend to be better at self-regulation and self-discipline (Duckworth & Seligman, 2006; von Suchodoletza, Gestsdottir et al., 2012). Due to the lack of clarity in the research literature, we therefore also undertook an exploratory analysis by gender.

Summary of findings

Before presenting the specific findings, Table 3 summarises the results of the analysis across the five dependent variables.

Table 3: about here

This reveals that there were very few main effects for gender but there were consistent main effects for age. Only one significant interaction effect was observed (Building Understanding), though the interaction effects for Productive Thinking and Metacognitive knowledge were only marginally non-significant. The next section examines the findings for the individual measures in more detail. For the category of Information Gathering, the two-way ANOVA revealed a main effect for age but no effects for gender, nor was there an interaction effect (see Table 3). The patterns of means are shown in Fig 4.

Figure 4: about here

This shows that contrary to expectation, 7-11 year old pupils used the strategy of information gathering more compared with 4-7 year olds and the 11-15 year olds more than both younger groups. Simple main effects analyses revealed that these differences were significant (see Table 3).

For the measure of Building Understanding, the findings were more complicated. Similar to Information Gathering, the two-way ANOVA revealed a main effect but here there was also an effect for gender and, importantly, there was also an interaction effect.

Figure 5: About here

Figure 5 show that in line with expectations, 7-11 year old pupils used the cognitive thinking skills involved in Building Understanding more compared with 4-7 year olds (see Table 3). Contrary to expectations the oldest pupils (11-13 years) described using Building Understanding less. Simple main effects analysis of the interaction (Ho, 2006, p 64-71) indicated that the mean for 7-11 year old girls was significantly different to all the other means. No other conditions were significantly different from each other.

For the measure of Productive Thinking, the findings were similar to Building Understanding, with the two-way ANOVA revealing a main effect for age. There were no effects for gender nor was there an interaction effect. The patterns of means are shown in Fig 6.

Figure 6: About here

Figure 6 shows a similar pattern observed for Building Understanding, whereby 7-11 year old pupils described using this kind of thinking significantly more compared with both other age groups. Also, although the interaction effect was not statistically significant (p = .06), simple main effects analysis revealed that the means for 4-7 year old boys and 11-15 year old boys were significantly different from both 7-11 year old boys at KS2 and girls. This difference should be interpreted with caution, however, as the interaction effect was not statistically significant. No other conditions were significantly different from each other.

For the measure of Metacognitive Knowledge, the findings were again similar to Building Understanding, but this time main effects were observed for both age and gender. The interaction effect was marginally non-significant (p = .07). The patterns of means are shown in Figure 7.

Figure 7: About here

This reveals the now familiar pattern observed for Building Understanding

whereby 7-11 year old pupils described these kinds of thinking significantly more compared with both other age groups. This was true for both boys and girls. Because the interaction effect was marginally non-significant (p = .06), a simple effects analysis was carried out. This analysis revealed that the mean rating for 7-11 year old girls was significantly different from all other means. In addition, the mean rating for 4-7 year old boys was significantly different from 7-11 year olds girls. No other conditions were significantly different from each other.

For the measure of Metacognitive Skillfulness, the findings were similar to Productive Thinking, namely a main effect for age but no effects for gender, nor an interaction effect. The patterns of means are shown in Figure 8.

Figure 8: About here

This shows the by now relatively consistent pattern for more complex kinds of thinking where skill usage is significantly more prevalent for 7-11 year olds compared with both younger and older children.

The results are something of a puzzle. The expected pattern of reported thinking increasing with age only occurred for the least complex kind of thinking, Information Gathering. For Building Understanding and Productive Thinking the 11-15 year olds described these kinds of cognitive skills less frequently than the 7-11 year olds. Even more puzzling is that this pattern was repeated for both Metacognitive Knowledge and Metacognitive Skillfulness. The schools were relatively comparable in terms of attainment and were all seeking actively to

support pupils' learning through the Learning to Learn project. The teachers were all similarly engaged in undertaking enquiries into their professional practice. It could be that the opportunity sample of schools was not sufficiently representative to produce an accurate picture or that some of the teachers of the 7-11 year olds have been more successful in developing learning to learn and metacognitive talk. We know that the kinds of thinking that pupils express is related to their expectations about what they should do in school: a feature of "doing school" (Pope, 2003). Our tentative interpretation at this stage is that, at least for these schools, the older students did not expect to have to demonstrate more complex thinking in the task. It may be that the template format was less successful at eliciting different kinds of thinking from older learners because of the cartoon style of presentation and so provides a less valid or less reliable measure. We know that there are particular challenges of this kind in the assessment of metacognition (Veenman, Van Hout-Wolters & Afflerbach, 2006). Or it may be that the demands in lessons at secondary level are not challenging the students to engage in more complex thinking and that they therefore do not routinely expect to demonstrate it. This, in turn, may relate to the nature of the curriculum and its assessment with a focus on information gathering and building understanding, rather than more complex aspects of thinking.

Whatever the explanation, it is certainly the case that the primary schools involved were more successful at providing a context where meta-cognition and self-regulation were more readily or more fluently expressed by their pupils. Taken with the evidence from the first part of this paper, this suggests that they

are being more successful at supporting some of the more effective approaches to improving learning through metacognition and self-regulation. By contrast, secondary learners may not be being challenged in a way in which they are thinking so productively about their learning, even though they are at an age where they are capable of doing this.

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Strategic and reflective thinking Engagement with and the management of thinking/learning supported by value-grounded thinking (including critically reflective thinking)						
Cognitive skills						
Information-gathering Experiencing, recognising and recalling Comprehending messages and recorded information	Building understanding Development of meaning (e.g. by elaborating, representing or sharing ideas) Working with patterns and rules Concept formation	Productive thinking Reasoning Understanding causal relationships Systematic enquiry Problem solving Creative thinking				

Table 1: Coding categories

Information	gathering	In Circle Time we share our thoughts and smiles			
Building und	derstanding	I like Circle Time because you tell other children about you			
Productive thinking		I didn't feel nervous because I got to know the other children and new friends.			
Strategic & reflective thinking	Metacognitive knowledge	Circle Time is a bit scary because sometimes you have to speak in front of everyone.			
	Metacognitive skilfulness	If people are stuck on a work (sic), asking the person or a friend to help you.			

Age	4-7 years	7-11	11-15	Totals
		years	years	
Male	80	38	49	167
Female	87	39	62	188
Totals	167	77	111	355

Table 3: Summar	v of mai	n effects a	and intera	actions	for the	five c	lependent

	Main Effect			Main Effect		Gender x Age interaction			
Dependent	Gender			Age					
variable	F	р	η²	F	р	η²	F	р	η²
Information Gathering	1.96 (1, 349)	.88		59.58 (2, 349)	<.001	.25	46.85 (1, 349)	.58	
Building understanding	19.22 (1, 350)	<.001	.05	23.66 (2, 350)	<.001	.12	5.19 (2, 350)	<.05	.03
Productive thinking	3.72 (1, 350)	.06		81.94 (2, 350)	<.001	.07	2.64 (2, 350)	.06	
Meta-cognitive knowledge	29.84 (1, 349)	<.001	.08	20.58 (2, 350)	<.001	.11	2.76 (2, 350)	.07	
Metacognitive skilfulness	0.70 (1, 349)	.40		7.31 (2, 349)	<.001	.04	1.42 (2, 350)	.24	

variables

F= F value, p= p value, η^2 = partial eta squared effect size





Building Understanding



Productive thinking



Metacognitive Knowledge

Figure 8: Means for Metacognitive Skilfulness by Age and Gender



Metacognitive Skilfulness