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# Children's Metacognitive Knowledge of Five Key Learning Processes

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To be successful in school, children must pay attention, ignore distractions, persist on tasks, be organized, and plan their work. However, these processes are not typically taught in school, and research has not yet examined whether children understand them. Given that children's understanding (metacognitive knowledge) of learning processes is associated with their performance, we investigated whether 1st- through 6th-grade children could explain what it meant to execute these 5 processes. We evaluated how many specific process components children mentioned in their definitions and whether the number of components they mentioned predicted scores on a picture memory task. Although almost all children were able to provide valid definitions of the learning processes, they mentioned only some of the components for each process. Children most frequently mentioned process components that were observable. For example, when asked to define *organization,* most mentioned organizing papers and other materials, but few mentioned managing time, thoughts, or actions. This indicates that children may be unaware of the actions needed to execute critical learning processes. We found that older children were more aware of the components of organization and planning than were younger children. In addition, the number of components children mentioned when defining *organization* and their combined knowledge of all processes predicted their performance on a picture memory task. Given children's limited metacognitive knowledge of these learning processes and the association of such knowledge with task performance, explicit instruction on these learning processes and related strategies may be beneficial.

***What is the significance of this article for the general public?***
This study showed that (a) children may not be aware of the components of important learning processes such as paying attention, ignoring distractions, persisting on tasks, being organized, and planning, and (b) the extent of children's knowledge of some processes is associated with their performance on learning tasks. Parents and educators should explain the steps involved in executing learning processes, when appropriate, to reinforce children's understanding. More schools should integrate metacognitive knowledge and strategy instruction into their curriculum at all grade levels.

*Keywords:* child development, education, executive function, metacognition, self-regulation

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To be successful in school, children must pay attention, ignore distractions, persist on tasks, be organized, and plan their work (Blair & Razza, 2007). However, these processes are typically not taught in school, and it is unclear how well children understand them. Teaching children about the components involved in processes like memory improves their strategy use, which in turn increases their memory skills (Cox, 1994). Few studies, however, have examined children's knowledge about learning processes other than those involved in memorizing or reading. This study examined children's metacognitive knowledge of the five key learning processes mentioned above.

Metacognition is awareness, understanding, and control of one's mental processes (Schraw & Dennison, 1994). Metacognitive knowledge, one component of metacognition (Brown, 1978; Schraw, 1998), involves one's knowledge of tasks, actions, or strategies and how these interact to affect thinking and learning (Efklides, 2009; Flavell, 1979). It includes knowledge of one's own abilities and available learning strategies (declarative knowledge), how to use strategies (procedural knowledge), and when to do so (conditional knowledge; Brown, 1978; Schraw & Dennison, 1994). This study focuses on declarative and procedural knowledge.

Metacognitive knowledge improves with age, varies depending upon task demands, and contributes to educational achievement (Kreutzer, Leonard, Flavell, & Hagen, 1975; Sobel & Letourneau, 2015). Basic metacognitive knowledge and skills develop during the preschool period (Veenman, Van Hout-Wolters, & Afflerbach, 2006). Preschool-aged children can describe what they know, who taught it to them, and their learning processes (Sobel, Li, & Corriveau, 2007; Tang & Bartsch, 2012), but they may not be fully aware of the details or components of learning processes (Annevirta & Vauras, 2001; Sobel et al., 2007). The ability to think about and understand one's own mental processes improves gradually throughout childhood (Louca, 2019). However, most research has shown that children are best able to articulate their knowledge of mental processes after age 8 (Louca, 2019). The more children know about how to learn, the more likely it is that they will be able to monitor and control processes needed to learn in the classroom (Veenman, Wilhelm, & Beishuizen, 2004).

Young children may have difficulty using metacognitive knowledge to direct their thinking and problem-solving because they lack a coherent theory of mind (Flavell, Green, & Flavell, 1995; Schraw & Moshman, 1995) and have more limited working memory capacity than do adults (Cowan, Nugent, Elliott, Ponomarev, & Saults, 1999). Theory of mind develops between three and five years of age and enables children to understand that they have control over their mental states (Flavell, 2004). If children do not understand that they have such control and that their thoughts may differ depending on the situation, they may not be able to articulate how they would think in a given situation. Thus, researchers do not typically assess children's knowledge of learning processes or strategies before preschool.

Working memory is also involved in metacognition and learning and is responsible for manipulation of information necessary for critical thinking and comprehension (Baddeley, 1996). Using metacognitive knowledge may take up space in working memory, which may make it difficult to access metacognitive skills while engaged in complex tasks. However, research has suggested that appropriate selection of strategies to complete tasks is more dependent on metacognition than on working memory (Roberts & Erdos, 1993). Although working memory continues to develop well into adolescence, prior studies have suggested that by age five, children have the basic working memory capacity necessary to complete problem-solving tasks and to articulate some metacognitive knowledge of learning processes (Whitebread, 1999).

Most research on children's metacognitive knowledge of learning has focused on memory, reading, and generic learning. Generally, these studies required children to endorse which metacognitive strategies they used from a list of options (Schraw & Dennison, 1994). Scores are associated with performance and strategy use on related tasks.

Picture recall tasks are commonly used to assess memory strategies. Children are given a series of cards with pictures of familiar objects to memorize and are asked to recall them after a short delay (Coyle & Bjorklund, 1997). The most successful individuals use organizational strategies to sort pictures into familiar categories (Worden, Mandler, & Chang, 1978). Although organizational strategies are clearly important for picture memory, attention and other learning processes may be as well. However, the contributions of these strategies to picture recall have not been assessed.

Only a few studies have asked children to describe their cognitive processes during open-ended interviews (Kreutzer et al., 1975; Myers & Paris, 1978; Sobel & Letourneau, 2015). Two consistent findings emerged: (a) children's descriptions of their learning strategies become more detailed with age and (b) even older children are often unable to articulate some key elements of learning processes. For example, Myers and Paris (1978) asked children to articulate their knowledge of reading strategies. They asked 40 second and sixth graders questions such as "What makes someone a really good reader?" and "What do you do if you don't understand a word or whole sentence?" Children were unable to report many important aspects of what makes a good reader, although their knowledge did increase with age.

Sobel and Letourneau (2015) interviewed children between four and 10 years of age about their definitions of *learning* and then asked them to give examples of the kinds of things they learned and how they learned them. Four- to five-year-olds were less likely than older children to mention processes involved in learning. Eight- to 10-year-olds reported thinking of learning as a process and gave specific examples of metacognitive strategies involved. These results show that elementary school–age children can give valid descriptions of their learning processes and articulate how they might use learning strategies in hypothetical situations (see also Sobel et al., 2007; Tang & Bartsch, 2012). However, the study did not shed light on how much children know or are able to articulate about the components involved in specific learning processes.

## Learning Process Components

In a typical elementary school day, children are repeatedly told to "pay attention," "be organized," "ignore distractions," "plan their tasks," and "keep working until finished." There is an implicit assumption that children understand what these commands mean. However, the learning processes needed for understanding them are far from simple. *Paying attention,* for example, involves three components: alerting, orienting, and maintaining attention (Fisher, Godwin, & Seltman, 2014; Posner & Rothbart, 2007). *Alerting* requires being sensitive to incoming stimuli. Children might prepare to pay attention by becoming aware of what they should attend to (e.g., instructions from the teacher). *Orienting* involves "aligning attention with a source of sensory signals" (Posner & Rothbart, 2007, p. 7). Examples of the orienting response include children's turning their heads toward the teacher or looking at the blackboard. *Maintaining* refers to sustaining attention despite distracting stimuli (Fisher et al., 2014). Although sometimes considered a part of paying attention, *ignoring distractions* also requires other components: avoiding task-irrelevant responses (e.g., talking to off-task students), executing goal-directed responses (e.g., keeping attention on the teacher), and manipulating the environment to avoid temptation (e.g., moving to a quieter area; Barkley, 1997; Ent, Baumeister, & Tice, 2015). Research has shown that attention difficulties and inadequate strategies for ignoring distractions predict lower school performance (Meltzer, 2010). However, few studies have investigated whether children are aware of the components involved in paying attention or ignoring distractions.

*Persistence,* another important learning process for school success, is most often described as the amount of time one continues to work on a challenging task (Eisenberg et al., 2001). It includes overcoming obstacles that can prevent continuing a task (Drake, Belsky, & Fearon, 2014), having sufficient motivation to continue (Claessen, 2010), and continuing to work on an activity until it is completed (Pintrich & Schunk, 2002). No studies have investigated whether children can articulate the components of persistence.

To successfully complete their coursework and manage multiple tasks and deadlines, children, even young ones, must stay organized and plan their work. Both of these learning processes have multiple components. *Organizational skills* include systematically managing materials, actions, time, and thoughts or memory (Langberg, Epstein, Becker, Girio-Herrera, & Vaughn, 2012). *Planning* involves goal setting, formulating a checklist of sequenced tasks necessary to achieve a goal, and executing each task until the goal is achieved (Gardner &

Rogoff, 1990; Luciana, Collins, Olson, & Schissel, 2009). It also requires monitoring, reevaluating, and updating steps needed to achieve a goal (McCormack & Atance, 2011). Little is known about children's understanding of these processes.

This study investigated elementary school–age children's knowledge of paying attention, ignoring distractions, persisting on tasks, being organized, and planning. We had the following three research questions:

> *Research Question 1 (RQ1):* How many learning process components do children mention when asked to give their own definitions of these learning processes?
>
> *Research Question 2 (RQ2):* Does the number of components children mention vary by grade?
>
> *Research Question 3 (RQ3):* Does the number of components children mention predict their scores on a picture memory task?

We hypothesized that mentioning a greater number of learning process components would positively predict picture recall.

## Method

### Participants

We interviewed 166 children (54% boys) attending a summer day camp at a university in Baltimore, Maryland. Children were entering first through sixth grades in the fall. Recruitment took place during three consecutive summers, although children participated only once if they attended camp more than one summer. No other exclusion criteria were used. The three waves of participants did not differ significantly on gender, ethnicity, grade, or parents' highest level of education. Therefore, their data were combined in all analyses. We categorized children into three grade groups for analyses (Sobel & Letourneau, 2015). There were 72 first and second graders ($M$ = 6.85 years, $SD$ = 0.57), 51 third and fourth graders ($M$ = 8.88 years, $SD$ = 0.61), and 43 fifth and sixth graders ($M$ = 10.71 years, $SD$ = 0.56). Fifty-five percent of the children were White, 22% Black–African American, 7% Asian, 3% another race–ethnicity, 10% multiracial. Most parents (84%) earned at least bachelors' degrees (7% associate degree, 4% some college–vocational–technical school, 4% high school degree, $<$1% less than high school).

### Procedure

Research assistants administered the Children's Knowledge of How They Learn Questionnaire, developed by the authors, and then a picture memory task. Interviews were recorded and transcribed.

### Measures

**Children's learning processes.** The Children's Knowledge of How They Learn Questionnaire was developed to assess children's understanding of the five important learning processes previously discussed. Children were asked questions about their knowledge of learning processes and how they gained such knowledge. Most relevant to this study, children were asked these two questions: "What does it mean to pay attention (ignore distractions, etc.)?" and "What do you do to help yourself pay attention (ignore distractions, etc.)?" We piloted the interview with two children from each age group (first–second, third–fourth, and fifth–sixth grades). Research assistants engaged in cognitive interviewing to assess whether children understood what was being asked. All pilot children understood the questions and provided codable responses.

**Picture memory.** The picture recall task had pictures of animals, vehicles, and foods (five items per category; Coyle & Bjorklund, 1997). Research assistants showed children the picture cards one by one in the same order, saying the name of each picture. Cards were arranged randomly on the table. Children were told,

> Here are 15 picture cards. You will have three minutes to memorize these pictures. After three minutes are over, I will take the cards away and ask you to tell me as many of the pictures as you can remember. You can do anything you want to help you remember (including moving cards).

After 3 min or when children said they were ready, the interviewer took the cards away and said, "Please name as many of the pictures as you can remember." Picture memory scores were the total number of correctly recalled pictures.

## Coding of Open-Ended Responses

We focused on learning processes that teachers and school psychologists often implicate as key reasons for school difficulties (Dawson & Guare, 2010; Meltzer, 2010). We examined children's responses in our study and searched the academic literature on metacognition and executive function to find components of each learning process commonly mentioned in researchers' definitions of these processes. Using a grounded theory approach, we reviewed children's responses to find examples consistent with those found in the literature (Strauss & Corbin, 1997). Components included in the final coding scheme were found in the literature and were reflected in at least one child's response. Scores (0 = not mentioned, 1 = mentioned) for each component were summed to create process scores.

Interrater reliability for open-ended responses was established by having two raters independently code 25% of the responses for each learning process. Interrater reliability was tested for each component using Cohen's kappa. Kappas of at least .60 were considered acceptable (Cohen, 1960; McHugh, 2012). Final kappas ranged from .71 to 1.00. The questionnaire, coding procedures, and the picture memory task are available in the online supplemental materials.

## Word Count

We controlled for developmental differences in children's language skills in two ways. First, we gave the same credit to linguistically simple and more complex responses. If children responded "focusing," they would receive the same code as did children who said "concentrating on the person you are paying attention to." Second, we controlled for the number of words used in children's responses in statistical analyses (see the word count procedure in Metzger, Sonnenschein, & Galindo, 2019). This helped disambiguate response length from response content.

# Results

## Preliminary Analyses

Given that girls and children with more advanced language skills often score higher on metacognitive inventories and learning tasks (Carr & Jessup, 1997), we first examined differences in word count (our proxy for language) and picture memory scores to see whether grade and gender should be included as covariates. One-way analyses of variance showed significant differences in word count across the three grade groups on almost every learning process definition ($p < .05$), as well as the overall word count for all definitions, $F(2, 158) = 9.39$, $p < .001$. First–second graders generally had significantly lower word counts than did third–fourth and fifth–sixth graders, who did not differ significantly from each other. Specifically for overall word count for all definitions, first–second graders ($M = 165.51$, $SD = 134.50$) had significantly lower word counts than did third–fourth ($M = 281.42$, $SD = 188.01$; $p < .001$), and fifth–sixth graders ($M = 258.21$, $SD = 144.97$; $p = .002$), who did not differ significantly from each other ($p = .479$). Accordingly, we controlled for word count in all analyses examining grade group differences. There were no significant differences in the number of components mentioned in girls' and boys' definitions of learning processes ($p > .05$). However, girls ($M = 11.99$, $SD = 2.48$) scored significantly higher than did boys ($M = 10.68$, $SD = 2.78$) on the picture memory task, $t(161) = 3.14$, $p = .002$. Therefore, we controlled for gender in all analyses that included picture memory.

## Children's Definitions of Learning Processes

To address RQ1, we analyzed children's definitions of the five learning processes to determine how many components were mentioned for each process. All children mentioned at least one component for paying attention, 92% of children mentioned at least one component for ignoring distractions, 69% mentioned at least one component for persisting on tasks, 92% mentioned at least one component for organizing, and 82% mentioned at least one component for planning. Fewer than 10% of the children mentioned all of the components for any of the processes. Children's awareness of the process components varied widely; some components were mentioned by as many as 80% of children, and others as few as 2%.

For *paying attention,* children were scored on awareness of "alerting, orienting, and maintaining attention". There were no grade-related differences in the percentage of children who mentioned these components. Definitions of *ignoring distractions* were scored for "ignoring task-irrelevant responses," "executing goal-directed responses," and "manipulating the environment." Again, there were no grade-related differences in these components. *Persistence* definitions were scored for "reflecting on task requirements," "overcoming obstacles," making efforts to increase "motivation," and "continuance." A higher percentage of fifth–sixth graders mentioned trying to increase motivation than did first–second or third–fourth graders. *Organization* was scored for "managing materials," "managing time," "managing actions," and "managing thoughts." A higher percentage of third–fourth graders mentioned managing materials (e.g., keeping desks and folders organized) than did first–second graders. *Planning* included components of "goal setting," "executing sequenced actions," and "updating the steps needed to accomplish tasks." For *goal setting,* a higher percentage of fifth–sixth graders showed awareness than did first–second or third–fourth graders, who also differed significantly from each other. For *executing sequenced actions,* a higher percentage of fifth–sixth graders showed awareness than did first–second graders.

To address RQ2, we conducted analyses of covariance comparing the mean number of components mentioned for each process by grade group, controlling for word count for each of the five learning processes. Due to violations of the homogeneity of variance in three of the five learning processes (attention, ignoring distractions, and organization), we used generalized linear modeling to analyze group differences. Differences in sample size across analyses were due to differences in the number of children who provided codable responses for each process. There were significant differences across grade groups for number of components mentioned for two of the learning processes: organizing, Wald's $\chi^2(2, N = 155) = 9.21$, $p = .010$, and planning, Wald's $\chi^2(2, N = 142) = 25.52$, $p < .001$ (see Table 1).

## Children's Knowledge of Learning Processes and Picture Memory Performance

To determine whether the number of components children mentioned predicted their picture memory scores (RQ3), we used separate ordinary least squares (OLS) regressions with number of components mentioned for each learning process predicting picture memory scores, controlling for grade group, gender, and the respective word count for that learning process. Ignoring distractions ($\beta = .157$), $t(146) = 2.27$, $p = .025$, $R^2 = .379$; $F(4, 146) = 22.26$, $p < .001$; organization ($\beta = .192$), $t(148) = 2.85$, $p = .005$, $R^2 = .410$; $F(4, 148) = 25.76$, $p < .001$;

Table 1
*Grade-Related Differences in Children's Awareness of Learning Processes*

| Learning processes (no. components) | All grades ($N = 166$) | First–second graders ($n = 72$) | Third–fourth graders ($n = 51$) | Fifth–sixth graders ($n = 43$) |
|---|---|---|---|---|
| Paying attention (3) | 1.73 (0.60) | 1.69 (0.66) | 1.74 (0.57) | 1.79 (0.52) |
| Ignoring distractions (3) | 1.17 (0.59) | 1.00 (0.49) | 1.32 (0.59) | 1.27 (0.67) |
| Persistence (4) | 0.81 (0.64) | 0.76 (0.53) | 0.79 (0.64) | 0.90 (0.78) |
| Organization (4) | 1.14 (0.56)$^{**}$ | 0.95 (0.48)$^{**b,c}$ | 1.30 (0.65)$^{**a}$ | 1.26 (0.49)$^{**a}$ |
| Planning steps (3) | 1.21 (0.76)$^{***}$ | 0.86 (0.72)$^{***b,c}$ | 1.25 (0.73)$^{***a,c}$ | 1.64 (0.62)$^{***a,b}$ |

*Note*. There were significant differences across grade groups for number of components mentioned for organization, Wald's $\chi^2(2, N = 155) = 9.21$, $p = .010$, and planning steps, Wald's $\chi^2(2, N = 142) = 25.52$, $p < .001$. For organization, first–second graders mentioned significantly fewer components than did third–fourth graders ($p = .005$) and fifth–sixth graders ($p = .026$), who were not significantly different from each other ($p = .626$). For planning steps, first–second graders mentioned significantly fewer components than did third–fourth graders ($p = .044$) and fifth–sixth graders ($p < .001$), who also were significantly different from each other ($p = .003$). Superscripts denote significant differences (a = significantly different from first–second graders; b = significantly different from third–fourth graders; c = significantly different from fifth–sixth graders). The numbers in the table are the average number of learning process components mentioned and the standard deviation in parentheses.
$^{**}$ $p \le .01$. $^{***}$ $p < .001$.

and planning ($\beta$ = .170), $t$(137) = 2.21, $p$ = .029, $R^2$ = .408; $F$(4, 137) = 23.56, $p$ < .001, significantly predicted picture memory scores when considered separately. Attention ($\beta$ = −.095), $t$(153) = −1.46, $p$ = .147, $R^2$ = .379; $F$(4, 153) = 23.33, $p$ < .001, and persistence ($\beta$ = .056), $t$(135) = 0.75, $p$ = .456, $R^2$ = .385; $F$(4, 135) = 21.11, $p$ < .001, did not significantly predict picture memory scores. For all regressions, grade and gender accounted for a significant amount of variance. Respective word count did not.

We then conducted an OLS regression to examine the unique contribution of each learning process to picture memory scores. Because the number of possible components within each learning process differed, we standardized these variables using $Z$ scores. We included the standardized number of components mentioned for each of the five learning processes as predictors. Grade group, gender, and total word count for all definitions were covariates. Number of components mentioned for organization significantly positively predicted children's picture memory scores above and beyond the variance accounted for by the other learning processes ($\beta$ = .150), $t$(112) = 2.06, $p$ = .042. Number of components mentioned for paying attention ($\beta$ = −.133), $t$(112) = −1.90, $p$ = .060; ignoring distractions ($\beta$ = .119), $t$(112) = 1.63, $p$ = .106; persistence ($\beta$ = −.020), $t$(112) = −0.26, $p$ = .794; and planning ($\beta$ = .148), $t$(112) = 1.89, $p$ = .061, were not significant unique predictors. Grade group ($\beta$ = .449), $t$(112) = 5.80, $p$ < .001, and gender ($\beta$ = .235), $t$(112) = 3.29, $p$ = .001, accounted for a significant amount of variance in picture memory scores, and word count did not ($\beta$ = .012), $t$(112) = 0.51, $p$ = .880. Overall, the model accounted for 48% of the variance in picture memory scores ($R^2$ = .479), $F$(8, 112) = 12.89, $p$ < .001. Supplemental analyses, including examples of children's definitions of learning processes, proportions of children who mentioned specific learning process components, and grade-related differences, are available in the online supplemental materials.

## Discussion

The present study used open-ended interviews to investigate elementary school–age children's knowledge of paying attention, ignoring distractions, persisting on tasks, organizing, and planning. We identified common components of each process through a review of empirical and theoretical literature and coded children's responses for evidence of those components. Although the majority of the children, even the youngest, demonstrated some knowledge of these processes, few were aware of all the components. In addition, the number of components children mentioned in their definitions of *ignoring distractions, organizing,* and *planning* predicted their scores on a picture memory task. These results provide support for the importance of metacognitive knowledge for task performance and highlight the potential need for additional support for the development of children's metacognitive knowledge.

Consistent with previous studies, we found developmental differences in children's metacognitive knowledge of learning processes (Sobel & Letourneau, 2015). Younger children mentioned more observable components of learning processes and fewer abstract components. For example, when asked to define *organization,* many mentioned managing materials, but few mentioned the management of time or thoughts. The same was true for *paying attention.* Most children, even the youngest, mentioned the need to look at the teacher (orienting), but they were less aware of the need to cognitively ready oneself to receive information (alerting). One explanation for the differences in children's awareness of the components involved in learning processes is that some are easier to observe than others. Paying attention (the learning process for which children mentioned the most components) includes more behavioral components that are easily seen and recognized than do the other processes (Fisher et al., 2014; Posner & Rothbart, 2007). Persisting on tasks and planning require more cognitive components, which are less observable (Gardner & Rogoff, 1990; Luciana et al., 2009).

Adults may provide varying levels of support for the development of different learning processes and components. Parents and teachers often scaffold children's thinking and behavior by making comments or asking questions about what they are doing (Winsler, 1998). For example, if children look away from the chalkboard during class, the teacher might correct them and explain that looking is part of paying attention. Through this type of exchange, children may become aware of the components of paying attention and develop the relevant vocabulary to explain the process (Dawson & Guare, 2010; Winsler, 1998). In contrast, persistence, organization, and planning are skills that children are often not expected to master until late elementary school (Friedman et al., 2014; Jozsa & Morgan, 2014), so teachers may be less likely to comment upon these.

To investigate the relation between metacognitive knowledge and learning task performance, we tested associations between children's knowledge of learning processes and their scores on a picture memory task. Children's knowledge of organization uniquely predicted their picture memory task scores, controlling for knowledge of other learning processes. It is not surprising that knowledge of organization was most strongly associated with performance because sorting and clustering (organization strategies) enhance performance on similar tasks (Coyle & Bjorklund, 1997). When the associations between knowledge of each learning process and picture memory scores were examined separately, knowledge about ignoring distractions, organization, and planning were all significantly associated with performance.

Taken together, these results suggest that children may need support to develop their knowledge of learning processes. Flavell (1979) posited that giving children the opportunity to use metacognitive strategies and helping them understand the processes involved in executing them (declarative knowledge) would increase metacognitive abilities. Indeed, research has shown that children whose elementary school teachers frequently talk about memory and strategies display better strategy use and memory performance (Ornstein, Grammer, & Coffman, 2010). Although teachers' ability to scaffold the development of children's metacognitive knowledge was not explored for the learning processes in the current study, it is reasonable to assume that similar strategies may help children develop metacognitive knowledge of these key learning processes.

Researchers have generally agreed that children should receive contextualized instruction on metacognitive components and strategy use throughout their daily routines, rather than in specific classes (Askell-Williams, Lawson, & Skrzypiec, 2012). Classroom interventions, which involve setting goals and discussing relevant metacognitive strategies that could be used to reach learning goals, have been successful in improving children's strategy use and academic achievement on related tasks (Meltzer, 2010; Villares, Frain, Brigman, Webb, & Peluso, 2012). Given evidence that children as young as preschool are aware of learning processes (Geurten & Willems, 2016; Kreutzer et al., 1975; Sobel & Letourneau, 2015), children may benefit from these programs, even in early elementary school.

Dignath, Buettner, and Langfeldt (2008) conducted a meta-analysis of metacognitive and self-regulatory training programs for elementary school students. They found that classroom programs that combined instruction on cognitive, metacognitive, and motivational strategies had the greatest effects. Embedding metacognitive questions in children's classwork on what it means to pay attention, for example, may be one way to help them reflect on what it means to execute these learning processes. Consistent with these findings, it may also be helpful to assist children in identifying reasons why processes are important and why they should pay attention in class.

Little research has examined how parents can foster metacognitive knowledge of learning processes; that which has been conducted has focused primarily on metamemory (Carr, Kurtz, Schneider, Turner, & Borkowski, 1989). However, research has suggested that parents may scaffold children's development of metacognitive knowledge and skills by guiding them through learning experiences and fostering the development of relevant vocabulary (Dawson & Guare, 2010; Winsler, 1998).

The three main limitations of the current study are its reliance on children's reports, its cross-sectional design, and its use of one learning task. Children's language skills are still developing during early elementary school, which may limit the sophistication of their verbal responses. However, young children can express their perceptions of learning processes and activities (Sobel & Letourneau, 2015). Children's ability to report their knowledge of learning processes may also be restricted by lower levels of working memory (Cowan et al., 1999). Future studies should include measures of working memory so that its effects can be disentangled from that of metacognitive knowledge. The cross-sectional nature of the study did not allow us to observe developmental changes in metacognitive knowledge over time. However, cross-sectional research is common in such research (Kreutzer et al., 1975; Sobel & Letourneau, 2015) and allows for helpful comparisons between children at different developmental levels. Finally, it should be noted that associations between metacognitive knowledge and performance on the picture memory task in this study may not generalize to other measures. Future studies should test associations between children's metacognitive knowledge and applied learning tasks.

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