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Development and evaluation of metacognition in early childhood education

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The aim of the present study is to provide information and suggest ways to improve and evaluate metacognition in early childhood. Metacognition is important to learning and knowledge transfer and preparing students to become lifelong learners is a main aim of schooling. The engagement of young students in metacognitive thinking is considered necessary, as they seem capable of developing fundamental forms of metacognition after the age of three. The development of metacognitive skills helps young children to become thoughtful about their learning process. Specifically, the implementation of interesting activities in an enjoyable manner that develops young children's high-order thinking could help them to enhance metacognitive skills and become effective learners. Physical activities during reciprocal and self-check teaching styles are such activities that could guide young students to reflect on their own learning and realise what they are doing.

Keywords: metacognition; early childhood; physical activities

1. Introduction

1.1 *Metacognition*

1.1.1 *Metacognition in daily life*

Metacognition *refers* to a *high level of thinking* that *involves active control over* the *cognitive processes engaged* in *learning* and consists of two components: (a) knowledge of cognition and (b) regulation of cognition (Schraw, 2002). *Knowledge of cognition* includes: (i) declarative, (ii) procedural, and (iii) conditional knowledge and refers to what individuals know about themselves as cognitive processors. Declarative knowledge relates to knowledge about oneself as a learner and the factors that influence his performance. Procedural knowledge is the knowledge of how to perform a specific task and conditional knowledge refers to knowing when and why to use a skill or strategy (Schraw, 2002). *Regulation of cognition* refers to how well students can control their learning mechanism and includes three essential skills: (a) planning, that has to do with the appropriate selection of strategies for an effective performance, (b) monitoring, that concerns a person's awareness of comprehension and task performance, and (c)

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evaluating, that is about the product appraisal of a student's work and the efficiency of his own learning (Schraw, 2002).

Studies have established the importance of metacognition in the acquisition of learning skills (Alexander, Fabricius, Fleming, Zwahr, & Brown, 2003; Hartman, 2002), and researchers agree that people with high level of metacognitive knowledge and skills have the ability to solve problems effectively (Gourgey, 2010). Such an ability occurs because knowledge about cognition influences individuals' selection of learning strategies (Pillow, 2008), and the use of appropriate strategies in problem-solving situations (Glaser & Chi, 1988).

Metacognition is considered essential to student success, as studies have found that students who use metacognitive abilities, learn and remember more than others (Woolfolk, 1998) and diagnose problems and correct them (Bereiter & Scardamalia, 1987), discover the best ways to reinforce what they have learned (Vandergrift, 2005).

1.1.2 *Metacognition in the early years*

Researchers claim that metacognition plays a critical role in students' memory and when neuroscientists talk about young children's metacognition, they mean infrastructural elements such as working memory rather than higher order components such as planning or organisation (Denckla, 2003). According to Flavell (2000), young children before the age of one year, begin to develop a 'theory of mind' with an understanding of mental phenomena and the ability to estimate mental states such as desires and intentions. Around the age of four, children begin to understand knowledge as part of a processing system that enables them to appreciate the importance of information and understand what is important for acquiring knowledge (Perner, 1991).

Metacognitive vocabulary and general meta-memory are improved over the preschool and kindergarten years (Weinert & Schneider, 1999). Four-year-old children can apply mental procedures such as 'knowing', 'thinking', or 'remembering', although they seem to have limited understanding of the concept of memory (Schneider & Lockl, 2002). Some aspects of memory monitoring appear as early as three-and four- year-old children, especially on tasks they find more interesting (Lyons & Ghetti, 2008; Schneider & Lockl, 2008). Whitebread et al. (2009), found that children of the same age can exhibit verbal and non-verbal metacognitive behaviours during problem-solving and regulation of emotional and affective states. They are able to understand the effort to remember (O'Sullivan, 1993), and the difference between difficult and easy item-pairs (Dufrense & Kobasigawa, 1989). Also, they can show conditional knowledge such as to allocate their attention in accordance with task demands (Miller, 1985).

Preschool children can apply simple strategic approaches to remember and recall items, when the tasks are meaningful to them (Schneider & Lockl, 2002). By the age of four, children can use simple steps to regulate their own learning, and at the age of six, they can reflect with accuracy on their own cognition (Schraw & Moshman, 1995). Blöte, Resing, Mazer, and Van Noort (1999) who investigated organisational strategies of four-year-olds found that their behaviour was highly strategic, and that they had the ability to transfer their strategies in new tasks.

First graders exhibited the highest level of metacognition after an instructional programme in science units that involved 170 students in grades 1–6 over a period of three years (Hennessey, 1999). Meta-components, strategies of successful learning, are related to experience (Flavell, Green, & Flavell, 1995) and motivational aspects of metacognition are related to students' interest in task (Magiera, 2008).

1.1.3 *Evaluation of metacognition in early childhood*

The assessment instruments which are used in early childhood education are observations, inner speech, semi-structured interviews, visible thinking routines, draw and write–tell techniques (Annevirta & Vauras, 2006; Fernyhough & Fradley, 2005; Ritchhart, Turner, & Hadar, 2009; Salmon & Lucas, 2011; Whitebread et al., 2009; Winsler, Manfra, & Diaz, 2007).

1.2 *Developing metacognition*

1.2.1 *Strategies for metacognition*

Many researchers have investigated strategies that can improve metacognition in learning (Schneider, 2008). Metacognitive awareness can be promoted by modelling metacognitive skills during instruction (Kramarski & Mevarech, 2003). 'Retrieval practice,' where students write down as much information as they can recall from the study task according to a generic prompt (Karpicke & Blunt, 2011). Metacognitive questions (Kramarski & Mevarech, 2004), self-questioning, and think-aloud protocols (Martini, Wall, & Shore, 2004), mental images and charts (McIntosh, 1986), metacognitive prompting (Chatzipanteli & Digelidis, 2011), and strategies such as imaging, focusing attention, executing, and evaluating (Lidor, 2004) are considered important in promoting high-order thinking.

Apart from the support provided by various strategies, researchers highlight the value of social interaction for promoting cognitive development and that is why they recommend the use of cooperative learning structures for encouraging development of metacognitive skills (Kramarski & Mevarech, 2003; Kuhn & Dean, 2004; Martinez, 2006). Iskala, Vauras, and Lehtinen (2004) claimed that peer learning enhances students' metacognitive processes. The 'self-check teaching style' in physical education seems to develop metacognitive activities (Papaioannou, Theodosiou, Pashali, & Digelidis, 2012). In this teaching style, students monitor and evaluate their performance based on criteria sheets that the teacher has prepared including the essential elements to a successful performance (Mosston & Ashworth, 2002). Other researchers suggest that reciprocal teaching style, a peer-learning approach, could promote metacognition (Theodosiou & Papaioannou, 2006). During reciprocal teaching, students work in pairs and give feedback to each other based on criteria sheets (Mosston & Ashworth, 2002). Finally, Luke and Hardy (1999) claim that guided discovery is an important method in promoting metacognition.

1.2.2 *Promoting metacognition in early years*

The development of metacognitive abilities in early years is important because these abilities improve children's awareness about their learning. Enabling students to acquire such abilities could reduce the differences in learning between younger and older children (White & Frederiksen, 1998). Preschoolers are not totally unaware of their thinking and have the ability to use simple metacognitive strategies like planning, monitoring, or persistence when they are facing challenging tasks (McLeod, 1997).

Several metacognitive techniques are studied in early years such as the drawing–telling technique which encourage self-reflection, and enable young children to verbalise or show evidence of mental activity (Kendrick & McKay, 2002; Salmon, 2008a). Visible thinking routine that stimulates dialogic thinking (Ritchhart, 2002), 'think-aloud' technique and self-questioning (Fisher, 1998), the awareness of their own

thinking (Carpendale & Lewis, 2004; Ritchhart et al., 2009; Salmon, 2008a, 2008b), pretend play, and metacognitive questions such as 'what kind of thinking did you do' or 'what did you think about? Why?' assist children to become conscious of their thoughts and feelings (Flavell, 1988; Schwartz & Parks, 1994).

Metacognitive teaching strategies such as 'reciprocal teaching' can encourage the construction of metacognitive theories and activities (Brown & Palincsar, 1989; Schraw & Moshman, 1995). Children's conceptions of thinking have been connected with the influence of social interaction (Carpendale & Lewis, 2004). Specifically, peer interactions can create behavioural outcomes and cognitive products that young students could not create on their own (Ashley & Tomasello, 2001). Metacognitive behaviours in young children (aged three to five years) emerge in learning activities as they work in pairs or small groups (Whitebread, Bingham, Grau, Pino Pasternak, & Sangster, 2007). Peer tutoring can also promote metacognitive activities such as monitoring and control (Shamir & Lazerovitz, 2007).

1.2.3 *Activities to promote metacognition in early childhood*

Educators could improve young children's metacognition in activities where children have increased motivation and engagement, such as physical activities. Through physical activities students develop social, emotional, and cognitive skills (Pellegrini & Smith, 1998). They express themselves, they develop skills and their imagination, and they face problems and solve them. Specifically, physical activities during reciprocal and self-check teaching styles could guide young students to use simple metacognitive strategies like monitoring and evaluating, strategies that reflect on their own learning and realise what they are doing.

More specifically, when educators want to teach a movement or a rule to young students firstly they must choose a simple exercise or game. Afterwards they have to write down in the criteria sheet the skill/rule in the detail they believe it is necessary for an effective performance. In cases where young students cannot read, educators can add cartoons in order to show students the correct movement. On the other hand, students have to read the criteria or watch the cartoons. In reciprocal teaching style, students work in pairs and one of them, the observer has to assess the doer's performance based on criteria. In self-check teaching style, the doer has to assess his own performance enhancing a kinaesthetic awareness.

These processes help students to be more cognitively engaged in the task because they do not perform only a motor skill but they understand better what is correct and incorrect. They also learn how to perform effectively as they check and evaluate performances. Adopting such activities is the best way to promote metacognition in this age, where children can employ rudimentary forms of metacognitive skills (Pappas, Ginsburg, & Jiang, 2003).

In an effort to provide examples that could help early childhood educators, two physical activities that promote metacognition are presented in the appendix. Practitioners implementing these activities can observe if young children can evaluate effectively their peers or themselves according to criteria sheets that are being provided.

2. Conclusion

Metacognition is a very important concept concerning the acquisition of learning skills and knowledge transfer as children can use it in a more flexible manner, and in new

areas of learning. Young children using metacognitive abilities and behaviours learn and remember more efficiently than others and become more strategic, flexible, and productive in their learning process. Evidence shows that there is a positive relationship between young children's self-regulation and high achievement, while poor self-regulation seems to be a predictor of future problems in school (Ponitz et al., 2008).

So, teachers need to help children develop metacognitive awareness from the early childhood. Metacognition is teachable and educators could assist their students, even at a very young age, as it seems that younger children also have the ability to estimate mental states. Young children's capacity for metacognition was found to increase when they participate in enjoyable tasks.

Physical activities during reciprocal and self-check teaching styles could be adopted to promote children's metacognition, since children prefer to learn through movement and games. During the reciprocal teaching style students work in pairs and give feedback to each other while in self-check style they evaluate their own executions based on criteria sheets that include the essential elements for a successful performance (Mosston & Ashworth, 2002). Implementing ways of working such as the use of these teaching styles could help young students enhance metacognitive strategies such as monitoring and evaluating.

Watching cartoons about the specific elements of a motor skill or rules of a game on criteria sheets is more powerful than watching or listening to their educator. In this way they learn about concepts, strategies (declarative knowledge), they realise how to perform a skill or play a game (procedural knowledge) more enjoyably, and they focus their attention on how tasks are accomplished.

The evaluation of their classmates' performance gives young students the opportunity to learn from the mistakes of others and that leads them to learn how to plan their own performance (planning) effectively. All these guide them to become autonomous and effective individuals.

Educators have the obligation to implement interesting activities in an enjoyable manner that could develop young students' high-order thinking and enable them to become self-regulated and autonomous learners for their entire life.

Notes on contributors

Athanasia Chatzipanteli received both her PhD and MSc through Democritus University of Thrace, Greece. Her PhD dissertation was entitled: 'Teachings styles and Metacognition', while her master's degree was centred around 'Music and Movement Programs in Preschools/Primary Schools'. Currently, she works as a teaching assistant at University of Thessaly, Greece; the main areas of her research being: pupil-centred teaching styles and metacognition in preschool/elementary/secondary education-physical education. To date, she has published in 15 peer-reviewed national and international journals, and has conducted 20 presentations in national and international congress proceedings.

Vasilis Grammatikopoulos, PhD is a lecturer in Educational Evaluation at the University of Crete, School of Education, Department of Preschool Education, Greece. In the past, he was postdoctoral teaching fellow at the Liverpool Hope University, UK and University of Macedonia, Greece. He was also academic scholar at the University of Thessaly, Greece for nine years. He has participated in numerous funded national and international research projects, and his main research interests are: educational evaluation, early childhood education evaluation, evaluation of physical activity in early childhood education. He has great experience in pre and in-service teacher training as he has taught in many training courses. He has published over 20 research papers in peer-reviewed international journals and is a member of the American Evaluation Association and American Educational Research Association.

Athanasios Gregoriadis, PhD is a lecturer of Early Childhood Education at Aristotle University of Thessaloniki, Department of Early Childhood Education, Greece. He teaches courses both in bachelor and master's Degrees. His main research interests are teacher–child relationships, early childhood curricula, and the evaluation of early childhood environments. He has participated and is currently participating as a coordinator and key staff member in five funded international and national research projects during the last seven years. He has published over 15 research papers in peer review international journals, and he is a member of the American Educational Research Association.

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Appendix

Description of ACTIVITY 1

Main goal: To improve metacognitive activities such as monitoring, evaluation, and reflection
Teaching style: Reciprocal

ACTIVITY 1

Other objectives:	***Equipment:***	***At the end of the lesson, preschoolers:***
To assist young children in • developing stability skills and • improving creativity • learning geometric shapes such as: circles and squares	Coloured construction paper (red for circles and green for squares), tape	• Will be able to evaluate their classmate • Will be able to perform stability skills • Will be able to recognise geometric shapes: circles and squares

Content – description	***Points of emphasis***
Name of activity: circles and squares Divide students into pairs. One student from each pair will perform the activity and the other will assess his peer Cut small shapes of paper in circles (red colour) and squares (green colour). Tape shapes on the floor in the movement area in a small distance between them. Ask children to move around the room. When the educator claps hands, children have to stand on one foot and get a body shape in the red circles and balance on one foot and one hand getting a body shape in the green squares Their peers are given criteria sheets where a student/ cartoon stands on one foot in the red circle, etc. and they have to check if the performance of their couple is correct	Students have to check how many times their classmates perform the right balance in the right shape

Evaluation:
The educator checks if the preschoolers evaluated their classmates effectively
(Is your friend standing on one foot in the red circle? How many times?)
(Is your friend standing on one foot and one hand in the green square? How many times?)
Ask children what other stability skill they themselves could perform
Ask children about the geometric shapes

Description of ACTIVITY 2

Main goal: To improve metacognition
• declarative knowledge (rules of a game-boundaries)
• metacognitive activities such as monitoring, evaluation, and reflection
Teaching style: reciprocal, self-check

ACTIVITY 2

Other objectives:	***Equipment:***	***At the end of the lesson, preschoolers:***
• To develop locomotor skills *in* setting appropriate *boundaries*	4 cones (for boundaries)	• Will be able to evaluate their classmate • Will be able to monitor their performances *and* evaluate themselves • Will be able to acquire more information about the rules of a game (boundaries)

Content – description	***Points of emphasis***
Name of activity: quick chase Divide students into pairs. One student from each pair will perform the activity and the other will assess his peer. The students who are outside have to check if their peers get out of boundaries One child of each couple remains outside the game in order to evaluate the other who plays the game The object is to tag or touch 5 players who are then out of the game The first player who is tagged has to become the new person who chases the others (hunter) Move inside the boundaries In the criteria sheet the educator can draw a cartoon that is not allowed to get out of boundaries **Evaluation:** Did you get out of boundaries? Did your classmate get out of boundaries?	Boundaries on your mind