

## THE DEVELOPMENT OF SELF-REGULATED LEARNING OF MOTOR AND SPORT SKILLS IN PHYSICAL EDUCATION: A REVIEW

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**Abstract:** This review presents recent research findings regarding self-regulated learning in physical education. First, a brief overview of self-regulated learning is provided focusing on social cognitive models of self-regulation development. Then, research conducted in physical education settings adopting a social cognitive perspective of self-regulated learning is reviewed. Research findings support the effectiveness of the four-level training model of self-regulation development. According to this model, students learn effectively motor and sport skills when they experience sequentially observational, emulative, self-controlled, and self-regulated learning. Thus, this model can be used as an instructional approach for teaching motor and sport skills in physical education. Reflecting on research findings, directions for future research are discussed and practical applications are offered.

**Key words:** Four-level model, Motor and sport skills, Physical education, Self-regulated learning

### INTRODUCTION

Mastering motor and sport skills is a complex and demanding process that requires investment of time and exhibition of effort. Development of expertise in sports and physical education requires not only innate talent and high level of instruction, but also the development of self-regulatory skills (Ommundsen & Lemyre, 2007; Zimmerman & Kitsantas, 2005). Therefore, the examination of the self-regulated learning development in sports and physical education is of great interest.

This paper reviews recent research regarding the development of self-regulated learning in physical education. First, we briefly present an overview of self-regulated learning focusing on a social cognitive perspective. Next, we critically review recent

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research that has examined the development of self-regulated learning in physical education contexts. Practical implications and suggestions for future research are also discussed.

### ***Self-regulated learning***

Self-regulated learning is an active, self-directive process whereby students monitor, regulate, and control their cognition, motivation, affect, behavior, and environment to achieve their goals (Efklides, Niemivirta, & Yamauchi, 2002). Self-regulation refers to “self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals” (Zimmerman, 2000, p. 14) and involves goals, motivational beliefs and self-initiated learning processes such as powerful strategies for attaining these goals (Zimmerman & Cleary, 2009). Key components of self-regulated learning are cognition, metacognition, motivation, affect, and volition (Boekaerts, 1996; Efklides, 2011).

Self-regulated learners are metacognitively, motivationally, and behaviorally active participants in their own learning process (Efklides, 2005; Zimmerman, 1989). They plan, organize, self-instruct, self-monitor, and self-evaluate during the learning process. They perceive themselves as competent, self-efficacious, and autonomous and they select, structure, and create environments that optimize learning. That is, self-regulated students see themselves as agents of their own behavior, believe that learning is a proactive process, are self-motivated, and use strategies to achieve desired academic results (Montalvo & Torres, 2004). Students who are able to regulate their own learning perform and learn better than their peers who lack self-regulatory capabilities (Pintrich & Zusho, 2002) and are more likely to be successful in school and become lifelong learners compared to non-self-regulated learners (Zimmerman, 2002). Thus, the development of self-regulated learners should be a major educational goal in all subject matters including physical education. In fact, the development of self-regulation facilitates the achievement of high levels of learning and performance in motor and sport skills (Zimmerman & Kitsantas, 2005) because the acquisition of motoric expertise is based both on social support (e.g., providing feedback) and on extensive practice activities that are self-planned, self-initiated, and self-sustained.

### ***Models of self-regulated learning***

Various models have been proposed to explain how students can self-direct their own learning to become self-regulated learners. For example, Puustinen and Pulkkinen (2001) reviewed five self-regulated learning models that have been

considerably developed and supported by several empirical studies. These models were developed by Boekaerts (Boekaerts & Niemivirta, 2000), Borkowski (1996), Pintrich (2000), Winne (Winne & Hadwin, 1998), and Zimmerman (2000). The theoretical background was an important differentiating feature of these models. For example, only two of the models were similar because their authors (i.e., Pintrich and Zimmerman) adopted the same background theory, the social cognitive theory. Two kinds of self-regulated learning definitions emerged from these models, a goal-oriented (Boekaerts, Pintrich, and Zimmerman) and a metacognitively weighted definition (Borkowski and Winne). Moreover, all the authors assumed self-regulated learning to proceed from some kind of a preparatory phase, through the actual performance or task completion phase, to an appraisal or adaptation phase. However, the components of each model and the relative weight given to each of these components vary. For example, Boekaerts' model mainly focuses on the preparatory phase of the self-regulated learning process and less on the performance and the appraisal phases. Moreover, Boekaerts and Pintrich are mainly motivation oriented in their research whereas Borkowski's and Winne's research is principally strategy oriented. Zimmerman's research has been both motivation and strategy oriented.

Recently, Efklides (2011) proposed the "metacognitive and affective model of self-regulated learning" that distinguishes two levels of functioning in self-regulated learning to describe the interactions between metacognition, motivation, and affect either at a macrolevel or at a microlevel as a person works on a task. At the Person level interactions between trait-like characteristics such as metacognitive knowledge and skills, self-concept, attitudes, emotions, expectancy-value beliefs and achievement goal orientations are hypothesized. These person characteristics guide top-down self-regulation in a general level of functioning. At the Task x Person level, that is, the level at which self-regulated learning events take place (e.g., during task execution), metacognitive experiences (e.g., feeling of difficulty, online affective states) play a major role in task motivation and bottom-up self-regulation. These two levels of functioning in self-regulated learning are reciprocally related.

Next, we focus on the social cognitive perspective of self-regulated learning (Zimmerman, 2000) because: (a) it is considered an appropriate framework for examining self-regulated learning in physical education (Petlichkoff, 2004), and (b) the majority of self-regulated learning research in physical education is guided by this model. This approach does not only describe the process of self-regulated learning (i.e., the cyclical model of self-regulation) but also provide an instructional approach for developing self-regulatory skills (i.e., the four-level training model). Moreover, it involves not only self-regulatory strategies but also motivational

beliefs, such as self-efficacy. In particular, this approach emphasizes the role of both social (e.g., modeling, social feedback) and self (e.g., self-observation) sources on the development of self-regulated learning and view self-regulated learning as a process, rather than an aptitude, that can occur in virtually any context (Zimmerman, 2000). That is, students can develop their self-regulatory skills in a structured and supportive physical education environment. An important aspect of Zimmerman's models is that they emphasise the role of socializing agents (e.g., teachers) in the development of self-regulated learning. Thus, in the domain of physical education, physical educators can play a significant role in promoting their students' self-regulated learning. Furthermore, an advantage of these models is that they can be easily introduced and implemented in the sport and physical education domains because they include processes and techniques that are common in sports (e.g., goal setting, modeling, feedback). Moreover, during the performance phase of self-regulation students can use various self-control techniques to enhance their performance. Such performance enhancement techniques (e.g., self-talk) are widely used in sport settings and can be incorporated in these models to make them more suitable for use in sport and physical education domains. Therefore, Zimmerman's (2000) models can be used to explain students' efforts to regulate their learning in physical education settings. Next, we briefly describe these models, that is the cyclical model and the four-level model of self-regulated learning development (Zimmerman, 2000).

### ***Social cognitive perspective of self-regulated learning***

#### *The cyclical model of self-regulated learning*

From a social cognitive perspective (Zimmerman, 2000), self-regulatory processes and associated beliefs interact in three cyclical phases: forethought, performance, and self-reflection. The forethought phase precedes students' engagement in a task and includes task analysis (e.g., goal setting) and self-motivational beliefs (e.g., self-efficacy). During the performance phase students perform the task, observe their own performance and use self-control strategies to facilitate the attainment of their goals. The self-reflection phase involves self-judgment (e.g., causal attribution) and self-reaction (e.g., self-satisfaction) processes. This view of self-regulation is cyclical in that processes, beliefs, and self-reflections in each phase can affect efforts to learn during subsequent phases (Zimmerman, 2002).

*The four-level model of self-regulated learning development*

Zimmerman (2000) has proposed that the development of self-regulation proceeds through four sequential levels, namely, observation, emulation, self-control, and self-regulation. At the observation level, students watch a model perform, listen to his or her verbal descriptions, and cognitively capture the key elements needed for performing the new skill. At the emulation level, students practice the skill receiving social feedback that helps them to correct potential errors and form appropriate performance standards. Students try to emulate the general movement pattern of the model in order to incorporate it into their personal movement repertoires. At the self-control level, students practice the skill independently by setting process goals and self-monitoring their performance. At this level, students internalize the skill and reach automaticity. At the self-regulation level, students have mastered the skill and can adapt and use it in changing conditions developing their own distinctive styles of performing. They focus on performance outcomes and use these outcomes to make adjustments to their skills if necessary. According to this four-level training model students who master each level sequentially will learn effectively. However, this is not a developmental stage model that posits that students will progress invariantly from one level to the next in a predefined sequence or that once the highest level is attained it would be used universally (Zimmerman & Kitsantas, 2005).

## **SELF-REGULATED LEARNING RESEARCH IN PHYSICAL EDUCATION**

Our review focused on research adopting Zimmerman's (2000) social cognitive models to examine self-regulated learning in physical education. Computer searches in databases (Scopus, Sportdiscus, ERIC, and PsychInfo) using specific key words (i.e., self-regulated learning, four-level training model, cyclical model of self-regulation, and physical education) and manual searches were conducted of articles in the English language literature from 1996 to 2012. In this review, we included studies that were conducted in the domain of school physical education and adopted Zimmerman's model as theoretical framework. These studies are reviewed next.

An early study by Zimmerman and Kitsantas (1997) examined the effectiveness of sequential practice from the third (i.e., self-control) to the fourth (i.e., self-regulation) levels of the social cognitive model of self-regulation development. Students were assigned to eight experimental conditions emerging from the

combination of four different types of goals (performance goal of attaining high dart-throwing scores, process goal of improving dart-throwing technique, transformed goal of converting throwing outcomes into strategic process adjustments, and shifting from a process to a performance goal) and the use or not of self-recording. Results showed that students who set a process goal first and then shifted to an outcome goal displayed the highest dart-throwing performance and reported the highest levels of self-efficacy, satisfaction, and intrinsic interest, compared to students in the other goal setting conditions. Self-recording had an additive positive effect on performance, self-efficacy, and satisfaction. Moreover, students who set process goals had higher performance compared to those who set performance goals supporting similar respective findings in physical education (Kitsantas & Zimmerman, 1998; Zimmerman & Kitsantas, 1996).

Kitsantas, Zimmerman, and Cleary (2000) examined the effects of modeling (observation level) and social feedback (emulation level) on ninth grade girls' dart-throwing performance. Results showed that girls who had observed a coping model who gradually improved performance performed better and reported higher self-efficacy, intrinsic interest, and satisfaction compared to girls who had observed a mastery model who performed perfectly. Furthermore, girls who received social feedback, regardless of the model condition, improved their dart-throwing performance and reported higher self-efficacy, intrinsic interest, and satisfaction compared to girls who did not receive social feedback.

The result of these two studies provided initial support for the effectiveness of the four-level training model of self-regulated learning development. However, these studies did not examine the effectiveness of the sequential practice from the emulation to the self-control level. This transition is considered a critical point in the development of self-regulated learning because students proceed from the practice with social support to the self-directed practice (Zimmerman, 2000). Kolovelonis, Goudas, and Dermitzaki (2010) examined the effectiveness of the sequential practice from the emulation to the self-control level. They found that sixth grade students who received social feedback at the emulation level and then set process goals and self-recorded their performance at the self-control level displayed higher dart-throwing performance compared to students in the other experimental groups. Moreover, fifth grade students who experienced one or both of these self-regulatory levels surpassed control group students. Furthermore, sixth grade students who received social feedback at the emulation level, and those who practiced with process goals and self-recording at the self-control level reported higher satisfaction and intrinsic motivation respectively compared to control group students. In a subsequent study, Kolovelonis, Goudas, and Dermitzaki (2011a)

found that self-recording had a positive effect on students' dart-throwing performance and setting combined process and performance goals was equally effective with setting only process or performance goals at the self-control level. Moreover, goal group students made more technical attributions and adaptive inferences compared to control group students.

In these studies (Kolovelonis et al., 2010, 2011a) participants were boys and girls from elementary physical education classes expanding previous studies (Kitsantas et al., 2000; Zimmerman & Kitsantas, 1996, 1997) which employed only adolescent girls. Moreover, Zimmerman and Kitsantas (1997) found that process goals were superior to performance goals and the shifting from process to performance goals was the most effective approach. On the contrary, Kolovelonis et al. (2011a) found that the combined process and performance goals were equally effective with setting only process or only performance goals. However, both studies (Kolovelonis et al., 2011a; Zimmerman & Kitsantas, 1997) compared the various goal conditions without involving students in emulative practice (i.e., practice with social feedback) first. Kolovelonis, Goudas, Hassandra, and Dermitzaki (2012) addressed this limitation examining the effects of setting either process or performance goals and self-recording at the self-control level after students had experienced emulative practice. Moreover, they expanded previous research by: a) adopting a pre- to post-test design, b) involving repeated demonstrations of the skill, c) employing teaching and testing in small groups, and d) using a common sport skill (i.e., basketball dribble). They found that students who received social feedback and observed repeated demonstrations and then set process or performance goals and self-recorded their performance improved their dribbling performance more than students who set goals but did not receive social feedback during the first practice session. All experimental groups surpassed the control group. No difference was found among groups in satisfaction and enjoyment.

### ***Goal setting***

Goal setting is a key component of self-regulated learning (Zimmerman & Kitsantas, 2005). Although during the observation and the emulation levels students are exposed to process goals represented by the performance standards demonstrated by an expert model, the social cognitive training model posits that goal setting is introduced at the self-control level. Replicating and expanding Kolovelonis et al.'s (2012) study, Kolovelonis, Goudas, Dermitzaki, and Kitsantas (2013) examined the potential effects of introducing goals at the emulation level. The results supported the effectiveness of this model. In particular, students who sequentially experienced

emulative and self-controlled practice either setting process or performance goals at the emulation or at the self-control level improved their dribbling performance from pre- to post-test. That is, setting goals at the emulation level was equally effective with setting goals at the self-control level. Moreover, students who set a process goal for their emulative practice and continued pursuing this goal at the self-control level reported higher levels of satisfaction and enjoyment compared to students who set performance goals.

### *Teaching style*

The teaching style may also affect self-regulated learning outcomes. However, previous research did not examine directly the effects of the teaching approach. Kolovelonis, Goudas, and Gerodimos (2011) hypothesized that the reciprocal and the self-check styles of teaching (Mosston & Ashworth, 2002) could be incorporated at the emulation and the self-control levels of self-regulated learning respectively. In the reciprocal style, students practice a task in pairs alternating in the roles of the doer who performs the task and the observer who offers feedback to the doer. In the self-check style, students practice a task independently in structured settings self-observing and self-evaluating their performance (Mosston & Ashworth, 2002). Kolovelonis et al. (2011) found that students who used the reciprocal and the self-check styles or their sequential combination improved their basketball chest pass accuracy and technique from pre- to post-test and outperformed control group students. However, no differences were found among the experimental groups. These results showed that the reciprocal and the self-check styles were effective in enhancing students' performance and could be used as instructional approaches at the emulation and self-control level respectively. However, the sequential practice with these two styles did not result in higher performance compared to the practice with a single teaching style as it had been hypothesized. Probably the practice session was not long enough for students to fully take advantage from both styles.

### *Self-talk*

The social cognitive perspective of self-regulated learning (Zimmerman, 2000) proposes that students can employ various self-control techniques during practice to enhance their performance. Kitsantas and Zimmerman (1998) found that an analytical strategy was more effective compared to an imaginal strategy. Sport and physical education settings have unique characteristics and demands, and thus the use of domain-specific techniques may be more appropriate. Self-talk is a technique



students can use during practice in sports (e.g., Goudas, Hatzidimitriou, & Kikidi, 2006). Kolovelonis, Goudas, and Dermitzaki (2012a) examined the effects of self-talk on students' performance during goal-directed practice in physical education. They found that students who combined self-talk with either process or performance goals outperformed students in the goal only and control group conditions. No difference emerged among the groups in self-efficacy, satisfaction, and enjoyment. Thus, self-talk is a technique that can enhance students' performance and could be incorporated into the social cognitive models of self-regulated learning. However, the specific demands of the sport task may affect the effectiveness of self-talk. Kolovelonis, Goudas, and Dermitzaki (2011b) found that elementary students who used self-talk during testing in two tasks in physical education surpassed those who did not. In particular, instructional and motivational self-talk were equally effective in a chest pass test, but motivational self-talk was more effective compared to instructional self-talk in a push-ups test. Thus, the type of self-talk should be matched with the demands of the task.

### ***Calibration***

Another factor associated with self-regulated learning that has recently drawn attention is performance calibration. Calibration refers to the degree to which a student's perception of performance corresponds with his or her actual performance (Keren, 1991). Calibration has important implications regarding students' motivation (Schunk & Pajares, 2009) and self-regulation (Efklides & Misailidi, 2010). Kolovelonis et al. (2013) examined the effects of practice at the emulation and the self-control levels on students' dribbling performance calibration. All students overestimated their performance with the exception of the students who set a process goal for their emulative and self-controlled practice who underestimated their performance. Similarly, Kolovelonis, Goudas, and Dermitzaki (2012b) found that students who practiced dribbling under different self-regulatory conditions did not differ in performance calibration. In general, students overestimated their performance. However, regardless of the group, sixth grade students were more accurate compared to fifth grade students. It seems that the practice at the self-regulatory levels is not a sufficient condition for improving students' performance calibration. What is needed may be an intervention designed to help students to improve their performance calibration.

The abovementioned studies examined students' accuracy in predictions of performance. Another aspect of students' calibration involves the accuracy of a posteriori estimations of performance. That is, students perform a task, evaluate

their performance and these evaluations are compared with the actual performance. In such a study, Kolovelonis and Goudas (2012) examined students' accuracy in recording their own or their peers' performance during the practice with the reciprocal and the self-check teaching styles. They found that students were moderately accurate in peer- and self-recording with a tendency to overestimate their own or their peers' performance in the basketball chest pass. Students who used the reciprocal and the self-check styles did not differ in recording accuracy. Furthermore, students who, regardless of the teaching style, received more accurate feedback outperformed in the chest pass test those who received less accurate feedback.

The aforementioned research examined the effectiveness of various aspects and processes included in the social cognitive models of self-regulation (Zimmerman, 2000). Next, we reflect on these research findings to highlight potential limitations and to suggest directions for addressing these limitations in future research.

### **REFLECTING ON RESEARCH FINDINGS AND FUTURE DIRECTIONS**

The research findings presented above have provided supportive evidence regarding the effectiveness of the four-level training model of self-regulated learning development. However, various issues regarding this approach remain unexplored or warrant further examination. The four-level training model has the advantage that combines both social support (i.e., social feedback) and personal sources (i.e., goal setting, self-monitoring). The model proposes that students who proceed sequentially from the observational, emulative, self-controlled, and self-regulated learning master motor and sport skills effectively. However, the effectiveness of the sequential practice through the four levels has not been examined yet. Previous research has focused on examining the effectiveness of various aspects of this model in order to establish the effectiveness of processes included in the model and the sequentiality of the proximate levels. The examination of the various aspects of the model preceded the examination of the effectiveness of the entire model because the model is complex and includes various aspects and processes at each level. Testing the entire model included all the processes in a single study without having evidence for their effectiveness would make the research design more complex and the interpretation of the results difficult. Previous research supported the effectiveness of the sequential practice from the observation to the emulation level (Kitsantas et al., 2000), from the emulation to the self-control level (Kolovelonis et al., 2010; Kolovelonis et al., 2012; Kolovelonis et al., 2013), and from the

self-control to the self-regulation level (Zimmerman & Kitsantas, 1997). Thus, encountering these positive results regarding basic aspects of the model, future research should examine the effectiveness of the sequential practice through the four levels. Such studies would provide further evidence regarding the effectiveness of this four-level training model.

Furthermore, in previous research students participated in the studies mainly at the individual level. The effectiveness of the implementation of the four-level model at a class level has not been examined yet. The implementation of this model at class level may require adaptations and adjustments. Moreover, social interactions among students may be considered when an instructional approach is implemented at the class level. Therefore, future research should be conducted within intact classes expanding previous studies in which students participated in small groups.

Moreover, mastering sports skills requires long-term practice. Thus, prolonged interventions involving more than one single lesson are needed to explore the effectiveness of the four-level training model in natural physical education settings. In such studies, retention measures should also be included because previous research has focused mainly on the immediate effects of using this teaching approach. Moreover, the quality of movement (i.e., technique of the skills) should be evaluated. In previous research, with the exception of a few studies (i.e., Kolovelonis et al., 2011), only the results of the movements were evaluated.

Another issue concerns the generalization of the previous findings due to the limited number and types of skills that have been used. Thus, the effectiveness of the four-level training model should be examined using various types of skills (e.g., open or closed) from different sports and different levels of complexity, as well as combinations of skills (e.g., dribbling and passing in basketball) which represent real game conditions in sports. The type of the skill may play a role in the implementation of the four-level training model. Closed skills require mainly automaticity whereas open skills adaptation. Thus, an interesting question is whether the way of the implementation of the model varies regarding the type of the task. For example, should students proceed to the self-regulation level and practice adapting a closed skill (e.g., basketball free shot) or should they focus only on the automaticity of this skill? Kolovelonis et al. (2012) examined the effectiveness of this model using an open skill (i.e., basketball dribble). However, the drills they used for students' practice simulated a "closed" rather than an "open" environment. Thus, future research should examine the effectiveness of the four-level training model using open skills that students will practice in open environments (e.g., dribbling against an opponent).

Goal setting is a key element in the self-regulated learning process. Research findings have supported the positive effects of setting goals in students' learning and

performance. During initial learning efforts process goals were superior compared to performance goals (Kitsantas & Zimmerman, 1998; Zimmerman & Kitsantas, 1996). Moreover, Zimmerman and Kitsantas (1997) provided evidence that the shifting from process to performance goals were the most effective approach. This pattern of results was also found in academic settings when a writing task was used (Zimmerman & Kitsantas, 1999, 2002). Kolovelonis et al. (2011a) found that the combined process and performance goals were equally effective with setting only process or performance goals. Except of process and performance goals, Kingston and Wilson (2009) have suggested another type of goals that they labelled “effect” goals. These goals refer to the focus on the physical and environmental effects of the task execution (e.g., a target). Physical education includes various tasks for setting “effect” goals (e.g., basketball free shot, volleyball serve). Research conducted by Wulf (2007) has shown that focusing on external aspects (e.g., a target) is more beneficial than focusing on internal aspects of the task (e.g., body movements). These findings contrast social cognitive research regarding the superiority of the process over the performance goals in learning new skills. Furthermore, Kingston and Wilson (2009) have suggested that process goals of a more holistic nature, for example, those that focus on a single context-relevant conceptual cue (e.g., smooth or tempo), may have positive effects especially in experienced learners. Undoubtedly, further research is necessary to explore the effectiveness of each type of goal considering issues like the type of the skill, students’ previous experience, and the learning phase.

Self-regulatory practice had positive effects on secondary girls’ motivational beliefs (Kitsantas et al., 2000; Kitsantas & Zimmerman, 1998; Zimmerman & Kitsantas, 1996, 1997). However, these positive effects did not consistently emerge in studies with elementary boys and girls (Kolovelonis et al., 2010, 2011a; Kolovelonis et al., 2012). Elementary students usually report higher levels of motivation for participating in physical education compared to secondary ones (Kolovelonis, 2007). Thus, the detection of treatment effects was difficult in the studies that employed elementary students. From an applied perspective, physical educators should focus on teaching elementary students self-regulatory process because these students are willing to participate in physical education. Another possible explanation of this result may be the fact that elementary students are often inaccurate regarding their capability self-beliefs (Schunk & Miller, 2002). Factors associated with this inaccuracy should be examined in future research.

A similar factor associated with self-regulated learning is students’ performance calibration. Generally, research regarding calibration accuracy is limited in sport and physical education settings. Initial evidence has shown that students are often miscalibrated regarding their performance (Kolovelonis et al., 2012b; Kolovelonis et al.,

2013). Thus, future research should examine the status and explore the factors associated with students' performance calibration in sport and physical education using various types of tasks. Moreover, interventions to improve students' performance calibration should be designed, implemented, and evaluated. Such interventions should be designed based on research findings regarding the factors associated with the improvement of students' performance calibration in sport and physical education.

Another issue regarding the effectiveness of the four-level training model concerns the role of students' self-efficacy. Previous research has shown that the practice in the various levels of the four-level training model had either positive (Kitsantas et al., 2000; Zimmerman & Kitsantas, 1997) or no effects on students' self-efficacy (Kolovelonis et al., 2010, 2011a; Kolovelonis et al., 2013). However, students' self-efficacy may affect the effectiveness of the implementation of this model. In particular, this approach may be adapted according to students' levels of self-efficacy. For example, students with lower levels of self-efficacy may need repeated demonstrations or the use of self-talk to enhance their self-efficacy because observational learning and self-talk are considered two basic sources of self-efficacy (Bandura, 1997). Furthermore, the effects of the instructional approach on students' affective responses (e.g., emotions) should be examined (Efklides, 2011).

Teaching styles are also associated with self-regulated learning. Kolovelonis et al. (2011) examined the hypothesis of incorporating the reciprocal and the self-check styles at the second and third level of the social cognitive model of self-regulation (Zimmerman, 2000) respectively. Although the results did not support the superiority of the sequential practice with the reciprocal and the self-check styles, the use of these two styles in longer practice sessions may produce larger effects. This hypothesis should be tested in future research. Moreover, the incorporation of other teaching styles that fit with the teaching requirements of the four levels of self-regulation would be examined in future research. For example, at the self-regulation level, when students should modify and adopt the skill in a changing environment, the use of the divergent discovery style of teaching (Mosston & Ashworth, 2002) may be an appropriate approach. Application of this teaching style requires that each learner produces divergent multiple responses to a single question, situation, or problem. For example, students may ask to produce three ways of dribbling an opponent, or passing the ball to a teammate in a basketball task.

Finally, a relatively unexplored issue concerns the transfer of the self-regulatory skills in other domains. From a social cognitive perspective, self-regulatory skills are domain specific. However, these skills are used in different domains, like sport, music, and writing (Zimmerman, 1998). Thus, the examination of how these self-regulatory skills can be taught in a domain and then to be transferred and used in another domain

is of great interest. Goudas (2010) has proposed a graded approach for examining the transfer of skills. First, it should be examined whether students continue to apply the skills they learned; in the setting they learned them. Then, it would be examined whether students use the skills in different circumstances of the same context (e.g., physical education) and whether the skills are employed without instruction in a similar setting (e.g., classroom) in a different subject (e.g., maths). The final step would be whether the skills are employed at home while studying or in other situations in everyday life.

Research suggested above will provide further evidence regarding the effectiveness of the four-level training model of self-regulation and highlight potential adaptations needed for improving its effectiveness. Next, practical applications regarding the implementation of the four-level training model are presented.

### *Practical implications*

The four-level training model of the self-regulation development (Zimmerman, 2000) can be an integrated model of teaching motor and sport skills in physical education. Based on this model and the research findings presented in this article, Goudas, Kolovelonis, and Dermitzaki (2013) have proposed an instructional approach of teaching motor and sport skills in sports and physical education contexts. According to this approach, learning a new skill begins with observational learning (i.e., verbal instructions, demonstration). Next, students practice the skill receiving social feedback from their physical educator or from their peers (e.g., reciprocal style of teaching). Feedback can include positive affirmative performance feedback and reminders about the proper performance, as well as positive reinforcements and attributional feedback. As students progress in mastering the skill, social feedback should be gradually withdrawn and replaced by self-generating feedback. That is, students should self-direct their practice setting goals and self-monitoring their performance using techniques such as self-recording. The use of the self-check teaching style is an appropriate teaching approach to involve students in self-directed practice. Moreover, during practice students should use self-control techniques, such as self-talk, to enhance their performance. Finally, depending on the type of the skill, students should either practice the skill in changing conditions to develop their competence to perform the skill in changing environments or to practice the skill to further develop automaticity in the case of skills performed in closed environments.

Physical educators can use this instructional approach to help their students to learn effectively motor and sport skills and to become self-regulated learners (Goudas et al., 2013). In the initial phase of learning physical educators should support students' efforts

to learn providing them with demonstrations, oral instructions, and social feedback. However, when students progress in mastering the skill, physical educators should gradually withdraw the social support and students should take responsibilities regarding their learning, self-directing their practice with goals and self-monitoring.

This instructional approach can also help physical educators to individualize teaching and learning in physical education. In particular, within a class students may be at different level of developing their skills and thus they may need practice in different teaching conditions. For example, students who have previous experience with a skill may proceed faster in the phase of self-directed practice setting goals and self-monitoring their performance. On the other hand, students who strive to acquire the performance standards of a skill may need more practice with social feedback. Thus, within a physical education class, students may practice a skill at different levels of self-regulation.

### **Conclusions**

The research findings reviewed in this article showed that the four-level training model of self-regulation development (Zimmerman, 2000) is an effective approach of promoting self-regulation in physical education. However, further evidence regarding the effectiveness of this model is needed. The four-level training model can become an instructional approach for teaching motor and sport skills in sports and physical education contexts. Using this approach, physical educators should help their students to learn effectively and to become autonomous and self-regulated learners.

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