

Students' Performance Calibration in a Basketball Dribbling Task in Elementary Physical Education

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Abstract

The aim of this study was to examine students' performance calibration in physical education. One hundred fifth and sixth grade students provided estimations regarding their performance in a dribbling test after practicing dribbling for 16 minutes under different self-regulatory conditions (i.e., receiving feedback, setting goals, self-recording). Two calibration indices, calibration bias and calibration accuracy, were calculated. The results showed that students who practiced dribbling under different self-regulatory conditions (i.e., receiving feedback, setting goals) did not differ in calibration bias and accuracy. Regardless of the group, students were overconfident. Moreover, sixth grade students were more accurate compared to fifth grade students. These results were discussed with reference to the development of performance calibration and self-regulated learning in physical education.

Keywords: Calibration, Physical Education, Grade/Gender Differences, Self-Regulation, Basketball Dribble

Introduction

The development of self-regulated learners is a major educational goal (Boekaerts, 1997). 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-regulated students see

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themselves as agents of their own behavior, believe that learning is a proactive process, are self-motivated and use strategies to achieve their academic goals. It has also been supported that the development of self-regulated learning is associated with positive learning outcomes in both academic and physical education settings (Kitsantas, Steen & Huie, 2009; Zimmerman, 2002). In fact, recent research in elementary physical education has shown that students can effectively use self-regulatory processes, such as goal setting, self-recording, and self-talk, to enhance their performance in motor and sport skills (Kolovelonis, Goudas & Dermizaki, 2010, 2011a, 2011b, in press; Kolovelonis, Goudas, Hassandra & Dermizaki, 2012).

To become self-regulated learners, students need to monitor accurately their ongoing cognitive states and processes, and to use the information obtained from this monitoring to regulate those processes (Hacker, Bol & Keener, 2008). Thus, a factor associated with self-regulated learning is calibration which is the degree to which a person's perception of performance corresponds with his or her actual performance (Keren, 1991). Calibration is considered one component in the process of developing self-regulatory competency and is a metacognitive skill for monitoring one's performance (Pieschl, 2009; Zimmerman, 2008). Learners make judgments about what knowledge or skill they have learned, and those judgments are compared to an objectively determined measure of that knowledge or skill (Winne, 2004). The more closely students' predicted performance matches their actual performance, the better calibrated they are (Hacker, Bol & Bahbahani, 2008). The underlying psychological process reflected in calibration entails a person's monitoring of what he or she knows about a specified topic or skill and judging the extent of that knowledge in comparison to some criterion task, such as an examination or a test (Hacker et al., 2008).

Calibration is educationally important because of its implications regarding students' motivation (Schunk & Pajares, 2009) and metacognitive control processes and self-regulation (Efklides & Misailidi, 2010). In particular, students who overestimate their capabilities may attempt challenging tasks and fail, which would decrease their subsequent motivation, whereas those who underestimate their capabilities may avoid challenging tasks limiting their potential development of necessary skills (Schunk & Pajares, 2004). Moreover, overconfidence may decrease effort exertion when needed (Efklides & Misailidi, 2010), provide a false sense of the strategy's effectiveness (Hacker, 1998), whereas students who underestimate what they can do may be reluctant to try the task and thereby retard their skill acquisition. Furthermore, more accurate monitoring has been shown to lead to improved self-regulation and thus to higher performance (Thiede, Anderson & Therriault, 2003).

Calibration research has shown that students are often inaccurate in judgments of their capability on a task or test (Chen, 2003; Hacker & Bol, 2004) with a tendency to overconfidence (Keren, 1991). In general, underconfidence is associated with higher performance and overconfidence with lower performance (Hacker et al., 2008). Stone (2000) hypothesized that self-regulated learners are well calibrated. However, it seems that calibration accuracy is hard to learn or resistant to change. Previous efforts to improve calibration accuracy have shown mixed results. Some studies have found modest gains in participants' ability to predict and postdict performance (Hacker, Bol, Horgan & Rakow, 2000; Nietfeld & Schraw, 2002) but some other have reported no significant change in calibration accuracy after practice or other interventions (Bol & Hacker, 2001; Bol, Hacker, O'Shea, Allen, 2005). Zimmerman, Moylan, Hudesman, White and Flugman (2008) found that an intervention designed to improve students' self-reflection improved the accuracy of students' self-monitoring of their problem-solving performance.

In sport and physical education research using the calibration paradigm to judge metacognitive bias normally varies from calibration testing in the cognitive domain, in that participants are immediately aware of their result in physical tasks (Fogarty & Ross, 2007). In particular, sport activities differ from academic ones by the presence of readily observable performance feedback (i.e., knowledge of results). For example, a basketball player can see after the execution if he was successful in the shot (Feltz & Magyar, 2006). Thus, in motor and sports skills where immediate feedback is provided in the form of success or failure calibration becomes an integral part of learning the task and environmental cues are always available to ensure the accuracy of calibration (Horgan, 1992). Furthermore, competence is not wholly dependent on knowledge but also depends on actual physical skill.

Calibration research in sport and physical education is limited. Fogarty and Ross (2007) asked participants to estimate how many tennis serves out of the 10 they could hit into the target area. Results showed that players were well calibrated on the easier task, but overconfident on the more difficult task (i.e., smaller target area). In a similar study (Fogarty & Else, 2005) golfers completed a putting and a chipping task after first estimating how well they would perform on each of these tasks. It was found that golfers were well calibrated on easier tasks (putting) and overconfident on more difficult tasks (chipping and pitching). Participants were also overconfident on the golf rules test, a result which was consistent with results in cognitive calibration research. McGraw, Mellers, and Ritov (2004) found that most recreational basketball players were overconfident regarding their shooting performance, but those who were more overconfident experienced less enjoyment. In a recent study in physical education, Kolovelonis, Goudas, Dermitzaki and Kitsantas (in press) found that performance calibration did not differ between students who practiced dribbling receiving social feedback and setting process or performance goals and control group students.

Undoubtedly, students' performance calibration in physical education is unexplored. Therefore, considering the important implication of students' performance calibration regarding their motivation and self-regulation (Efklides & Misailidi, 2010; Schunk & Pajares, 2009) further research is needed to examine the status of students' performance calibration in elementary physical education.

Furthermore, no study to our knowledge has examined grade and gender differences in students' performance calibration in physical education. It has been theorized that capability self-beliefs become more accurate and specific with age and cognitive maturity (Schunk & Miller, 2002) because students become more realistic about their capabilities, are better equipped to interpret multiple sources of information about competencies, and have a more differentiated view of their abilities (Eccles, Wigfield & Schiefele, 1998). Thus, in the present study differences between fifth and sixth grade students in performance calibration were examined.

Regarding gender differences, previous research in academic settings has shown contradictory results regarding the role of gender in self-efficacy judgments as well as in calibration (Chen, 2003). Some research has reported gender differences in calibration among fifth graders, but not among middle school or high school students (Chen, 2003). Furthermore, some research has reported gender differences in students' beliefs regarding their capabilities (i.e., self-efficacy) favoring adolescent boys, some have reported differences favoring girls, and others has revealed no gender differences (Schunk & Meece, 2006). In view of these mixed findings, the role of gender in students' performance calibration requires further examination, particularly in physical education where this kind of research is limited.

The aim of this study was to explore fifth and sixth grade students' calibration regarding their dribbling performance in physical education. Moreover, grade and gender differences in

performance calibration were examined. We hypothesized that students would overestimate their dribbling performance, and sixth grade students would be better calibrated compared to fifth grade students. No specific hypothesis for gender differences was established due to previous mixed results.

Method

Participants

Participants were 100 students (40 boys and 60 girls) between 11 and 12 years of age, who attended two fifth grade (40 students) and three sixth grade (60 students) physical education classes from two elementary schools located in a medium-sized city in central Greece. Students participated in the study voluntarily. No student refused to participate. Students had little previous experience in the basketball dribble and none of them participated in basketball clubs out of school. Students were randomly assigned to five groups using the proportional stratified sampling method and practiced dribbling under different conditions (see procedure section).

Measures

Basketball dribble. Students had to dribble among five cones that had 3.05 m distance between each other. The distance between the first cone and the starting line was also 3.05 m. The test lasted 30 seconds and each student's score was the total number of cones that he or she dribbled successfully. Students were asked not to touch the cones during dribbling, to change the dribbling hand in each cone and to collect the ball by themselves in the case of losing its control. High test-retest reliability ($r : .95$) has been reported for this test (Barrow & McGee, 1979).

Calibration. Prior to the dribble post-test students were asked the question: "How many cones will you dribble in the post-test?" Based on this estimation and students' actual scores in dribbling post-test two calibration indices were computed, the bias and the accuracy score (Hacker et al., 2008). Calibration bias was computed as students' estimated performance score minus the actual performance. Calibration bias is an index of the direction of the calibration. Positive bias indicates overestimation of performance and negative bias underestimation. The absolute values of the bias scores resulted in the accuracy index which reflects the magnitude of calibration error. Values closer to zero indicate higher calibration accuracy.

Procedure

Permission to conduct the study was obtained from the Greek Ministry of Education Lifelong Learning and Religious Affairs and the school principals. Students participated in the study in groups of four, in the school gym, with the presence of a trained experimenter who was a physical education teacher blind to the aims of the study. Students were told that the purpose of the study was the improvement of their dribbling skill. Initially, students were informed about the procedure of the study which consisted of the dribbling pre-test, the dribbling instructions and modeling, the 16-minute practice phase, and the post-tests. After the initial guidelines, students were informed about the scoring system, performed a trial run and then they were pre-tested in dribbling. Then, students were provided with oral dribbling instructions and observed the experimenter's dribbling demonstration.

Next, all students practiced the dribble for 16 minutes following different self-regulatory conditions, which included either the practice with social feedback or the simple practice in the first 8 minutes and setting process or performance goals in the next 8 minutes. In particular, in the first 8 minutes Group 1 and 2 students practiced dribbling receiving social

feedback (affirmative responses, performance reminders, and reinforcement). In the next 8 minutes Group 1 students set process goals (i.e., focus on dribbling low with fingers-wrist) and Group 2 students set performance goals (i.e., improving 20% their pre-test scores in dribbling test). Students of both groups self-recorded their performance. Group 3 and 4 students practiced dribbling without receiving social feedback in the first 8 minutes, but they set the same process (Group 3) or performance (Group 4) goals and self-recording their performance in the next 8 minutes. Control group students practiced the dribble without receiving social feedback, setting goals or self-recording. After the end of the practice students answered the calibration question and were post-tested in dribbling.

Statistical Analyses

Group differences in calibration bias and accuracy were examined with separate analyses of variance. Grade and gender differences on calibration bias and accuracy were examined with separate 2 (grade) X 2 (gender) analyses of variance. Effect sizes of partial η^2 and Cohen's d were also calculated (Cohen, 1988).

Results

Means and standard deviations of students' calibration bias and accuracy scores separate for each grade and gender are presented in Table 1.

Table 1. Means and Standards Deviations for Calibration Bias and Accuracy Scores

	Fifth Grade						Sixth Grade					
	Total		Boys		Girls		Total		Boys		Girls	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Calibration Bias	5.30	7.13	5.85	7.65	4.75	6.71	2.97	5.75	2.22	4.77	3.33	6.21
Calibration Accuracy	6.70	5.79	7.85	5.45	5.55	6.03	4.73	4.38	4.25	3.01	4.98	4.94

Note: Positive calibration bias scores indicate overestimation of performance. Calibration accuracy scores closer to zero indicate higher accuracy.

The one-way ANOVA showed a nonsignificant difference between groups in calibration bias, $F(4, 95) = 0.73, p = .57$, and accuracy, $F(4, 95) = 0.99, p = .41$. Thus, students of all groups were pooled to examine grade and gender differences in calibration bias and accuracy in the total sample.

In calibration bias, the 2 (grade) X 2 (gender) ANOVA showed a nonsignificant main effect for grade, $F(1, 95) = 3.55, p = .063$, and gender, $F(1, 95) = 0.00, p = .99$, and a nonsignificant Grade X Gender interaction, $F(1, 95) = 0.67, p = .42$.

In calibration accuracy, the 2 (grade) X 2 (gender) ANOVA showed a significant main effect for grade, $F(1, 95) = 4.01, p = .048$, partial $\eta^2 = .04$, a nonsignificant main effect for gender, $F(1, 95) = 0.57, p = .45$, and a nonsignificant Grade X Gender interaction, $F(1, 95) = 2.11, p = .15$. That is, regardless of the gender, sixth grade students were more accurate ($M = 4.73, SD = 4.38, d = 0.38$) compared to the fifth grade students ($M = 6.70, SD = 5.79$).

Discussion

The aim of this study was to examine students' performance calibration in physical education. Students provided estimation measures regarding their dribbling performance after they had practiced dribbling for 16 minutes following different self-regulatory conditions. Two calibration indices were calculated, the bias and the accuracy index (Hacker et al., 2008). The results showed no difference among groups in calibration bias and accuracy. Next, data from all groups were pooled and analyzed to examine grade and gender

differences in students' performance calibration. The results showed a main effect for grade in calibration accuracy.

In particular, sixth grade students were more accurate in estimations regarding their post-test dribbling performance compared to fifth grade students. This result is consistent with views that capability self-beliefs become more accurate and specific with age and cognitive maturity (Schunk & Miller, 2002). Growing up students become more realistic about their capabilities, are better equipped to interpret multiple sources of information about competencies, and have more differentiated views of their abilities (Eccles et al., 1998). It has been supported that younger students typically overestimate how much they can remember or learn, whereas older students' estimates of memory and learning are much closer to their actual performance on academic tasks (Lan, 2005). Moreover, another possible explanation of this result maybe the fact that sixth grade students displayed higher competence in dribbling performance compared to fifth grade students. Calibration accuracy correlates positively with performance (Bol & Hacker, 2001; Chen, 2003). Furthermore, it has been found that low-achieving students are less accurate and have a greater tendency towards overconfidence than high-achieving students who are more accurate tending to be slightly underconfident (Bol & Hacker, 2001; Hacker & Bol, 2004; Hacker et al., 2008; Horgan, 1992; Keren, 1987; Kruger & Dunning, 1999). However, this interpretation needs further examination because other research did not support it (Fogarty & Else, 2005).

No difference was found between genders in calibration accuracy. Previous research in academic settings has shown contradictory results (Chen, 2003; Schunk & Meece, 2006). Girls often perform as capably as boys in various academic domains but they may report lower self-efficacy, especially at higher academic levels (Schunk & Pajares, 2009). In sports setting, females may report lower levels of self-efficacy probably because their performance is usually inferior compared to males. Moreover, males may underestimate the demands of a task, and females may devalue their abilities (Feltz, Short & Sullivan, 2008). However, in the present study, the levels of calibration accuracy regarding dribbling performance were similar in both boys and girls. Undoubtedly, the role of gender in students' performance calibration in physical education requires further examination.

Regarding calibration bias no grade or gender difference was found. Calibration bias is an index of the direction of the calibration. Positive values in this index were found in both grades and genders indicating that students overestimated their dribbling performance. This result is consistent with previous findings in sport settings showing that athletes were overconfident regarding their performance, especially in more difficult tasks (Fogarty & Else, 2005; Fogarty & Ross, 2007; McGraw et al., 2004). Probably, students might have perceived the dribbling test as difficult because they were not accustomed to estimate how many cones they could dribble in a specific time. It has also been supported that students may deliberately overestimate their performance to look good to the experimenter or even to themselves (Baumeister, 1998). However, these interpretations need further examination.

No difference was found among students who practiced dribbling under different self-regulatory conditions. This result is consistent with Kolovelonis, Goudas, Dermizaki, and Kitsantas' (in press) findings that students who practiced dribbling with social feedback and set process or performance goals did not differ in calibration accuracy from control group students. It seems that calibration accuracy is hard to learn or resistant to change. Probably, feedback and practice alone are insufficient for improving calibration accuracy (Hacker et al., 2008). Previous efforts to improve calibration accuracy have shown mixed results. Zimmerman et al. (2008) found that an intervention designed to improve students' self-reflection improved students' self-monitoring accuracy. Thus, when a self-regulated learning

intervention designed explicitly to improve students' self-reflection can improve their accuracy in self-monitoring. However, in the present study, none explicit technique for improving calibration was adopted. Therefore, self-regulatory practice does not automatically increase calibration accuracy, unless this is explicitly pursued through a well-designed and specific intervention. Such an intervention should enhance students' self-reflection processes regarding their achievement, help them to self-reflect on their errors, and encourage them to seek assistance from their teacher or a peer (Zimmerman et al., 2008).

Performance calibration has implications regarding the development of self-regulated learning. It has been supported that self-regulated learners are well calibrated students (Stone, 2000). Students need to accurately monitor their performance and the effectiveness of the processes they use during practice because this information would be used to regulate these processes and performance (Hacker et al., 2008). More accurate monitoring has been shown to lead to improved self-regulation and higher performance (Thiede et al., 2003). Calibration has also implications regarding students' motivation (Schunk & Pajares, 2009). Horgan (1992) has suggested that good calibration has motivational benefits. Students with good calibration tend to make controllable attributions for both success and failure. These attributions have fewer harmful effects regarding future participation because are adaptive for students' learning and can help them to focus on improving themselves, persisting in their learning efforts and mastering the new skill (Schunk, 2008). Conversely, poor calibrated students, especially those who are overconfident, are unlikely to learn from their mistakes, may suffer frustration, and lack of motivation to continue their efforts. Well-calibrated people are accurate in judging their capability to perform a task, and thus they learn more effectively (Schunk & Pajares, 2004).

Students' performance calibration can have practical implications regarding learning skills in physical education. Overconfident students may believe that they have master a skill, and thus they may put less effort during practice and may lack motivation to continue to strive for the highest levels of achievement (Horgan, 1992). On the other hand, students who underestimate their capabilities may avoid challenging tasks limiting their potential development of necessary skills (Schunk & Pajares, 2004). Thus, physical educators should help students to become well calibrated in physical education. Students should be helped to fully understand the demands of the task, and what success at the tasks requires in order to prevent them from overestimating or underestimating what they can do. Greater experience with various tasks informs students regarding the skills needed to succeed (Schunk & Pajares 2009). Moreover, good calibration may facilitate effective goal setting. In particular, the calibration methodology is an effective way of assessing the realism of goals that students set (Fogarty & Else, 2005).

Furthermore, performance calibration is associated with some teaching styles. The reciprocal and the self-check styles are two teaching styles that can enhance students' performance in physical education (Kolovelonis, Goudas & Gerodimos, 2011). These styles involve students in the process of observing and recording their peers or their own performance. Consistent with the results of the present study, Kolovelonis and Goudas (2012) found moderate levels of accuracy with a tendency to overestimation in students' recordings of their peers and their own chest pass performance. Training students in using these styles giving emphasis on improving their accuracy on discriminating their own or their peers' performance may enhance students' performance and calibration accuracy in physical education (Byra, 2004).

A possible limitation of this study concerns the fact that students predicted their dribbling performance in a single trial. Future research should involve students to estimate their

performance in more than one single trial and examining students' performance calibration including various types of motor and sport tasks (e.g., open or closed, gross or fine, discrete or continuous skills) from various sports. Furthermore, factors associated with students' performance miscalibration should be explored. The difficulty of the task and the provided feedback as well as students' self-perceptions and personality characteristics may affect the status of their performance calibration in physical education. Finally, although students in this study practiced dribble under different self-regulatory conditions, they were not explicitly trained to estimate their dribbling performance during practice. Thus, the development and evaluation of interventions designed to improve students' performance calibration in physical education could be a fruitful area for future research (Fogarty & Else, 2005).

Conclusions

The findings of this study showed that students were overconfident when estimated their basketball dribbling performance. However, sixth grade students were more accurate compared to fifth grade students. Considering the important implications of performance calibration regarding students' motivation (Schunk & Pajares, 2009) and self-regulation (Efklides & Misailidi, 2010), interventions to improve students capability to accurately evaluate their performance are warranted.

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