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PART VIII

The role of student and teacher cognition in student learning

Introduction

The study of student and teacher cognition is a key aspect in efforts to increase our understanding of the teaching and learning process. Thinking and decision making play an important role in physical education classes, ultimately determining how students interact and what they learn. Throughout this part, both students and teachers are characterized as active mediators in the teaching and learning process. The focus of the first three chapters is student cognition, including the perspectives and attitudes that students bring to physical education classes, how their competence beliefs affect their willingness to engage and their learning, and ways to structure the learning environment to facilitate thought processes that enable them to learn. Students are viewed as active and controlling agents in their learning rather than passive recipients of information.

Using cognitive mediation, metacognition, and self-regulation as theoretical bases, Solmon provides an historical overview of student cognitions in Chapter 33, Student cognition: Understanding how students learn in physical education. Researchers have provided evidence that an awareness of cognitive processes is important in gaining a clearer understanding of how students learn from teaching, and that the ways that teachers structure learning tasks can act to enhance or constrain cognitions that facilitate learning. Despite the promise evident in this line of research, however, over the past decade there have been relatively few studies investigating students’ thoughts as they learn. Solmon argues that a focus on student learning is a critical element in demonstrating the worth of PE programs and calls for multi-level analyses that can explore social and individual factors related to self-regulated learning.

Both Garn and Webster highlight the complexities of student cognition in the PE context using multidimensional theoretical frameworks to structure and connect knowledge about PE from the student perspective. In Chapter 34, Student physical self-concept beliefs, Alex Garn focuses on students’ physical self-concept beliefs, reflecting cognition aimed inwardly toward physical abilities commonly used and physical attributes on display in PE settings. Collin Webster concentrates on students’ attitudes and perspectives in Chapter 35, Student attitudes and perspectives, reflecting cognition aimed outwardly toward experiences with teachers, pedagogy, curriculum, and peers in PE settings. Both Garn and Webster articulate the motivational, affective, and behavioral implications associated with students who make positive evaluations about themselves (i.e.,
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physical self-concept) and their learning environment (i.e., attitudes). It is unclear, however, how students’ physical self-concept beliefs and attitudes directly impact learning PE content. These chapters situate facets of student cognition as critical components of quality PE and engagement in health-enhancing behaviors.

The focus of the next two chapters shifts to cognitive aspects of teaching. Teachers are characterized as thoughtful and reflective practitioners, and it is acknowledged that their understanding of students’ cognitive processes is a critical element in effective teaching. In Chapter 36, Teacher beliefs and efficacy, Pamela Kulinna and Donetta J. Cothran explore the complicated relationship between two key elements of teacher cognition: beliefs and efficacy. Teacher beliefs serve as a lens through which they interpret the environment, structure their knowledge, and make decisions. Prospective teachers enter teacher preparation programs with strongly established belief systems. Likewise, practicing teachers in professional development sessions also have strongly held beliefs refined through their teaching experiences. In order for professional development programs to be effective, it is imperative that these prior belief systems be considered. To understand how teachers’ beliefs serve to facilitate, or alternatively impede, student learning, it is important for teachers to be aware of their belief systems and, as they develop their knowledge about teaching, that they reflect on those beliefs. Kulinna and Cothran describe how teachers’ belief systems and values about the purposes of PE and about how students learn influence the decisions they make. Additionally, they point out that teachers must consider students’ beliefs and values if they are to teach effectively.

Nate McCaughtry and Matthew Ferry outline the emotional dimensions of being a physical educator in Chapter 37, The emotional dimensions of physical education teacher knowledge. Teacher emotions and emotional understanding of students are identified as crucial elements for sustaining positive learning environments in PE and promoting the wellbeing of teachers and students. They make persuasive arguments about the role of teachers’ emotions in decision-making processes that affect day-to-day practices. The emotional toil of coping with marginalization and low status within the broader school curriculum is also described. Despite these professional barriers, many physical educators are able to develop emotional knowledge of their students that helps create caring environments and strong teacher-student bonds. McCaughtry and Ferry argue that emotional knowledge of students or a lack of it helps explain a variety of common PE phenomena ranging from curricular planning and implementation to blaming students when lessons go awry.

In light of the recent concerns about the role of physical education in addressing public health concerns, this part concludes with a chapter that explores the interaction of teacher and student cognitions as they relate to beliefs about physical activity, health-related fitness, and obesity. In Chapter 38, The nature and consequences of obesity bias in physical education: Implications for teaching, Weidong Li examines how obesity bias, defined as anti-fat attitudes and stereotypical beliefs toward overweight individuals, affects teaching practices and student learning. He provides evidence that both implicit and explicit bias exist in PE classes on the part of teachers and students, and that those cognitions have a negative effect on student learning and engagement in physical activity. Specifically, obesity bias can lead to the marginalization of overweight students, negatively affecting their emotional wellbeing and social functioning. When this happens, the very students who are most in need of lessons that will enable them to develop skills and dispositions to be physically active are alienated from PE and physical activity, further increasing their health risk. In this concluding chapter, the social ecological model is offered as a conceptual framework to address issues related to the inclusion of overweight students by developing school-wide programs to reduce obesity bias and promote physically active lifestyles. That framework encompasses multiple levels
that interact to influence a wide array of cognitions that affect student learning, including individual factors, the social and instructional context, school, family and community issues as well as society and public policy. This model can be used not only to guide efforts to promote cognitions that promote inclusion for overweight students, but also to structure the PE learning environment effectively for all students.

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A survey of definitions using a web-based search engine reveals that the term cognition encompasses a wide array of processes and constructs that intersect as individuals comprehend their surroundings, give meaning to their experiences, acquire knowledge, make decisions, and develop plans of action. As Gage and Berliner (1992) observed more than two decades ago, cognition can be simply defined as “all the ways in which people think” (p. G-3). So, from a broad frame of reference, all thought processes, inclusive of beliefs, perceptions, attention, concentration, emotions, motivations, mental abilities, learning strategies, reasoning, and decision making are elements of cognition, given that they are related to how individuals acquire knowledge and make sense of their environments (Solmon, 2006). As McCaughtry and Ferry (Chapter 37, this volume) point out in their discussion of teachers’ emotional understandings, the human experience is incredibly complex and holistic in nature. To isolate individual aspects of the holistic human experience is, by nature, contrary to that conceptualization and doing so poses a risk of dissecting the experience to the point that the comprehensive meaning is lost. Seemingly, however, it is necessary to isolate aspects of that complex human experience to better understand them before we can fully examine how they interact.

The focus of this part of the handbook is on the broad range of cognitions that form the basis of the human learning experience, including beliefs, knowledge, emotions, and perceptions that are examined in detail in other chapters. The emphasis of this chapter is on what we know about students’ thought processes as they learn, and based on that, how teachers and practitioners in physical activity settings can structure the learning environment to engage students in cognitions that enable them to learn. Across domains of educational research, social cognitive theories have played an increasingly important role, and the value of studying the thoughts of learners in the context of social factors that affect cognitive processes has been acknowledged (Solmon, 2006). It is recognized that individual and social perspectives are both critically important in the teaching and learning process, and the myriad social and situational factors that profoundly influence cognition are addressed throughout this handbook. Although important findings relative to social factors as they affect individual learner cognition are addressed, the emphasis here will be on individual cognition.

The term cognition has generally been used interchangeably with thought processes (Peterson, 1988; Wittrock, 1986b). The study of thought processes as students learn is rooted...
in the work of John Dewey (1966, 1990), who characterized students as educational theorists who are active and controlling agents in their own learning. Dewey argued that students’ views should inform the educational process, and his philosophy provides a rationale for the study of students’ thought processes as an important research paradigm. A wide array of cognitive processes are critical elements in the teaching and learning process, including interpreting stimuli in the environment, selecting and paying attention to instructional cues, and deciding how to interact in classes. Examples of decisions that students make related to their cognitions that have a powerful impact on what they learn are associated with: how much effort to exert, whether or not to use strategies and/or seek help when they encounter difficulties, and whether they will persist in a learning activity or task.

A basic assumption of frameworks that incorporate a cognitive approach is that our actions are governed by thought (Roberts, 1992). That may not always be a tenable assumption, however, since our actions are not always preceded by thoughtful decision making. Sometimes we may act, or react, with little or no consciousness or awareness of our thought processes, or we may act without really thinking. Even though students may not be aware of their cognitions as they learn, a better understanding of the cognitive processes that foster learning will enable teachers and researchers to apply these findings to develop instructional strategies that will encourage students to think and act in ways that empower them to learn.

The purpose of this chapter is to review and synthesize recent literature that is related to student cognition in physical education (PE). Given space limitations, I rely on summaries of earlier work presented in previous volumes (Solmon, 2003, 2006) and focus on recent additions to the literature. To situate this body of work in the existing literature, I begin with a brief historical overview. Next, cognitive mediation, metacognition, and self-regulation are posed as theoretical bases that serve as frameworks for the investigation of student cognition, and motivation is situated as a cognitive process in this literature. The major findings of research on student cognition in PE settings are organized around four themes: (a) student characteristics that influence their ability to successfully engage in cognitive processes that will enable them to learn, (b) recent research that has focused on student learning, (c) studies that have used approaches grounded in metacognition and self-regulated learning, and (d) the relationship between cognitive function and PE, physical activity, and physical fitness. Based on those major findings, I present implications for practice that are supported by the research. I conclude by pointing out directions for future research, summarizing the key points, and posing reflective questions for discussion.

**Brief historical perspective**

In the broader field of research on teaching in PE, the motor learning literature is the context for the earliest research on the role of cognition. Cognitive concerns dominate the initial phase of learning a motor skill, as learners focus on information presented through instructions and demonstrations to understand the elements required in the task and to develop cognitive representations of the skill to be learned (Magill, 2001). As learners acquire a basic level of proficiency, motor performance becomes more automated and cognitive demands related to processing information about the skill are reduced, enabling learners to direct their attention to more technical aspects of the skill, specific points of technique, or strategies in using the skill. In their review in the early 1970s, Nixon and Locke (1973) surmised that the focus of research in teaching in PE up to that point had focused primarily on motor skill acquisition. They insightfully observed, however, that knowing how individuals learn skills does not necessarily translate to knowing how to help them learn skills. They called for researchers to begin asking substantive
understanding how students learn

questions in research studies designed to learn how teachers can best help PE students learn, and understanding students’ cognitions is an important element in doing that.

The process-product paradigm dominated educational research in the early 1970s. Process-product studies examined relationships between teacher behavior as the instructional process and measures of student achievement as the product variable. A strength of this approach was that studies were conducted in field based settings, and this line of research made a contribution to the knowledge base about effective teaching during this time frame. As the field of research on teaching evolved, however, limitations and inherent weaknesses in the application of the process-product paradigm became apparent. The lack of a theoretical basis was viewed as a serious deficiency, and basic assumptions of this approach were called into question. The shortcomings of this paradigm are documented in several reviews (e.g., Doyle, 1977; Lee & Solmon, 1992; Shulman, 1986; Wittrock, 1986b) and will not be reiterated in detail here. There is general agreement that the process-product research provided a structure to drive more sophisticated inquiry in the 1970s, but also that this approach represents a simplistic view of teaching that lacks the complexity to fully explore how students learn from teaching. Shulman (1986) points out that the reliance on overt, observable behaviors inherent in the paradigm disregards the cognitive activities of both students and teachers and argues that a clear understanding of how students learn from teaching must include the investigation of student cognition.

The shift in educational research from the process-product paradigm to approaches that incorporate the study of cognition parallels the cognitive revolution in psychology, characterized by MacKeachie (2000) as a shift from the behaviorist approaches dominant in the 1950s and 1960s to an emphasis on human cognition. A survey of the editions of the *Handbook of Research on Teaching* (Gage, 1963; Travers, 1973; Wittrock, 1986a) provides evidence of this. Peterson (1988) points out there is virtually no mention of students or learning in the chapter titles in the first two editions, which were dominated by a focus on teachers and teaching. An emphasis on students and cognition emerged in the third edition, as several chapters addressed issues related to student learning. Wittrock (1986b) provided a review of the research on students’ thought processes and several other chapters address issues related to student learning and cognition. The fourth edition of that handbook (Richardson, 2001) continued to reflect an emphasis on learners and how their cognitions affect their learning. The publication of handbooks focused on self-regulation (Boekaerts, Pintrich, & Zeidner, 2000; Vohs & Baumeister, 2011; Zimmerman & Schunk, 2011) also support the contention that a focus on cognitive processes in learning continues to be an important line of inquiry.

Although there has been a continued focus on cognition and self-regulated learning across academic disciplines, the research on student cognition specific to PE has lagged behind other academic content areas. In 1999 Luke and Hardy characterized interest in students’ thought processes in PE as “limited.” Several scholars in PE, however, have examined aspects of student cognition in PE classes. That body of work has made a significant contribution to the knowledge base about effective teaching in that context as summarized in earlier reviews (Lee, 1997; Solmon, 2003, 2006). Despite the promise evident in this line of inquiry, and the acknowledgement that understanding how students learn is a critical element in research on effective teaching, my literature search for this chapter suggests that a focus on student thoughts as they learn has not been a point of emphasis in journals that publish research in PE over the past five years.

**Theoretical bases and core elements in the study of student cognition**

One of the criticisms of the early research using the process-product paradigm was the lack of a theoretical basis to guide the research. Examining direct relationships between instructional
processes and learning products may have the capacity to determine “what works” but that simplistic approach cannot tell us why “it” works, how “it” works, or in what contexts “it” might be effective. Approaches that include a focus on cognition necessitated a paradigm shift to theoretical views with the capacity to provide an understanding of why different instructional approaches are effective and how students learn from teaching.

Theoretical perspectives used to investigate student cognitions are grounded in the view of learners as active and controlling agents in the learning process, as characterized in Dewey’s (1966, 1990) work. Three broad categories of theories have been used to frame the study of cognition: cognitive mediation, constructivism, and critical theories such as post-structuralism. In this chapter I focus on research that is grounded in a mediational perspective, as constructivist and post-structuralist views are presented in other chapters in this volume. It is important to note, however, the assertions that meaningful learning is grounded in personal experience and that the understanding of formal instruction is mediated by myriad influences is central to these theoretical approaches. A cognitive constructivist perspective recognizes that learners develop (i.e., construct) their individual ways of knowing through active restructuring of existing knowledge from the framework of their personal experiences and understandings (Powell & Kalina, 2009).

Through a feminist post-structural lens, learners are viewed as active agents who make choices and participate in defining their identities rather than passive participants in institutionalized processes (Azzarito, Solmon, & Harrison, 2006). These theoretical views are complementary in that they both emphasize that learning requires active, effortful involvement on the part of the learner. As research on student cognitions has evolved, the mediational framework has been operationalized to some degree in constructs of self-regulated learning and metacognition. Consistent with the cognitive mediational paradigm, the conceptualization of learners as active agents in their learning is central to those constructs. An additional consideration that is a core element in the study of cognition is motivation as an underlying cognitive process.

Cognitive mediation

Doyle (1977) describes the evolution of the mediating processes paradigm. In the two-factor process-product approach the link between teacher behavior and student achievement is conceptualized as a direct relationship. The cognitive mediational approach advances that model by expanding to a three-factor model that recognizes that mediating factors intervene in the relationship between what the teacher does and what students learn. From this perspective, it is recognized that learning does not automatically occur from teaching. Instead, learning occurs when students are actively engaged in the process, activating cognitions that enable them to learn from teaching. Teachers produce learning and achievement only to the degree that they activate students’ cognitions.

Early work using the mediating processes paradigm relied on overt, observable variables such as time on task, observer estimates of attention, and task completion rates. Doyle (1977) criticized this limited conceptualization of student mediation and argued that researchers needed to move beyond that approach to investigate cognitive processes rather than the reliance on observations of behavior. Considering cognitive elements as mediators between teacher behavior and learning outcomes recognizes that students have different perceptions of teacher behaviors and other classroom events, and that based on those unique perceptions they think, act, and learn in individual ways. The critical link between teacher behavior and what is learned is students’ active and controlling role in mediating the effects of teaching. From this perspective, the teacher’s goal is to create a learning environment that encourages and enables students to think and act in ways that enable them to learn.
Using Doyle’s work as a guide, Lee and Solmon (1992) urged scholars in PE to incorporate the study of student cognitions in research studies to gain a clearer understanding of how students learn from teaching. Dodds, Griffin, and Placek (2001) acknowledge that the cognitive mediational model provides a basis to investigate students’ cognitions, but point out that the learners’ domain specific knowledge is an important element that has often not been examined in the investigation of understanding how students learn from teaching. They argue that to fully understand learner cognition the development of student knowledge must be considered.

**Metacognition and self-regulation**

The rationale for investigating student cognitions is based on the assumption that, if we gain an understanding of how thought processes promote learning, we will be able to structure the learning environment and design tasks that enable students to use those cognitive processes effectively. Inherent in that assumption is that learners can exert a level of control over their cognitions if encouraged to do so. Wittrock (1986b) defined metacognition as an individual’s knowledge about and control over their cognitive processes. It encompasses monitoring, planning, and evaluating efforts to master a task. Simply stated, metacognition is an individual’s awareness of his or her thinking. Luke and Hardy (1999) advocated for the use of metacognition as a framework to study students’ thoughts in PE, criticizing the existing research in PE for a tendency to “reduce the complexity of learning to a number of isolated variables, such as motivation, that remain adrift from any wider conceptual framework” (p. 175). Metacognition provides a structure to consider multiple variables rather than studying aspects of cognition in isolation, enabling researchers to examine cognition as a more authentic holistic process. As the investigation of student thought processes has evolved, recent research in PE (Chatzipanteli & Digelidis, 2011) and sport settings (Brick, MacIntyre, & Campbell, 2015) has used a metacognitive framework to study teaching and learning.

Self-regulation is a parallel concept to metacognition. According to Zimmerman and Schunk (2011), it is a process “whereby learners personally activate and sustain cognitions, affects, and behaviors that are systematically oriented toward the attainment of personal goals” (p. 1). Grounded in social cognitive theory, the construct of self-regulated learning encompasses cognitive, motivational, affective, and social contextual factors (McBride & Xiang, 2013). As active participants in their learning, students construct individual meanings, identify goals to guide their efforts, and develop strategies to work toward those goals (Pintrich, 2003). Consistent with characterizations of metacognition, planning, monitoring, and evaluating progress toward goals are central to self-regulated learning. The continuum of self-determination (Ryan & Deci, 2000) has been used by researchers to characterize levels of self-regulation (i.e., McBride & Xiang, 2013). Four levels of regulation have been used to operationalize based on the level of internalization of an individual’s reason for engaging in an activity: (a) external (because I have to), (b) introjected (because I ought to), (c) identified (I see value in the activity and I want to), and (d) intrinsic (because I enjoy the activity). More internalized regulations are more autonomous and should lead to a higher quality of engagement (Ryan & Deci, 2000).

**Motivation as a cognitive process**

Achievement motivation is seen as a critical determinant of success and the educational literature is replete with studies investigating motivation. Scholars in PE and promotion of physical activity have followed suit, and a preponderance of recent research in PE pedagogy has been framed from a motivational perspective. Defined by Roberts (2001) as the “dispositions, social
variables, and/or cognitions that come into play when a person undertakes a task at which he or she is evaluated, or enters into competition with others, or attempts to attain some standard of excellence” (p. 6), motivation is recognized as a cognitive process. Solmon (2003) characterized motivation as a central construct that underlies more global cognitive processes. Motivation involves being willing to exert effort, to work at a challenging level, and to persist when difficulty is encountered, which ultimately leads to achieving goals. A plethora of theories have been used to investigate motivation, and the focus of many chapters in this volume is to closely examine recent research from various theoretical perspectives. It is beyond the scope of this chapter to provide an in depth account of motivation in PE, but it is not possible to examine student cognition in isolation from motivation. From a practical standpoint, if an individual lacks motivation for a particular activity or task, cognitions will likely be geared toward avoiding engagement, so being motivated is a prerequisite for fostering cognitions that will lead to learning.

**Current trends and issues**

During the past two decades concern about the consequences of physical inactivity and rise in obesity levels has received increased attention from the media, from government agencies and commissions, and from the research community. Reviewing the list of published articles in the*Journal of Teaching in Physical Education, Research Quarterly for Exercise and Sport, Physical Education and Sport Pedagogy,* and*Sport, Education and Society*reveals a focus on pedagogies of the body, sport and culture, promotion of physical activity, the role of PE in the prevention of obesity, and understanding motivation in physical activity settings, but research studies focused on cognitions that influence student learning are comparatively sparse. Only a small proportion of studies focus on what, how, or if, students learn in PE classes and the cognitions that are involved in that process. Recently, scholars have advocated for the use of physical literacy (PL) as a framework for defining the focus of PE (Castelli, Centeio, Beighle, Carson, & Nicksic, 2014; Giblin, Collins, & Button, 2014; Kirk, 2013). PL is a philosophical view articulated by Whitehead (2010) that embraces a holistic perspective of the lived experience and rejects mind-body dualism. She conceptualized PL as the embodiment of the motivation, confidence, physical competence, knowledge and understanding that enable an individual to realize his/her innate potential through embodied experiences. Cognition is a fundamental element in conceptualization of PL. Although much has been written from this philosophical perspective, the measurement of PL as a learning outcome has not been clarified (Giblin et al., 2014) and to date, there is little, if any, data-based research using this framework.

The focus of this section on current issues and trends is on recent work. Earlier reviews (Solmon, 2003, 2006) have synthesized research by examining constructs involved in cognition by organizing research findings into categories outlining cognition as a scheme of processes as they might occur along a timeline. That is, I have emphasized that students enter instructional settings with an array of prior knowledge, experiences, and beliefs that serve as a lens or filter through which students perceive instruction and teacher behaviors. Based on their individual characteristics, students give unique meanings to classroom interactions. They do not all interpret instruction in the same way, and may or may not interpret what the teacher says in the way that is intended. Based on these perceptions, they make decisions about their engagement in learning activities. They choose whether to exert effort, to use strategies, to seek help when they encounter difficulties, as well as other decisions that determine whether or not they learn. Readers are referred to the review by Solmon (2006) for a detailed overview of earlier work. Consistent with the recent trend toward a more global view of cognition, four themes are used to organize the current trends and issues for this chapter. First, conditions and characteristics that
have been identified as prerequisites for effective cognition are delineated. This is followed by a synthesis of recent work investigating student learning in specific domains. Next, the work using metacognition and self-regulation as a framework is presented. This section concludes with a brief summary of an area that has received an increasing amount of attention in recent years: the relationship between PE/physical activity/physical fitness with cognition and academic achievement.

**Requisites for effective cognitive engagement**

In order for students to actively engage in learning activities they must have a reason to do so. Earlier I described motivation as a central construct that underlies global cognitions. Motivation is associated with higher levels of cognitive engagement such as elaboration and critical thinking (Stolk & Harari, 2014). Regardless of the theoretical approach undertaken to explain motivation, it is clear that an individual must attach some level of value to an endeavor before she or he will be motivated to engage in and learn an activity. According to the expectancy value model (Eccles, 2005), subjective task values enable individuals to answer the question “Why should I do this activity?” Four dimensions or elements of value are outlined in the expectancy value framework: (a) intrinsic value (interest/enjoyment/satisfaction), (b) attainment value (importance of doing well), (c) utility value (usefulness), and (d) perceived cost (benefits vs. investment required). If students do not value an activity at some level, they are unlikely to invest their effort in learning. Students’ past experiences, cultural backgrounds, socializing agents, and existing knowledge may predispose them to value certain activities, or alternatively to be alienated from class activities.

Some students come to PE settings with an intrinsic interest in physical activity and sport based on positive prior experiences that may include family involvement in physical activity and a history of success. Others, however, do not see inherent value in the content of PE. Several scholars have explored the social construction of bodily meanings and examined how media images and culture influence choices that students make regarding their involvement in PE (Azzarito & Kirk, 2013). That work has a strong focus on gender and privilege, as well as skill level, and is represented in other chapters in this volume. This research on body pedagogies is relevant to addressing the issue of value for students who, because of their backgrounds and prior experiences, are not attracted to PE. Spencer-Cavaliere and Rintoul (2012) provide evidence that PE continues to be an uncomfortable experience for some children. They examined students’ perspectives about alienation in PE. The sixth graders in their study articulated feelings of powerlessness, meaningless, and isolation, leading to negative feelings and a lack of value. A study by Frisette (2013) demonstrates that listening to students’ voices can inform teachers and researchers about ways to address concerns about value. The adolescent girls in her study were able to identify barriers they perceived to their involvement in PE and the ways that they were able to negotiate barriers to be successful.

In addition to finding value in a task, it also is critical that individuals believe they can experience some level of success in an activity. Even when individuals see value in an activity, if they do not believe that some level of success is possible, or that they can demonstrate some level of competence, it is unlikely that they will choose to exert effort on a task. Elliot and Dweck (2005) assert that competence is the conceptual core of motivation. The manner in which competence is evaluated is a key consideration. When competence is judged according to self-referenced (personal improvement) or task-referenced (mastering a task/achieving a goal) criteria then success is always a possibility. When the criteria for success or demonstrating competence are externally referenced relative to the performance of others, students with less
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experience and lower ability often believe that, no matter how much effort they exert, success (beating others in the class) is not a realistic possibility. When students are concerned about whether or not they can be successful, the focus of their cognitions is likely to shift from a focus on the task at hand to anxiety related concerns about maintaining self-esteem. Garn’s chapter (Chapter 34, this volume) on students’ self-concept beliefs provides insight into the influence ability beliefs have on student learning.

In addition to valuing the task and believing they can be successful, students must also be positioned to understand and interpret instruction. Webster (Chapter 35, this volume) provides a review of recent studies focused on students’ perceptions of instruction. What is important with regard to cognition is to reiterate that individual students, based on their prior knowledge, experiences, and beliefs, do not always perceive instruction the same ways, and often do not perceive instruction in the manner in which the teacher intends (Solmon, 2006). In order to fully understand students’ cognitions as they learn, it is important for teachers and researchers to determine the meanings that students construct based on their perceptions of instruction.

Learning domain specific knowledge

A discussion of student cognition is incomplete without the consideration of the development of students’ domain specific knowledge (Dodds et al., 2001). Investigating how student knowledge develops is a labor intensive effort, and those efforts are complicated by the difficulty inherent in measuring what students actually learn. Another confounding issue relevant to student knowledge in PE is the lack of clarity about what is to be learned (Nyberg & Larsson, 2014). There has been an ongoing debate for decades concerning what the basis for content taught in school PE should be. That debate continues, driven to some degree by efforts to increase the status of PE to be recognized as a meaningful element in a core academic curriculum (Reid, 2013).

Studies that measure learning in PE classes are not commonplace, as time on task, appropriate practice trails, and more recently levels of in-class physical activity often are accepted as proxies for learning. Some researchers who have measured learning do so in the context of comparing one methodology or teaching approach to another. In many cases there is little if any consideration of why or how one method facilitates learning as compared to another, but some researchers have addressed that issue. There has been extensive investigation of the instructional effects of the Sport Education model (for a review see Araújo, Mesquita, & Hastie, 2014), as well as Teaching Games for Understanding (for a review see Stolz & Pill, 2014). Although both reviews point out methodological shortcomings and make suggestions for future research that focuses on how students learn, there is general support for the conclusion that teaching approaches that situate learning experiences in authentic contexts, as these models do, are effective in helping students to learn techniques and strategies by promoting cognitions that foster understanding of game play. Researchers also have investigated how the Spectrum of Teaching Styles affects student learning and engagement (Byra, Sanchez, & Wallhead, 2014). Although learning was not measured, Sanchez, Byra, and Wallhead (2012) concluded that students reported higher levels of cognitive involvement in the inclusion style, as compared to command and practice style lessons. Taken together, findings from these lines of research support the notion that the teaching approach used affects how and what students learn through the activation of their cognitions. In her commentary on curriculum priorities for PE, Ennis (2011) cautions that instructional models that merely engage students in moderate to vigorous physical activities undermine the educational focus on knowledge and skill development needed to foster students’ dispositions.
to embrace physically active lifestyles. It is important for researchers to continue investigations relevant to student cognitions that promote the acquisition of domain specific knowledge to do that.

Metacognition and self-regulation

Consistent with the trend evident across educational research (Pintrich, 2003), over the past decade research in PE related to student cognition has been framed using the metacognition and self-regulation literature. Luke and Hardy (1999) advocated for the use of metacognition as a conceptual framework to guide research on student cognition, but to date there still has been relatively little research published that focuses on metacognition and self-regulated learning in PE. These approaches encompass a broad range of cognitions, including attentional focus, use of learning strategies, self-efficacy and confidence, self-evaluation, monitoring, and planning. From earlier work summarized by Solmon (2006), we know that structuring tasks sequentially at an appropriate level of difficulty and designing appropriate practice so that learners can experience success can decrease anxiety and stress and help students focus their attention on learning. Instructional cues can help individuals concentrate on key aspects of a learning task and when learners encounter difficulties, learning strategies can help them master tasks. The studies cited in the earlier review generally considered these variables in isolation, and the more recent work grounded in metacognition and self-regulation provides a more comprehensive picture of student cognitions.

Several researchers (e.g., McBride & Xiang, 2013) have used self-regulated learning to frame their investigations of motivation, but have not included a measure of learning in the research design, and that work is addressed in the section on motivation. A few studies have, however, included a pre-post design as an indicant of learning. Chatzipanteli and Digelidis (2011) used question prompts designed to activate students’ metacognitive process while they performed a volleyball serve test. Participants completed five trials, and after a short break completed five additional trials where, after each attempt, they completed a survey designed to prompt metacognitive processes, including analyzing each trial, planning to improve performance, monitoring, evaluation, and reflection. Performance on the second set of trials was significantly better. Although the results support the notion that this technique can be used to promote metacognition and improve learning, the lack of a comparison-control group and the short duration of the instructional episode are methodological weaknesses in this study.

Kolovelonis and colleagues (Kolovelonis, Goudas, & Dermitzaki, 2010, 2011; Kolovelonis, Goudas, Dermitzaki, & Kitsantas, 2013; Kolovelonis, Goudas, Hassandra, & Dermitzaki, 2012) conducted a series of studies on self-regulated learning of skills in a PE setting. A strength of these studies is the use of an experimental design with different levels of treatments and control conditions, and the use of motor tasks (i.e., dart throwing and basketball dribbling) but the short time allocated for students to practice the task (16 minutes) is a limitation. They found that emulative practice with social feedback followed by self-control practice where students set goals and monitored their progress was effective in skill acquisition and promoting motivational beliefs (Kolovelonis et al., 2010, 2012, 2013). Self-recording also had a positive effect on skill performance (Kolovelonis, Goudas, & Dermitzaki, 2011). This line of studies provides evidence that when tasks are structured to promote students’ involvement in their learning they not only perform better but also demonstrate more positive affect as compared to control conditions. Tasks that increase student autonomy and promote more internalized regulations foster both learning and higher levels of motivation.
Physical activity, physical fitness, physical education, and cognition

In the context of high stakes testing, school administrators have in many cases sought to decrease time for PE and other opportunities for children to be physically active to allocate increased time to prepare for standardized testing (Monnat, Lounsbery, & Smith, 2014). This trend has sparked efforts to support the argument that sacrificing time for children to be active in order to increase time spent in math and reading is not associated with increased test scores, and there is clear evidence that is true (Trudeau & Shepard, 2008). Correlational studies provide evidence that children who are physically active (Donnelly & Lambourne, 2011) and physically fit (Chomitz et al., 2009) perform better academically than those who are not, and that short bouts of physical activity during the school day improve attention-to-task for elementary school students (Mahar, 2011). The line of reasoning that PE and physical activity can improve cognition and may improve academic achievement scores in addition to improving children’s health may be useful in efforts to ensure that PE requirements are not eroded. Care must be taken, however, to ensure the content of PE is valued in its own right as an important element in school curricula and that programs are not reduced to simply promoting high levels of physical activity at a target heart rate.

Implications for evidence-based practice

The knowledge base generated from research on student cognition supports several implications for teaching. First, practitioners must be aware of ways that prior knowledge, cultural experiences, and other characteristics affect whether or not students are motivated to learn in PE. In the current educational context, it is important that teachers ensure that students in their classes see value in the content being taught and that the instruction is meaningful to them. Additionally, care must be taken to structure activities so that students believe that they can be successful in the learning activity if they are willing to exert effort. A focus on personal improvement and task mastery, as opposed to normative comparisons, and sequencing tasks at an appropriate level of difficulty are important elements in structuring classes so that students can experience success. When those issues have been addressed, then teachers can focus on ways to provide instruction that will facilitate cognitions that enable students to learn.

Selection of curricular models and teaching approaches affects student cognitions, in that models that create more authentic situated learning experiences generally elicit a higher level of cognition than teaching approaches that rely solely on direct instruction. Inclusion of tasks that require students to analyze their performance, set goals, and monitor their progress can facilitate cognitive involvement and promote learning, facilitating higher levels of internalization and self-regulation. Lastly, because students do not always perceive instructional behaviors and class events as the teacher intends, it is an important endeavor for teachers to include checks for understanding in their lessons. Asking students what they are thinking, what they understand, and what suggestions they have for instruction can provide valuable insight into the ways that students learn (Koekoek, Knoppers, & Stegeman, 2009) and whether they are learning.

Future directions

The study of student cognition in PE is an important area of research that has not received much consideration in recent years. I have tried to make the argument that a research focus on student learning in PE is a critical element in demonstrating the importance of PE programs in schools and that this area deserves more attention. Much of the recent work has been conducted using experimental designs in contrived settings with very short instructional phases.
Although the pressure to publish a high quantity of research produces a system that encourages this, and these studies do make a contribution, research conducted in real world settings is needed. To gain a better understanding of student cognition, studies conducted in authentic field settings with practicing teachers using metacognitive/self-regulation frameworks are essential to promote a more comprehensive understanding of student learning. It also is critical that valid and reliable assessments of learning be included in studies that focus on student cognition. Given the complexity of the human learning experience, research designs that apply multi-level analyses that enable researchers to examine social and individual factors to explore metacognition and self-regulated learning hold promise.

**Summary of key findings**

- Cognition encompasses a wide range of thought processes related to knowledge acquisition including beliefs, perceptions, attention, concentration, emotions, motivations, learning strategies, reasoning, and decision making.
- In order for students to be motivated to learn by engaging in cognitive processes, they must see value in the content and believe that they have the ability to experience success if they exert effort.
- To understand how to foster student cognition that promotes learning, teachers and researchers must have an understanding of the individual meanings that students assign to instructional behaviors.
- Curriculum and teaching approaches that situate learning in authentic contexts are effective in increasing techniques and strategies that promote cognition and foster understanding of game play.
- Learning styles with higher levels of student autonomy and cognitive involvement (inclusion) are more effective at increasing student learning than those with direct teacher control (command & practices styles).
- The instructional approach used by the teacher can serve to enhance or constrain students’ cognitive engagement.
- Metacognition and self-regulated learning provide frameworks that enable researchers to examine cognition from an integrated holistic perspective rather than isolating individual variables.
- Sequential task structuring and instructional cueing at an appropriate difficulty level can foster student success, decrease anxiety and stress, and enhance students’ focus on learning.
- Learning activities can be structured to engage students in metacognitive processes that will translate to higher levels of internalization, self-regulation, and motivation.
- Tasks structured to promote student involvement in the learning process increase student performance and contribute to positive affect. Tasks that promote student autonomy and promote internalized regulation foster both learning and higher motivation levels.
- Activities that involve students in analyzing their performance, setting goals, developing strategies, and monitoring progress are associated with higher levels of learning.

**Reflective questions for discussion**

1. What should students be learning in PE, and how can we engender a culture shift within students and teachers to increase the focus on learning in school PE?
2. How can learning in PE be assessed?
3. How does the emphasis on physical activity promotion in schools enhance or constrain research on teaching and learning in PE?

4. How can teachers challenged with large class sizes, inadequate facilities and equipment, and students who are seemingly not motivated or interested in PE successfully incorporate learning activities in their curricula that will promote student cognition that promotes learning?

References


Understanding how students learn


