Curricular Coherence: A Key to Effective Physical Activity Programs

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I wish to extend my thanks to the AIESEP Board and Conference Planning Committee for inviting me to present the 16th annual José María Cagigal Lecture. I am honored to be among the very distinguished group of scholars who have delivered this lecture. José María Cagigal was a distinguished scholar whose many contributions in the fields of sport psychology, sport history, and sport philosophy enhanced and extended our understandings and appreciation of sport. In my efforts to learn more about his scholarship, I was interested to find the diagram pictured in Figure 1 that he cited in an article written for the *Olympic Review* in 1977. Although it was first developed thirty years ago, this categorization of sport as entertainment, competition, and school activity, such as that found in the "Sport for All" philosophy, continue to inspire us as we gain new insights into the holistic content of sport and physical education.

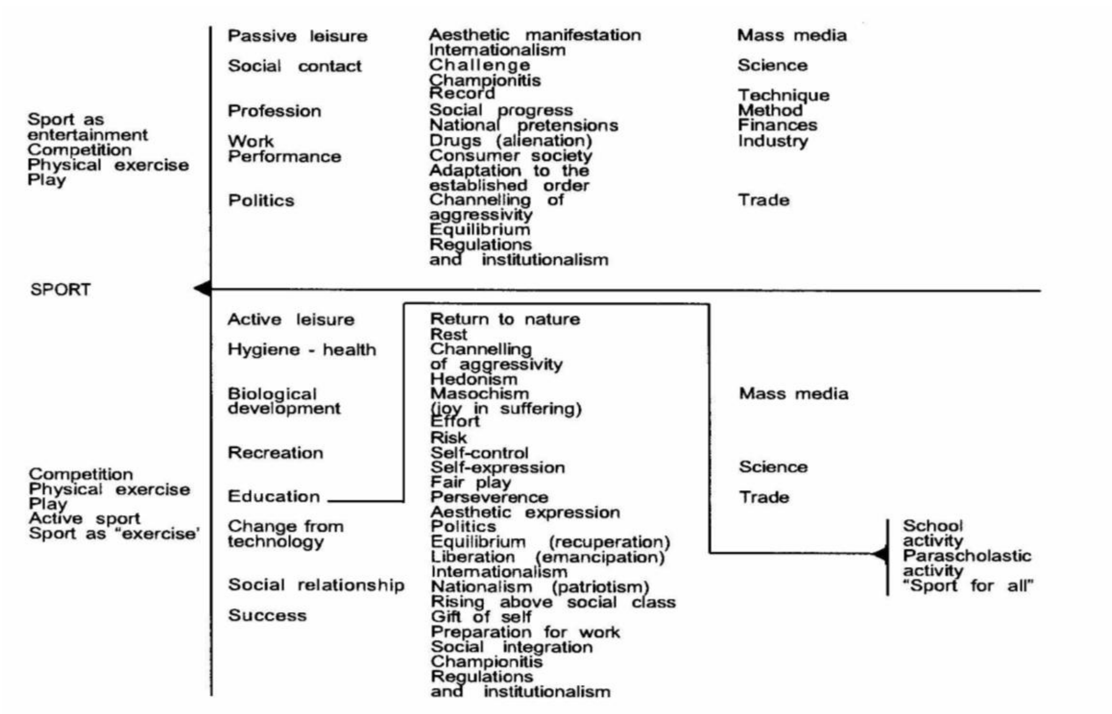


Figure 1. Elements for a theory of sport. As cited by J.M. Cagigal in "Sport and Human Progress," Principal report to the International Symposium on Sport and Human Progress, Paris, 1975. Olympic Review, 113, p.175.

I have selected “curriculum coherence” as my topic today because of its critical importance to student engagement in sport and physical activity content in physical education. As a curriculum specialist, I have been most interested in aspects of programs that facilitate student engagement and knowledge development associated with movement and physical activities of all types, leading to enhanced student understanding and learning. Certainly, one key to students’ continued interest and engagement is the presentation of a curriculum that *students’* perceive to be coherent.

A coherent curriculum is characterized by visible connections between educational purposes and students’ lived experiences (Beane, 1995). In a coherent curriculum, students’ readily acknowledge the content’s immediate relevance and value in their lives. Traditionally, pedagogists evaluating program effectiveness have focused on teaching practices used to convey content topics and tasks to students. Recently, scholars have examined another critical component of effective educational programs, the influence of salient *connections* associated with students’ engagement with, and understanding and performance of the content (Fredericks, Blumenfeld, & Paris, 2004). Equally important, are connections among content topics, the learning context, and students’ past and current lived experiences. For students to engage meaningfully in physical education, it is essential that they acknowledge these relationships and perceive their immediate relevance and usefulness in their lives. These connections appear to be key elements in perceptions of curricular coherence.

Today, I would like to begin by describing essential elements of curricular coherence as proposed by James Beane (1998) and then discuss two design elements that may facilitate students’ perceptions of coherence associated with learning. I will use as examples, two curriculum models, Teaching Games for Understanding, a family of models that currently is the source of considerable attention, and a new curriculum model, Be Active Kids!, a science-based physical education curriculum for elementary children ages 8-11. I will argue that these models emphasize student learning in the form of conceptual change and assist teachers to create a pedagogical context that is sensitive to students' lived experiences and feelings, factors that scholars, such as Clive Pope (2005), suggest are key elements of "affect."

Curriculum Coherence

Curricular coherence as described by James Beane (1995) consists of four key elements that appear to enhance students' perceptions of meaning and relevance. First, a coherent curriculum is characterized by "visible" linkages between purposes and students' everyday life experiences. Students who experience the curriculum acknowledge its immediate relevance and worth in their lives and strive to seek knowledge and apply it meaningfully. Students are active learners in this process and are encouraged to monitor and mediate their own knowledge growth. A second element of coherence can be found within the progressive content sequencing that can foster development of interrelationships among concepts, tasks, and assessments. These relevant associations create an internally reinforcing and stabilizing curricular structure, providing constancy and conceptual strength to the program. Through careful planning, experiences are designed and positioned strategically within coherent curricula to facilitate knowledge growth and concept transformation. Third, content topics and themes are selected specifically to evoke a sense of relevance within students' current social and situational contexts. Students' sense of immediate thematic and contextual significance enhances their feelings of interest and a concomitant willingness to engage both intellectually and physically in the content. Finally, a coherent curriculum provides extensive opportunities for students to fully and consciously explore how they and others experience and make sense of the concepts and tasks provided. It emphasizes the centrality of students' experiences within a few, complex topics or themes. Coherence developed in this way nurtures students' willingness to accept challenges and persist in the problem solving process. Clearly, an abiding sense of connectedness pervades each of these four characteristics. Within a coherent curriculum, significant relationships are fostered (a) pedagogically, across content topics, themes, and concepts, (b) contextually, between content topics and students' lives, and (c) socially, between and among students and teachers.

Thus, connectedness appears essential to the construct of coherence as a key element in student learning. Connectedness as an English term is derived from the Latin verb, *connectere*, to bind together or to be related in some proper or logical way. When used in discussions of curriculum, connectedness is thought to support student engagement through a web of cognitive, social, and emotional connections that facilitates understanding and guides performance. Connectedness is central to conceptualizations of curricular coherence both through the creation of common knowledge foundations shared by class members and the weaving of topical sequences that refine and extend knowledge, heightening its perceived usefulness.

Learning as Conceptual Change

Unlike behaviorists who define learning as a permanent change in behavior or performance that can be observed and measured, cognitive psychologists define learning as a change in the way a person thinks, reasons, believes, and processes information, in part by expanding or altering his or her existing knowledge base (Alexander, 2006). The change in conceptual knowledge structures or mental models contributes to individuals' understandings of phenomena and their perceptions of knowledge coherence (Alexander, 2006). These changes may occur directly, as new information is added to the current structure, or indirectly, in the form of more radical restructuring (Vosniadou & Brewer, 1987), such as that required to understand scientific concepts, complex game tactics, or the integrated role of movement and physical activity in health and well-being. Many of these complex relationships require an understanding of knowledge within the social and emotional context, associations which, at times, appear to defy common-sensical conceptualizations and diminish students' perceptions of knowledge coherence.

Conceptual change as a learning objective, however, poses new challenges to physical educators because of more complex conceptualizations of learning and the learning process. In this approach concept development and deep understanding are the focus of instruction, rather than the production or reproduction of isolated behaviors. Eliciting these deep, contextually situated understandings is the focus of cognitive based learning and teaching strategies that we identify as constructivist (Kirk & Macdonald, 1998; Kirk & MacPhail, 2002; Lave & Wenger, 1991; Rovegno, Nevett, Brock, & Babiarz, 2001).

In current conceptualizations of constructivism, a learning theory that has evolved from cognitive psychology, learning is defined as the learner's active constructions and reorganizations of content to reflect more complex and relational understandings. In fact, it is the relationships among concepts or the way that ideas connect to form large constructs, schema, or models that is a primary emphasis of constructivist approaches to teaching and learning.

Constructivists argue that "nothing has meaning or is learned in isolation" (Shuell, 1986, p. 416). In fact, to be included in a developing knowledge structure, all ideas or concepts must be connected or related to something else of meaning or value to the learner to be remembered and applied. Therefore, prior experiences and informal and formal knowledge that learners bring to new situations play a critical role in facilitating or constraining conceptual change. Within this conceptualization, it is the constructivist teacher's role to assist learners to become aware of relationships and build explicit connections between knowledge and new information presented in the instructional setting.

The Role of Embedded Structures and Strategic Knowledge

Two key curricular components, embedded structures and strategic knowledge, facilitate student conceptual change, enhancing their perceptions of coherence. Curricular structures are embedded lesson segments, tasks, or frameworks that facilitate coherence and provide stability and predictability for both students and teachers. They act to highlight subtle relationships within the content, making them more overt or explicit. In fact, the complexity inherent in many physical education environments accentuates the value of the focusing, centering, and stabilizing functions of embedded structures as essential to a coherent physical education curriculum. There are several different types of structures used within current constructivist conceptualizations of physical education that we describe as curriculum models.

Models typically are extensively developed, externally designed curricula that hold promise to support and facilitate teachers' and students' efforts to enhance learning in physical education. Each of these models uses conceptual structures embedded within the program to provide stability and internal consistency in program planning and task selection. Embedded curricular structures appear to facilitate student reconceptualization of content, nurturing transformative learning processes. I will discuss a few of the curricular structures inherent in two of these models, Teaching Games for Understanding and Be Active Kids!, a health-related, science-based physical education curriculum. Each contains elements and structures that emphasize significant relationships and connections, enhancing student perceptions of coherence.

Embedded Structures in Teaching Games of Understanding

Bunker and Thorpe (1982) designed the Teaching Games for Understanding curriculum with an embedded macro-structure of concepts and game categories to assist teachers and students to classify games and understand complex concepts essential to effective game play. In this curriculum, an emphasis on the strategic and progressively complex interactions of space and time, for example, results in a deepening understanding of the commonalities inherent in tactical game play. Commonalities are reiterated through selections of content within game categories and the continual manipulation of offensive and defensive elements of tactical play. Teachers focus student attention on significant game components, such as the relations that evolve as the number of players and size and shape of boundaries change, to reinforce spatial and temporal concepts and guide student attention, resulting in deepening understanding. Teaching Games for Understanding is a coherent and effective curriculum in which students, teacher, and curriculum work concomitantly to enhance the inherent connections among players, tactics, and the game context.

A second embedded structure that maintains the stability and consistency in games instruction within a Teaching Games for Understanding approach is the problem framing structures embedded within the lesson structure, itself. Although some variations to the structure occur depending on the curriculum designers' or teachers' purpose, most discussions of the model use an iterative game progression within the lesson or the unit to facilitate students' construction of domain-specific tactical skills and concepts. Bunker and Thorpe' (1982) initial conceptualization of this structure depicted in Figure 2 used six stages to enhance students' engagement and understanding. In practice, students begin most lessons with a small sided game that may be slightly more tactically or socially complex than they currently have the skills and understandings to play successfully. Teachers then ask the students to analyze their performance and together teachers and students identify a tactical skill to improve through instruction and analyses of the decision-making process. Students return to the game environment frequently to assess their progress and identify progressively more complex tactics to improve.

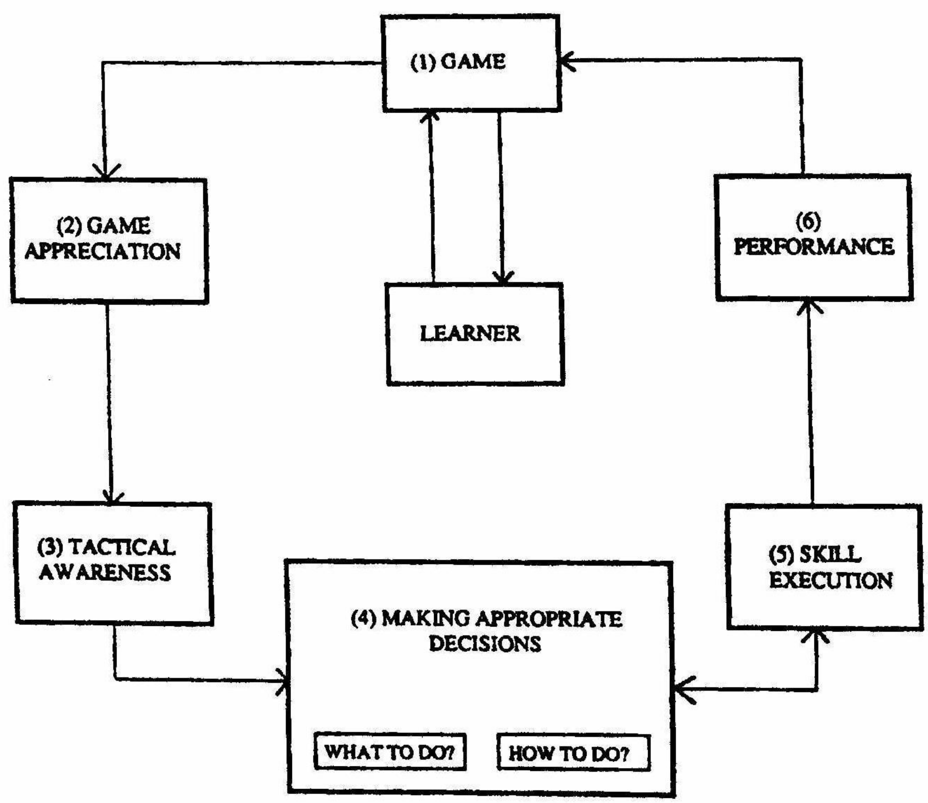


Figure 2. Bunker, D., & Thorpe, R. (1982). A model for the teaching of games in the secondary school. *Bulletin of Physical Education, 10(1),* 6.

Interestingly, Kirk and McPhail's (2002) revision of the Teaching Games for Understanding model uses a flowchart of game and tactic progressions which is similar to Bunker and Thorpe's initial conceptualization. Kirk and McPhail, adaptation, presented in Figure 3, however, emphasizes the situated nature of game decisions within a modified structure embedded within the curriculum. In both instances, though, the embedded structures assist teachers to plan a progressive series of tasks that integrate cognitive, strategic, and physical performances to make the offensive and defensive relationships within and across games salient and meaningful. Although tactical problems increase in complexity as players become more observant and knowledgeable, the foundational iterative structures in which they are presented to students remains stable and constant.

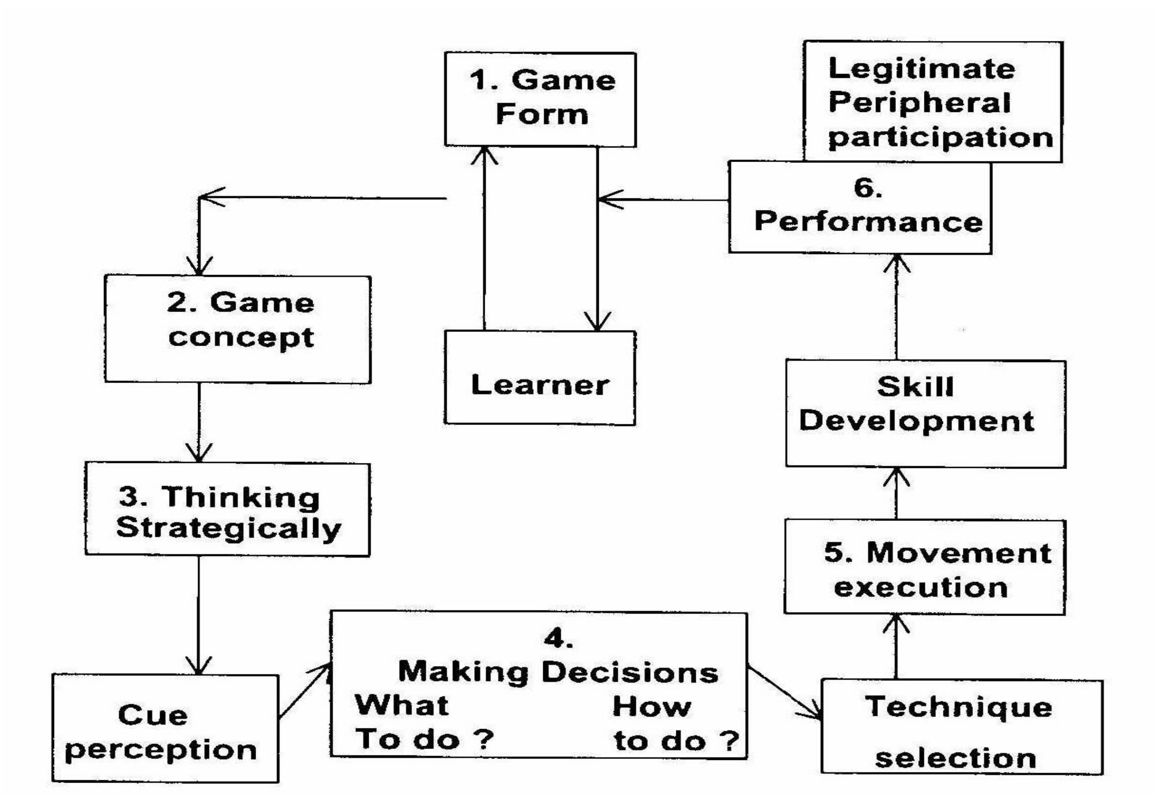


Figure 3. Kirk, D., & MacPhail, A. (2002). Teaching games for understanding and situated. learning: Rethinking the Bunker-Thorpe model. *Journal of Teaching in Physical Education, 21*, 185.

In a third example pictured in Figure 4, Gréhaigne and his colleagues (e.g., Gréhaigne, Richard, & Griffin, 2005a, Gréhaigne, Willian, & Godbout, 2005b) use a variation of this structure in the Tactical Decision Learning model with multiple iterations of mini-game and student-centered problems to engage students in a coherent pattern of increasingly more complex tactical understandings. These structures are essential to student learning and perceptions of curricular coherence.

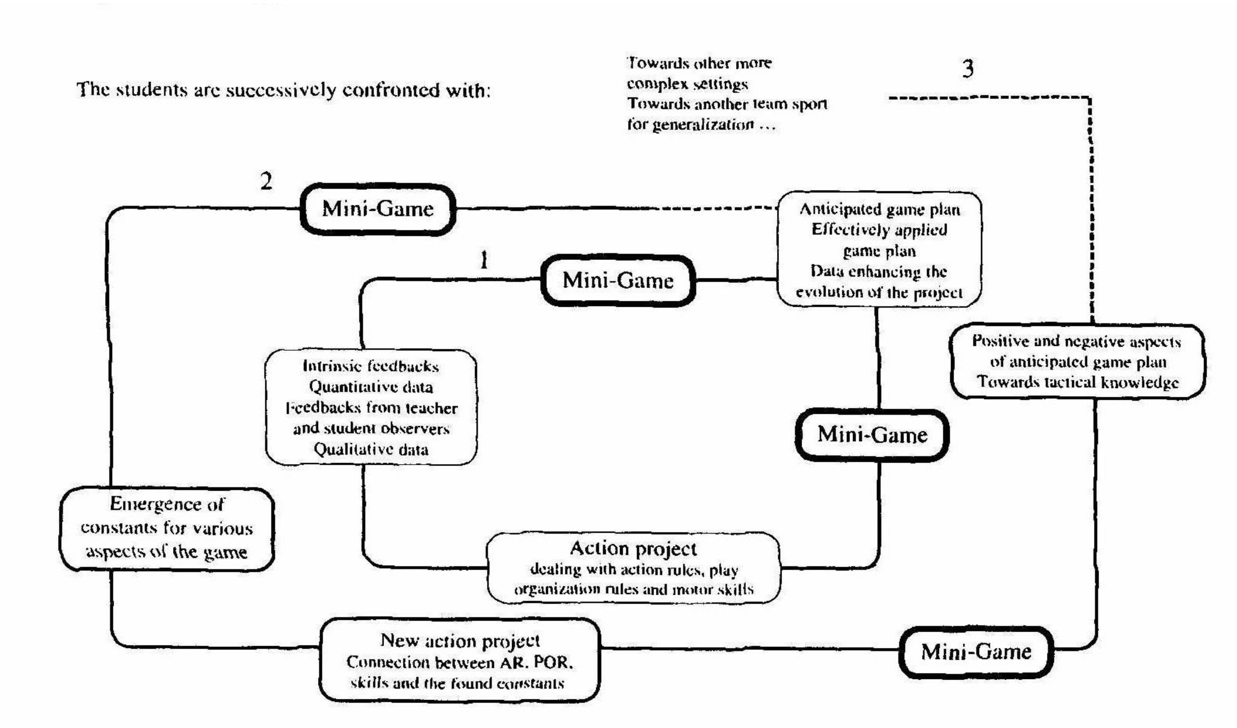


Figure 4. Gréhaigne, J-F., Willian, N., & Godbout, P. (2005). Tactical decision learning model and students' practices. *Physical Education and Sport Pedagogy, 10,* 260.

Structures Embedded in Be Active Kids!

This emphasis on embedded structures essential to curricular coherence also is reflected in the Be Active Kids! curriculum. The Be Active Kids! curriculum was designed at the

University of Maryland in the United States to examine changes in children's conceptual learning associated with physical activity and fitness content. Research has led to 5 years of United States National Institutes of Health funding to design, implement, evaluate, and disseminate a conceptually oriented, health-related fitness curriculum for elementary children.

This curriculum is funded through science education and is designed to reflect United States National Content Standards in health-related science education and physical education. The purpose of the curriculum is to increase children's knowledge of health-related science, which we typically describe in physical education as fitness content, and to enhance their interest in science and science careers. The lessons reflect a constructivist focus in which the goal is to engage students physically and cognitively in active, in-depth learning of a few key cognitive concepts. The curriculum consists of 3 units, "Dr. Love's Healthy Heart," with a focus on cardiovascular endurance; "Mickey's Mighty Muscles," lessons highlighting muscular strength and endurance; and "Flex Coolbody's Fitness Club" with a curricular emphasis on flexibility and nutrition. Lessons are sequenced across units and grades. The curriculum consists of 10 lessons in each unit at each grade for a total of 90 lessons. A goal of the curriculum is to engage students meaningfully in the scientific inquiry process in physical education. Specifically, students conduct experiments to examine health related concepts and principles and analyze the effects of exercise on their bodies.

This is <u>not</u> a sit in the classroom program, however; instead, children participate in moderate to vigorous physical activity in every lesson as they engage in the scientific inquiry process. Specifically, one of our objectives is to provide evidence of student learning, defined as conceptual change within physically active school settings. This curriculum was designed with specific embedded structures to assist teachers to provide a stable, coherent environment focused on the explicit relationships among the content, context, and children's lived experiences.

At the University of Maryland, we have evaluated the Be Active Kids! curriculum as an experimental intervention in a randomized clinical trial involving 30 elementary schools, 15 of which were randomly assigned to the experimental group, teaching the Be Active Kids! curriculum, and 15 to the control group which taught the school district's traditional, multi-activity elementary curriculum. The intervention was conducted with 3^{rd} - 5^{th} grade (8-11 year old) students and physical education teachers in a large urban public school district in which approximately 77% of the students were African American.

One explicit structure used in the Be Active Kids! curriculum is validated, standardized knowledge testing. This structure assists students, teachers, and school administrators to evaluate the effectiveness of the curriculum to enhance student learning. For example, standardized testing of student knowledge growth in the "Dr. Love's Healthy Heart" unit led to the adoption of the curriculum in all 150 elementary schools in this large urban school district.

In Figure 5, the graph of students' knowledge growth at the conclusion of the "Dr Love's Healthy Heart" unit reflects gain scores adjusted using regression residuals. The light-colored bars represent data from the 15 control schools and the darker bars represent the students' knowledge growth in the 15 experimental schools. Schools participating in the experimental group registered statistically significant gains in students' health-related science knowledge. In all three grades students' knowledge grew significantly from pre to post test in this unit when compared to children in control group schools who participated in regular, multi-activity physical education.

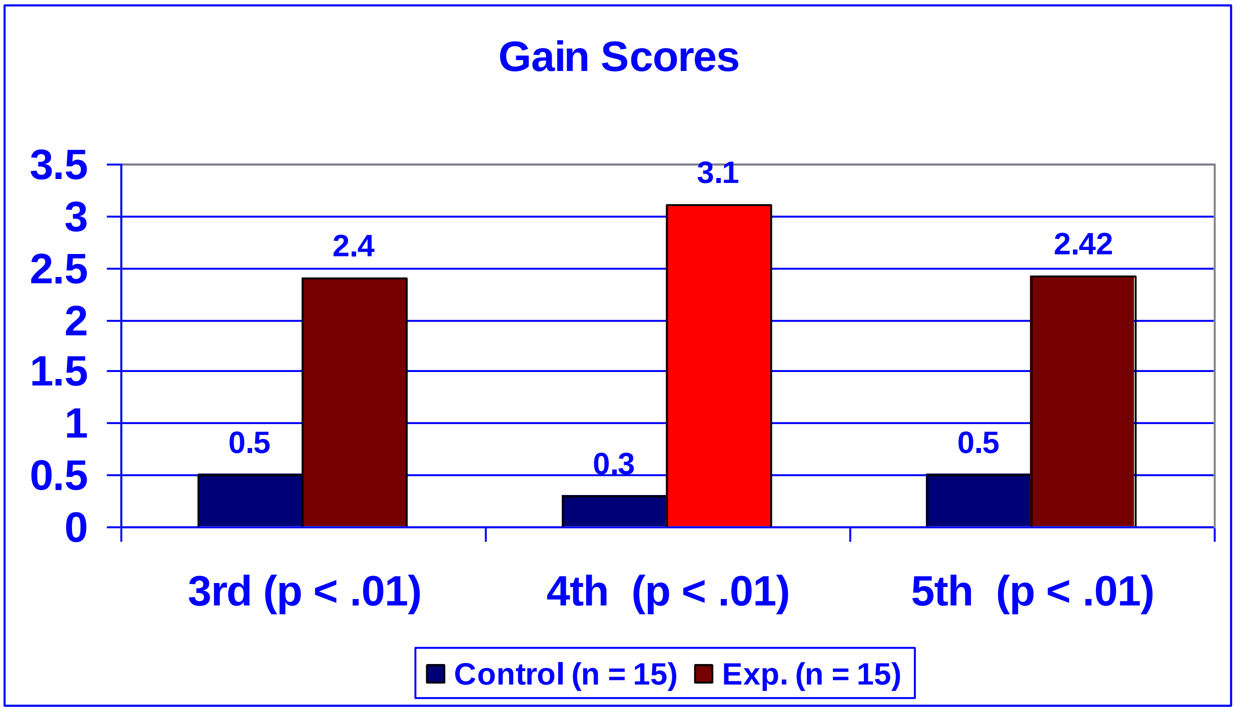
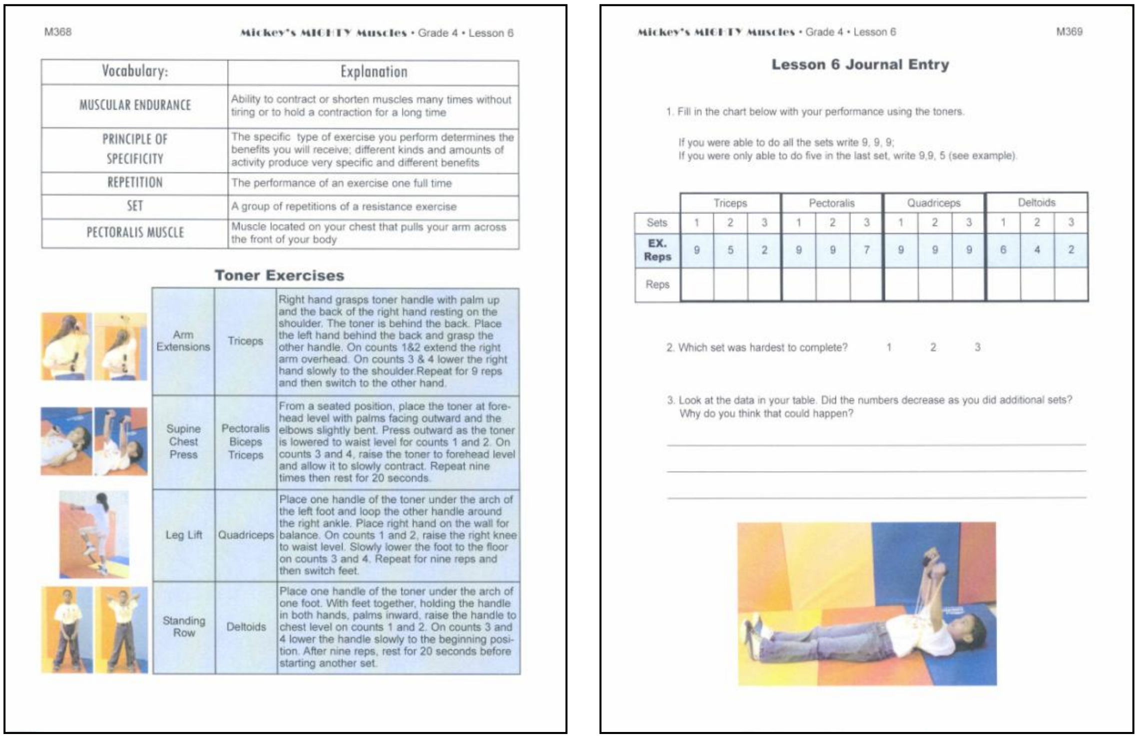


Figure 5. Residual gain scores for Be Active Kids intervention: "Dr. Love's Healthy Heart" unit

The Be Active Kids! curriculum, uses other embedded structures, as well, to reinforce the content concepts and provide a more formal assessment of student learning. For example, each student participating in the Be Active Kids! curriculum receives a 70 page student *Science Journal*. The student *Science Journals*, contain a two page entry for each lesson. All journal entries are similar in structure to the example in Figure 6 from the "Mickey's Mighty Muscles" unit, Grade 4, Lesson 6. The left side of the page provides tables and reference information that the children in the role of "junior scientists" use to analyze and respond to questions presented on the right side of the entry. As students complete a short journal entry for each of the 90 lessons across three grades, they begin to focus cognitively on the lesson content and learn to use their experiential knowledge to respond in writing to questions about the effects of exercise on their bodies. Further, both teachers and students have an opportunity to check for understanding and intervene to assist students to understand and use fitness concepts more effectively.



M368 Mickey's MIGHTY Muscles • Grade 4 • Lesson 6

Vocabulary:	Explanation
MUSCULAR ENDURANCE	Ability to contract or shorten muscles many times without tiring or to hold a contraction for a long time
PRINCIPLE OF SPECIFICITY	The specific type of exercise you perform determines the benefits you will receive; different kinds and amounts of activity produce very specific and different benefits
REPETITION	The performance of an exercise one full time
SET	A group of repetitions of a resistance exercise
PECTORALIS MUSCLE	Muscle located on your chest that pulls your arm across the front of your body

Toner Exercises

Arm Extensions	Triceps	Right hand grasps toner handle with palm up and the back of the right hand resting on the shoulder. The toner is behind the back. Place the left hand behind the back and grasp the other handle. On counts 1&2 extend the right arm overhead. On counts 3 & 4 lower the right hand slowly to the shoulder.Repeat for 9 reps and then switch to the other hand.
Supine Chest Press	Pectoralis Biceps Triceps	From a seated position, place the toner at fore-head level with palms facing outward and the elbows slightly bent. Press outward as the toner is lowered to waist level for counts 1 and 2. On counts 3 and 4, raise the toner to forehead level and allow it to slowly contract. Repeat nine times then rest for 20 seconds.
Leg Lift	Quadriceps	Place one handle of the toner under the arch of the left foot and loop the other handle around the right ankle. Place right hand on the wall for balance. On counts 1 and 2, raise the right knee to waist level. Slowly lower the foot to the floor on counts 3 and 4. Repeat for nine reps and then switch feet.
Standing Row	Deltoids	Place one handle of the toner under the arch of one foot. With feet together, holding the handle in both hands, palms inward, raise the handle to chest level on counts 1 and 2. On counts 3 and 4 lower the handle slowly to the beginning posi-tion. After nine reps, rest for 20 seconds before starting another set.

Mickey's MIGHTY Muscles • Grade 4 • Lesson 6 M369

Lesson 6 Journal Entry

1. Fill in the chart below with your performance using the toners.

If you were able to do all the sets write 9, 9, 9;
If you were only able to do five in the last set, write 9,9, 5 (see example).

	Triceps			Pectoralis			Quadriceps			Deltoids		
Sets	1	2	3	1	2	3	1	2	3	1	2	3
EX. Reps	9	5	2	9	9	7	9	9	9	6	4	2
Reps												

2. Which set was hardest to complete? 1 2 3

3. Look at the data in your table. Did the numbers decrease as you did additional sets? Why do you think that could happen?

Figure 6: Be Active Kids!, Student *Science Journal* entry for “Mickey’s Mighty Muscles” unit, Grade 4; Lesson 6.

A third type of curricular structure in the Be Active Kids! curriculum assists students to connect the fitness concepts to their lives by inviting parents to engage with their children in an evening event, entitled “Family Science Activity Night.” In this event, the children lead family members through a series of “experiments” to assist them to experience and understand the concepts from both a child-centered and adult-oriented family health perspective. Currently, Family Science Activity Night consists of nine experiments that reflect the three curriculum units and five fitness components. Upon arriving at the event, families receive a lab notebook in which they can collect data about family members’ performances in the experiments and analyze the effects of exercise on pulse rate, muscular endurance, and caloric balance, for example. Family Science Activity Nights have been very successful in the urban schools in our study, inviting

African American and Hispanic families back to school to engage in learning about the benefits of physical activity for health.

Strategic Knowledge

The second curricular component that facilitates students' conceptual change and enhances their perceptions of coherence is the use of strategic knowledge within the curriculum. Strategic knowledge is explicitly taught and learned as domain-general and domain specific strategies that foster and *accelerate* student learning. Strategies refer to mental operations or techniques used to solve problems or to enhance performance (Murphy & Alexander, 2006). Strategies can be categorized as domain general or domain specific. Domain general strategies assist students to monitor and self-regulate their own performances. Some, such as metacognitive strategies, assist students to understand and remember (e.g., Lidor, 2004; Pressley, Goodchild, Fleet, Zajchowski, & Evans, 1989), focus on the content and motivate themselves for optimal learning (Winne, 1995), or capture and organize information (Alexander & Murphy, 1998). Many content problems students face in current conceptualizations of physical education curriculum require them to think deeply and meaningfully to construct a solution.

Domain general strategies are applicable <u>across</u> content topics or areas and assist students to monitor the metacognitive processes used to solve problems. For example, they might be taught to classify the type of problem and match the solution strategy with the problem-type. Additionally, they can be encouraged to ask themselves questions to focus and assess the solution process, such as "Will my plan solve this problem?" Finally, once a solution is proposed, metacognitive strategies can be used to assess if the solution, in fact, solves the given problem. Metacognitive domain-general strategies are critical to student ownership and autonomy. They facilitate conceptual change within a range of content topics, and assist students to achieve success and acknowledge a sense of curricular coherence

Domain-specific strategies facilitate problem solution within specific content areas or topics (Murphy & Alexander, 2006). The effective use of domain-specific strategies requires specialized understanding of the types of decisions and problems that are most likely to be found within the content and a repertoire of solutions to fit the problem. Student performances benefit from repeated domain-specific strategy practice situated within authentic contexts. Students benefit from expert mentoring to make subtle relationships more explicit and to facilitate transfer to other similar situations or contexts. For example, game tactics could be described as domain-specific strategies used to think about, make decisions, and solve problems in game environments (Dodds, Griffin, & Placek, 2001; Griffin & Placek, 2001). Offensive game players, for example, may be challenged to solve a particularly well executed zone defense, while students in a fitness curriculum may consider different intensity levels and activity types needed to achieve caloric balance. Murphy and Alexander (2006) emphasize that, "Students who do not possess a sufficient repertoire of general and domain-specific strategies are doomed to wander through [tasks] in an aimless and precarious manner" (p. 92).

Teachers who teach for domain-general and domain-specific strategic learning demonstrate, model, and explicitly teach metacognitive strategies, facilitating decision making and problem solving within contexts that are interesting and meaningful to students. Strategic teaching and learning is *effortful* and requires teachers to infuse, prompt, scaffold, and reward students for thinking strategically. Likewise, students need curricula with specific lessons focused on assisting them to monitor and self-regulate their thinking and use of domain-general and specific strategies (Griffin, Dodds, Placek, & Tremino, 2001; Winne, 1995). For example, they need to adopt a "self-as-agent" strategy, setting relevant goals, personalizing the process to their needs and interests, self-regulating their thinking and strategy use, and self-assessing their progress and performance. Teaching students to think strategically assists them to better understand their own learning and to persist when confronted with difficult or challenging problems (Murphy & Alexander, 2006). Cognitive psychologists (e.g., Alexander, 2006; Alexander & Judy, 1988) are contributing important insights to our understanding of student learning and are confirming the role of metacognitive and strategic processes in knowledge restructuring necessary for student progress in cognitive decision making and problem solving resulting in enhanced physical performances.

Strategy Use in Game Play

Several research studies have been conducted to examine the nature, origin, and sources of knowledge in physical education and sport settings. These researchers emphasize both the value of domain-general strategies of self-monitoring and domain specific tactics such as those found in complex approaches to games.

We have been aware for a number of years that effective game players, for example, need domain-specific knowledge of game tactics to make instantaneous and anticipatory decisions in a timely and effective way to contribute to team success. Turner and Martinek (1995), for example, argue that game players must understand the overall dynamics of game play, including the conditional knowledge of when and where to use their techniques in the context of the game situation. Further, game participation is contingent on making appropriate decisions that physical education teachers are in a position to facilitate through an articulation of critical, interconnected offensive and defensive tactical (domain-specific) concepts that facilitate game performance and students' perceptions of coherence.

Gréhaigne and his colleagues (e.g., Gréhaigne & Godbout, 1995; Gréhaigne, Godbout, & Bouthier, 2001; Gréhaigne et al., 2005a; Gréhaigne et al., 2005b) describe game play within the Tactical Decision Learning Model (See Figure 7) as a complex process in which the students' role is to observe and analyze the development and consequences of tactical solutions within complex game play. Further, they are encouraged to construct multiple and flexible mental solutions of the tactical problems leading to a repertoire of motor skill solutions (Gréhaigne et al., 2005b). Although students' understanding of tactical game play may gradually accumulate as new knowledge is added to prior understandings, for many girls and boys in the United States, for example, who have participated in sport with little thought to the tactical nature of the game, major restructuring or knowledge transformation is required to conceptualize games as tactical problems.

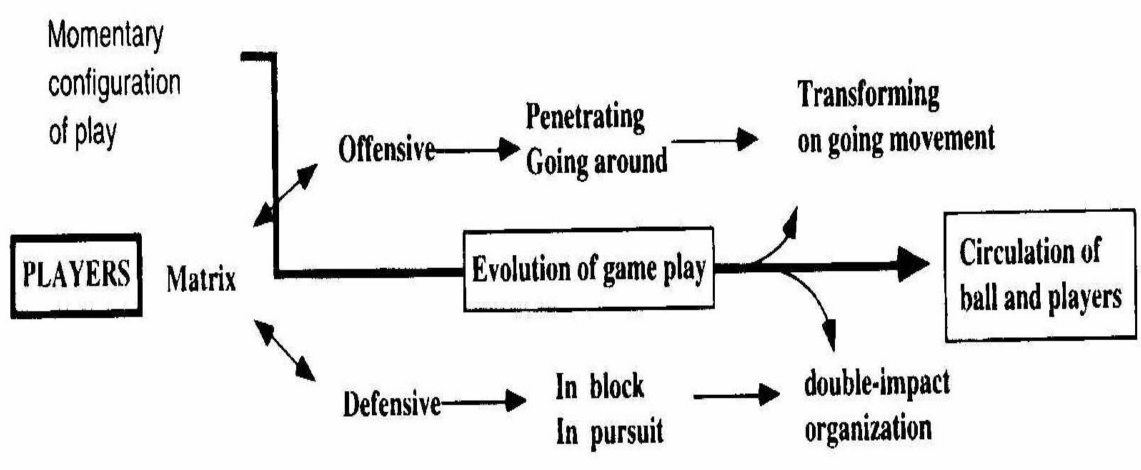


Figure 2. Modelling of general movement in team sports

Figure 7. Gréhaigne, J-F., Willian, N., & Godbout, P. (2005). Tactical decision learning model and students' practices. *Physical Education and Sport Pedagogy, 10,* 258.

Certainly, implementing Gréhaigne's play configurations and modeling based on defensive and offensive matrices brings a welcome focus on cognitive conceptualization as a prerequisite to tactical success. Gréhaigne urges physical educators to look "more closely at the internal logic of every team sport as a coherent system of representations in the form of matrices that provide a frame of reference for the multiple coordinated movements that occur between and among offensive and defensive players engaged in tactical solutions and responses within these coherent game structures" (Gréhaigne et al., 2005b, p. 258). Gréhaigne and his colleagues provide excellent examples of the use of domain specific strategies within complex games-oriented physical education content.

Rather than a series of isolated skills practiced in stationary positions, game matrices require cognitive analysis and domain-specific strategic thinking that assist students to view the texture of games as a holistic and coherent endeavor. The use of matrices results in proposed physical solutions leading directly to consequences linked coherently within the tactical complexity of the game. Thus, within this format conceptual change for some students occurs as a gradual and easy process in which their increasing ability to observe and respond takes on a coherent relevance that is connected directly to the context and to interesting sport experiences. For other students, this accumulation phase of conceptual change may be punctuated by weak or radical knowledge restructuring that requires a major reconceptualization of their role in team play, maturing from an ego-centered "run and shoot" perspective to an interrelated team-oriented "think, support, and respond" environment. In complex, content topics, such as advanced team tactics, major or radical restructuring is essential for some students to progress toward advanced conceptualizations. It often requires students to acknowledge that their current solutions are not effective, leading to a desire to reconceptualize their understandings and to willingly engage in an effortful process to change their conceptual understanding of game and team play.

Strategy Use in the Be Active Kids!Curriculum

Like the Teaching Games for Understanding model, the Be Active Kids! curriculum uses domain-general and domain-specific strategies to engage students in the health-related science content. In Be Active Kids!, the scientific inquiry process is employed as a domain-general structure to provide reoccurring opportunities for students to examine the personal effects of exercise on their bodies. In this curriculum, children work cooperatively within the scientific process, predicting, observing, recording, and analyzing data, drawing conclusions, and communicating their findings to others, in a procedure that resembles the one used by scientists to examine phenomena and create new understandings. A primary objective is to engage students in the domain-general scientific inquiry process in physical education. Students apply the inquiry process to conduct domain-specific experiments examining health-related science concepts and to analyze the effects of exercise on their bodies.

One domain general strategy used in the Be Active Kids! curriculum is a redundant learning cycle strategy, called the 5Es, used frequently in science education. Within this strategy, each "E" is designated as an explicit segment of the lesson and used to reinforce elements of the scientific inquiry process. The lesson is introduced through the warm-up or *Engagement* segment that provides both physical and cognitive activities enhancing students' personal interest in the topic, presenting a grade-appropriate problem, and challenging them to rely on past and present experiences necessary to solve the problem. During the *Exploration* segment of the lesson, students again are physically active as they observe, monitor, and assess the effects of physical activity on their bodies, collect data documenting their own physiological changes, and work cooperatively with others who are experiences similar feelings. Unlike traditional lessons in which the teacher directs the activity *telling* students the one correct way to perform, the constructivist-oriented teachers in the Be Active Kids! curriculum assist students to use cooperative learning strategies to *Explain* their observations, compare these results to their predictions, and propose a rationale for their findings. During the *Elaboration* segment, teachers assist students to apply this information outside of physical education, connecting it meaningfully to topics discussed in other school subjects and at home as they participate in physical activity with their families. In the *Evaluation* segment of the lesson, students respond to teacher-posed questions, compare their finding to those presented in tables and charts, reflect on their results, and write responses to questions posed in their student *Science Journals*.

Embedded within the "Es" in the teachers' manual are concrete physical activity tasks and sample teacher-student dialogues designed to model pedagogical processes for physical educators that enrich student knowledge construction. Emphasizing the natural content connections between health-related physical education and life sciences connects physical education in a meaningful way to the school's academic mission. Additionally, elaborating the biological commonalities between and among students of diverse backgrounds facilitates a social and contextual connectedness that enhances the relevance and meaning of the physical education content in students' lives.

Curricular Coherence in Physical Education

Designing and teaching to emphasize connections between and among content topics and between physical education content and school and life experiences, are essential for the presentation of a physical education curriculum that *students* perceive is coherent. Physical educators take small, but important, steps in this direction when they assist students to create visible linkages between the content that they are learning and their everyday experiences. In the Be Active Kids! curriculum, for example, students become more interested in physical activity when they acknowledge its role in their health and the health of their families. Not only do they discuss the value of the current topic for their loved ones, they bring their families to school and, in turn, take the curriculum home through daily homework challenges in which they are encouraged to teach a family member the concepts they learned that day in physical education. For example, children may explain to a sibling or grandparent how to take their pulse, perform exercises using canned foods as hand weights, or calculate the time they can spend exercising to counter a sugar-laden after school snack. Further, using a Self-as-Agent perspective, home and in-class tasks are performed without the teacher's or an adult's direct supervision or coaxing. Instead, children are taught to monitor their progress and adjust the intensity or duration of physical activity in response to scientific principles they have learned while conducing experiments in physical education.

The progressive sequencing within the 90 lesson curriculum builds student knowledge of concepts and understandings, leading to conceptual change. The relationships are made explicit and are reinforced predictably across lessons, units, and grade levels. The reinforcing and stabilizing nature of the 5 Es provide consistency and conceptual strength so that both students and teachers are directly aware of the growth in their understanding and performance of content and cognitive, physical, social, and emotional relationships associated with a coherent curriculum. Additionally, the curricular focus on lesson-spanning principles such as overload, specificity, and progression of exercise leave a lasting impression embedded within the social and situational contexts of the school and family. Likewise, the opportunity to experience, monitor, and control the effects of exercise on their body provides a sense of ownership that is distinctly personal and transforming. Within this environment, students seek opportunities to make sense of these concepts that have here-to-fore been relegated to the external world of “science,” acknowledging their worth as they elevate the value of physical education as viable content.

Curricular coherence appears to be an essential element in program effectiveness within constructivist approaches to teaching and learning. A pervasive theme throughout is the focus on the value of relationships and the search for embedded linkages between students’ experiences, content, and context. Students and teacher partner to identify personal, situational, contextual, and conceptual connections that form a web of experiences. Together these connections promote cumulative knowledge growth and transformation associated with deepening understandings and enhanced performances essential for student engagement now and for a lifetime.

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