Theoretical Perspectives on Knowledge and Learning and a Student Teacher’s Pedagogical Content Knowledge of Dividing and Sequencing Subject Matter

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This study describes and interprets (a) a student teacher’s decisions about task content and content progression across an elementary and high school sport unit and (b) those aspects of his pedagogical content knowledge that he used to explain and justify his decisions. The student teacher’s pedagogical content knowledge of dividing and sequencing subject matter can be summarized briefly: first, tell about the biomechanically efficient body position, and second, play games. Both the student teacher’s decisions and pedagogical content knowledge and guidelines for content progression that are in the curriculum literature are interpreted by using broad theoretical perspectives of knowledge and learning that pervade educational thought. Taken-for-granted perspectives that knowledge and learning are molecular are questioned, and the potential of more holistic, nonlinear perspectives is considered.

Since the 1970s, a rapidly growing number of studies have focused on teacher cognition (Clark & Peterson, 1986). The purposes of these studies are (a) to describe such cognitions as teachers’ thinking, implicit theories, decision making, images, and subject matter knowledge and (b) to uncover how cognition connects with practice. For example, compared to experts, novices—who have less elaborate, less connected schemata—had problems giving unplanned explanations and connecting concepts within and across lessons (Borko & Livingston, 1989). Teachers who were more knowledgeable about the subject matter modified textbook content and asked questions that required synthesis, whereas teachers who were less knowledgeable closely followed the textbook and asked recall questions (Hashweh, 1987). Research on links between cognition and action aims, in part, to explain teachers’ actions in regard to the role played by cognition.

In this study I first examine a student teacher’s decisions about task content and progression (i.e., how he divided and sequenced content) across an elementary and high school sport unit. I then describe those aspects of his pedagogical content knowledge that he used to explain and justify his decisions. Following other research on teachers’ cognition, my first goal is to illustrate how aspects

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of pedagogical content knowledge can contribute to explanations for teachers’
decisions and other actions. (As such this study does not look at the teacher
education process nor at the sources for student teacher conceptions—both im-
portant topics for further analysis, but beyond the scope of this paper.)

Ideally, the way a teacher divides and sequences subject matter should be
in accord with the nature of knowledge in the discipline and how pupils learn
and develop that subject matter. The second goal of the study, in turn, is to
interpret the student teacher’s decisions and pedagogical content knowledge using
broad theoretical perspectives of knowledge and learning and to raise issues
and open debate about theoretical perspectives that underlie task content and
progression in physical education.

The identification of problems and the clarification of issues in terms of
theory are potential contributions of interpretive research to the scholarly literature
(Peshkin, 1993). Studies with a single participant also afford the opportunity to
gain insight into the connection between conceptions and actions by exploring
these conceptions in depth. However, interpretive, single-participant studies, such
as this, are ill-suited for generalizing to populations, in this case student teachers
(Firestone, 1993). Although readers may recognize commonalities between this
case and their own settings and may in this way generalize findings, this study
was not designed to illustrate typicality.

**Research on Content Progression in Physical Education**

Deciding what content to teach and how to sequence that content is a
central task of teaching, yet the scholarly literature in physical education indicates
little about teachers’ progressions or their rationales for their choices. Rink (1983)
and Gusthart (1985) reported that teachers’ use of informing, refining, extending,
and applying tasks varied across teachers. Petersen (1991) found that teachers’
content progressions were influenced by children’s affective responses such as
enjoyment, boredom, and interest and by children’s ability to manage the social
aspects of the activity. Teachers’ progressions were also strongly influenced by
a skill theme, traditional sports and games, or movement education model. Similar
to the student teacher in this study, one participant in the Petersen (1991) study
used a traditional sports and games model. For this participant the game was
paramount and, although he recognized children’s individual differences, the
teacher maintained the same progression for all children because he thought class
control was more important.

There is also little research on the effects of progression on student learning
in physical education. One notable exception is the work of Rink, French, Werner,
Lynn, and Mays (1992) and French et al. (1991). They reported a positive effect
of an intraskill task progression for improving performance of volleyball skills;
practicing the final test was not effective. Madden and McGown (1989) found
no significant differences between an intraskill progression and the “inner game
method”—a more holistic progression in which subjects performed the whole
skill but changed their focus of attention to certain elements of the skill. With
both progressions, subjects made significant improvement in performance. These
studies suggest that using a progression of tasks facilitates learning, but it is too
early to draw conclusions about the shape that progression should take.
Theoretical Perspectives Underlying Progression

Despite the dearth of research, reviews indicate that the physical education literature has long promoted guidelines for progressions aimed at facilitating learning (Barrett, 1985; Petersen, 1991). I propose, in this next section, that such guidelines are rooted in broad theoretical perspectives of knowledge and learning that pervade educational thought. These perspectives can be part of educators’ implicit conceptions that influence their practice (Berlak & Berlak, 1981; Clark, 1988; Shepard, 1991). I begin by describing the research of Berlak and Berlak (1981), which served as the primary theoretical framework for the interpretations in this paper, and then I describe several guidelines for progression in terms of the Berlak and Berlak research.

Learning Is Holistic Versus Learning Is Molecular

In an attempt to capture the complexity of open education programs, Berlak and Berlak (1981) identified 16 dilemmas of practice. These dilemmas included, for example, knowledge is personal versus knowledge is public, learning is social versus learning is individual, and knowledge as given versus knowledge as problematic. Teachers resolved these dilemmas in different ways depending on the situation, but also had predominant modes of resolution.

Berlak and Berlak (1981) used the 16 dilemmas as frameworks both to describe the complexity of teachers’ actions and to analyze aims of schooling. They showed how predominant modes of resolving dilemmas represent taken-for-granted ways of thinking about teaching and learning that reside in the larger society and were, through teachers’ actions, instantiated in school experiences.

One dilemma, learning is holistic versus learning is molecular, underlies teachers’ decisions about dividing and sequencing content:

From the molecular perspective learning is the taking in and accumulation of discrete parts or pieces; when one has mastered the pieces one knows the whole. Retention of knowledge from this perspective depends on introduction of parts properly divided, sequenced and reinforced. From the holistic perspective learning is the active construction of meaning by persons, the understanding of a whole, a process that is in some essential way different from learning a series of parts or elements. People remember better what has been learned because it has “meaning.” (Berlak & Berlak, 1981, p. 151)

Modes of resolving the dilemma of learning as molecular versus holistic are evident in the guidelines for progression in the physical education literature discussed next.

Linear and Hierarchical Models

Linear and hierarchical models for progression represent a more molecular perspective on knowing and learning in physical education. These models have their roots (a) in Gagne’s (1977) idea of vertical transfer, in which simple skills are learned first to serve as the basis for more complex skills, and (b) in behavioral psychology, which suggests that content should be divided into small parts to be reinforced and mastered in a hierarchical chain (Peterson, Clark, & Dickson, 1990; Resnick & Klopfer, 1989; Rink, 1993; Shepard, 1991).
One such example in physical education would be the progression resulting from a "hierarchical" or "procedural" task analysis used to identify and sequence the subskills required for students to achieve an instructional goal (Siedentop, Mand, & Taggart, 1986). Another is the skill perspective model for analyzing movement identified by Barrett (1985) in her historical research on elementary physical education. This model posits a hierarchical progression from fundamental motor skill to specialized motor skill, to games, dance, gymnastics and aquatics. Barrett (1985) writes:

This model recognizes that fundamental and specialized motor skills can be identified in all areas of the curriculum and that specialized motor skills are dependent upon the development of fundamental motor skills if they are to be applied effectively to the more advanced environments. (p. 13)

The distinction between the foundational fundamental skill and the specialized skill rests, in part, on the addition of a specific purpose for the movement as it is performed in a particular game, dance, gymnastics, or aquatic situation (Barrett, 1985, p. 15).

The skill perspective progression is molecular in that the context for a skill and, in turn, the individual's purpose is added onto the fundamental skill to become the more advanced specialized skill. Likewise, the decision-making and higher order thinking skills inherent in games and game-like activities are taught after the decontextualized fundamental skills.

Petersen's (1991) review and categorization of recommended practices revealed similar molecular guidelines in the curriculum, motor learning, and motor development literature. For example, she reported that the guideline, "Teach the mature pattern of fundamental skills before teaching 'specialized sport skills,' " is commonly recommended by scholars.

**Spiral and Less Linear Models**

Barrett (1985) also identified a spiral model for content analysis. Derived from the work of Laban, part of the recommended progression is for teachers to spiral back to revisit concepts. Mastery of basic concepts is not expected before more complex, contextual ideas, including relationship concepts (which often emphasize the context of the movement), are introduced. The fundamental unit of knowledge is the movement concept, which is, in Barrett's (1985) terms, "a group of skills organized around a common idea" (p. 18). These movement concepts represent a more holistic perspective on knowledge components than the more tightly defined subskills that are the components of a behaviorist task analysis.

Other less linear models include Rink's (1993) stages of games skills development and games for understanding as described by Thorpe, Bunker, and Almond (1986). Rink proposes four stages for guiding progression: (a) concern for control over an object and individual skills, (b) combinations of skills and cooperative situations, (c) basic strategies, and (d) more complex strategies and the full game. Although she uses the term stage, she does not describe a step-like, mastery progression:

It is not possible to master a stage. Minimal levels of competency must be obtained before students can be successful with the experiences at a
higher level, but even varsity basketball practices include experiences at all stages. (Rink, 1993, p. 253)

Games for understanding is more holistic still, in that the recommended progression is explicit in its inclusion of higher-order thinking skills right from the start. The progression begins with components of the basic game strategy with skills taught as the need arises.

Matrix Models

Although some physical education models are more holistic than others, none are as holistic as the matrix models. Doll (1989) contends that a unit of subject matter should be conceived as a "multifaceted matrix" (p. 251) and the focus should be on exploring the connections among components of the matrix.

Doll bases his proposal on postmodern, post-Newtonian views of reality and learning that emerged with quantum physics and chaos theory. In contrast to the modern view of learning as a linear accumulation of discrete, controllable, molecular units, Doll suggests that curriculum theorists regard learning as a transformative (nonlinear), holistic process with errors considered necessary fuel for development. Similarly, Ennis (1992a) argues for basing curriculum work on the perspective put forth by chaos and dynamical systems theories that learning is a complex, holistic, interdependent process. She suggests educators recognize and plan for moments when the learning process becomes unstable, and knowledge and values restructure.

In extending the theoretical support for Doll’s curriculum as a matrix, Prawat (1992) contends that neither vertical nor horizontal transfer, both molecular in conception, have lived up to their promise as bases for curriculum planning. He suggests that a more productive way to view transfer is as a function of connectedness as constructivist research proposes:

Instead of emphasizing the importance of decontextualization or disconnection in transfer, as does the traditional model, this alternative perspective stresses the importance of knowledge connectedness—the assumption being that knowledge is more accessible, and thus more likely to be transferred to novel situations, when it is a central or integral part of one’s cognitive structure. (Prawat, 1992, p. 375)

Based on a constructivist view of transfer, Prawat proposes that progression should be more like a zigzag with the focus on learning well and deeply a "network of big ideas" (p. 387).

Postmodern, constructivist, and dynamical systems theories will never tell a teacher exactly how to structure and sequence tasks for, say, a volleyball unit. Nevertheless, these theories offer broad holistic perspectives on the nature of knowledge and learning that can guide content progression in the same way the more molecular behavioristic and prescriptive theories have guided educational thinking for years. Together, these theoretical perspectives offer a basis for interpreting teachers’ decisions about task content and progression.

Methods

This case study was one of five case studies in a larger project examining student teachers’ pedagogical content knowledge of and decisions about task
content and progression. Student teachers, from the small pool of student teachers assigned within a reasonable traveling distance to me, were asked to participate if he or she was teaching an entire sport unit at both the elementary and high school and if an assistant and I could schedule observations of every lesson of at least one class for each unit.

Because the goal was to examine pedagogical content knowledge and content decisions, but not student teaching per se or the effects of teacher education, I chose to report the findings by case studies rather than themes that crossed the five student teachers. The case reported in this paper was selected from the five cases because it illustrated links between knowledge and action well. Moreover, it raised, for me, compelling questions and issues about content selection and progression and about broader, often taken-for-granted, theoretical perspectives on knowledge and learning.

Field Observations and Interviews

The student teacher, Ted, was observed by myself or a trained assistant as Ted taught each lesson of a nine-lesson volleyball unit for one third-grade and one fourth-grade class in a rural K–8 school. We also observed Ted teach a 5-week, two to three lesson per week badminton unit for 11th and 12th grade in a rural high school. We recorded the content, organization, and progression of each task; the student teacher’s explanations, demonstrations, and feedback; and, to the extent possible, the pupils’ verbal and motor responses. Available lesson plans and handouts were collected.

Ted was interviewed informally each day by myself or my assistant. I told my assistant what questions to ask. We asked Ted to discuss his task content, organization, and progression decisions and to explain why he made the decisions he made. We typed his responses on a laptop computer.1 When Ted followed the task content, organization, or progression of his cooperating teacher, we asked him to comment on his cooperating teacher’s ideas and to say what he would do differently if he was the sole teacher.

At the end of student teaching I interviewed Ted formally. This semistructured interview was tape-recorded and transcribed. I asked Ted to discuss his background in physical education and athletics, his personal history as a learner, how he thought children learned, his task content, organization, and progression, factors that influenced his decisions, his opinion of the school curriculum, and what, if anything, he would do differently if he taught a similar unit.

Neither my assistant nor I had any relationship to Ted prior to the start of the study and neither supervised his student teaching. I assured Ted that my interest was in his thinking and that no reports of the study would be available until well after he graduated. To check on the accuracy of the interview data, the assistant was told to ask Ted about some of the topics that Ted and I had discussed in previous interviews.

Data Analysis and Member Checks

I analyzed data throughout field work using the techniques of constant comparison (Glaser & Strauss, 1967) and analytic induction (Goetz & LeCompte, 1984). The assistant was not involved in the analysis or interpretation of the data. The analysis stimulated additional interview questions and a search for
discrepant cases. In addition, the on-going analysis enabled me to summarize, periodically, the emerging findings to Ted during interviews. He was asked if the descriptions of his content, organization, and progression and the analysis were accurate and was encouraged to modify and expand his responses.

Because the second goal of the study was to interpret the student teacher’s decisions and pedagogical content knowledge using theoretical perspectives on knowledge and learning and raise issues about such perspectives, I kept a research journal to record my emerging analysis and to elicit a deeper understanding and critique of theoretical literature as it related to practice. Interpretive research is, at heart, a subjective telling of what a researcher learned during the course of the study. A researcher’s understanding and interpretation of the scholarly literature is as much a part of this story as is her or his understanding of the setting. Thus, in the research journal I engaged in a dialogue with the literature on the nature of knowledge, progression, and learning and the setting I was observing. I explored possible applications of the literature, implications of the student teacher’s actions and pedagogical content knowledge, and alternative ways to divide and sequence subject matter.

At the end of field work all data and the research journal were reviewed again and summarized. The interpretation of the student teacher’s decisions and pedagogical content knowledge is presented in the first section of the findings. The dialogue with the scholarly literature on knowledge and learning and the setting, although evident throughout the paper, is the focus of the second section.

**Findings**

**Overview of Ted’s Content Decisions**

_Volleyball With Third and Fourth Grades._ There were 16 fourth graders and 24 third graders who attended this rural, Midwest K–8 school. A typical lesson had the children warm up by swinging their arms while jogging and hopping, do one or two tasks to practice the bump from one bounce or the underhand serve, and then play a full-class (12 per side for Grade 3 and 8 per side for Grade 4), one-bounce, bump-only competitive game over a net about 4 feet high. Serving was initially from the front row and then the back row, but never from behind the end line. Across the nine-lesson unit Ted taught the bump, underhand serve, and modified volleyball and used 3 informing tasks, 2 refining tasks, 1 extension task, and 18 application tasks (Rink, 1993). Unit tasks are as follows:

**Lesson 1**
1. Bump from one bounce, teacher tosses to one child at a time.
2. Bump competition, same as Task 1 with points for accuracy.
3. Practice rotating without playing.
4. Full-class game, one-bounce bumps only, 4-foot net.

**Lesson 2**
5. Bump competition, same as Task 2.
6. Full-class game, same as Task 4.
Lesson 3
7. Bump competition, same as Task 2.
8. Full-class game, same as Task 4.

Lesson 4
(After university supervisor visit)
9. Consecutive bumps, one-bounce, four–six children in circle.
10. Consecutive bumps competition, same as Task 9 with competition among groups.
11. Full-class game, same as Task 4.

Lesson 5
12. Consecutive bumps competition, same as Task 10.
13. Full-class game, same as Task 4.
14. Full-class game with beach ball.

Lesson 6
15. Consecutive bumps competition, same as Task 10.
16. Underhand serve, four lines.
17. Refining task underhand serve, four lines.
18. Refining task underhand serve, four lines.
19. Full-class game, same as Task 4 adding underhand serve.

Lesson 7
20. Consecutive bumps competition, same as Task 10.
21. Underhand serve, four lines, same as Task 16.
22. Full-class game, same as Task 4 adding underhand serve.

Lesson 8
23. Full-class game, same as Task 4 adding underhand serve.

Lesson 9
24. Consecutive bumps competition, one-bounce, full class in one circle, competing against school record.
25. Full-class game, same as Task 4 adding underhand serve.

To teach the bump, Ted demonstrated and explained the mature pattern, had the children try the bump action without the ball, and then bounced a ball onto the outstretched arms of one child at a time. After one trial the children competed in three lines with Ted still tossing to one child at a time. Children then played the full-class game. The competitive bump task and game were the tasks for the next two lessons. Following a visit from Ted’s university supervisor, who spoke to him about the low number of trials per child, Ted used one extension task in which four to six children in a circle tried to bump continuously with one bounce. After a few trials Ted had the children try to better the class record of consecutive bumps.

Ted taught the underhand serve by explaining and demonstrating the mature pattern. The children, in four lines, practiced three times each with Ted giving two refining tasks.

Badminton at the High School. Ted’s cooperating teacher suggested that Ted observe another teacher teach the first badminton lesson in the unit and then teach what she taught. Following this teacher, Ted began his unit with a lecture reviewing the six-page, single-spaced list of rules, etiquette, terminology, and
singles strategy that the high school teachers had prepared. Ted demonstrated
with three pupils how to rotate and score. He also demonstrated what he called
"the mechanics of the shots" and explained a little about strategy. He did not
have the pupils do drills to practice the shots, but started them playing doubles
games. The pupils then played a mixed doubles tournament for all other lessons
in Weeks 1 through 3 and a singles ladder tournament in Weeks 4 and 5.

In both the elementary and high school settings Ted sought his cooperating
teacher's advice about lesson plans and often followed this teacher's suggestions.
When asked to comment on his cooperating teacher's suggestions and the school
programs, he made very few critical statements and spoke in support of the
curriculum and the content taught. He said the only changes he would make, if
he could teach the units again, were those changes suggested by his university
supervisor. Thus, although Ted's lessons most often reflected the school curricu-
um, he supported the programs and would repeat the units.

Pedagogical Content Knowledge Linked to Ted's Decisions

Ted explained and justified his content decisions by referring to aspects
of his pedagogical content knowledge of teaching volleyball and badminton, in
particular, his conceptions (i.e., knowledge) of how pupils learn and how to
divide and sequence skill and game content. These conceptions are organized in
two sections: First, tell about the biomechanically efficient body position, and
second, play games. Ted's conceptions and decisions about teaching the biome-
chanically efficient body position and his progression from having learners prac-
tice isolated skills to playing games represent a molecular view of knowledge
and learning. His conceptions and decisions about teaching games were somewhat
more holistic.

Because Ted's high school badminton content was almost exclusively tour-
nament play, there were far more tasks used at the elementary level and, conse-
quently, more data about elementary task content. In turn, most of the examples
in this paper are from the volleyball unit; however, his decisions for both elemen-
tary and high school units were consistent with his pedagogical content
knowledge.

Biomechanically Efficient Body Position

Ted divided volleyball and badminton content into skills and games. He
divided skill content into components of the biomechanically efficient body
positions of mature performers. He focused solely on telling about and reinforcing
these body positions. Teaching meant telling the children about a molecular
component of the mature body position. In the bump, for example, he demon-
strated and explained about keeping the elbows straight, knees bent, feet in a
stride, and thumbs together. He had the children stand in this mature position
and he tossed the ball onto their forearms. Ted discussed the mature pattern of
skills as the "correct way" of performing; developmental patterns were "problems,"
"incorrect," or "infractions." Learning meant hearing about and then making "specific changes" in body components to the biomechanically efficient,
mature positions.

In badminton he demonstrated "the mechanics of the shots." He said he
should have had the high school students practice the shots, but did not: "I think
they could have used a day or two with just the skills. . . . Some of them did need to, you know, relearn how to hit it.” His use of the term *relearn* further illustrates a conception of learning as hearing about or seeing the “mechanics” of the mature pattern that the pupils had “learned” as 9th and 10th graders.

Ted’s task progression was, in essence, to go from Rink’s (1993) Stage 1, that is, concern for individual skills (without her suggested extension tasks) to Stage 4, that is, modified games (volleyball) or the full game (badminton). His focus on telling about the biomechanically efficient body position with few extension tasks meant that he did not teach the contextual aspects of skills, and the open skills of volleyball and badminton were taught as if they were closed skills. For example, he did not attend to the perceptual aspects of skills or how the movement patterns of skills change in game environments. Neither did he attend to effort or space aspects in relation to either movement quality or variety:

Researcher: OK, you taught them about body position. Why?
Ted: I taught to keep the arms straight for the reasons that with their arms closer to your body you’ll have a hard time getting it over. You have, I don’t know what to call it, you have a better surface area. And I taught keeping one foot slightly in front so they wouldn’t have the problem—when I watched them, they tended to keep their legs straight, and they hit it straight up. They didn’t put one foot in front of the other. I just thought the momentum they had when they had one foot in front of the other helped them get the ball over the net.

Researcher: You did not teach the bump as an open skill—you did not teach the perceptual parts of the skill—like how to know where to line up under the ball or how to move to the side to hit it. You just set it up straight to them. Do you have any idea why?
Ted: I took it for granted that when the ball went to the side, they would do it. My fourth graders can take it when it’s coming behind them, and I assumed they would figure it out, if it was down low, that they would have to bend their knees to get it.

Because he had been an athlete, Ted said he knew that players needed “side to side movement,” but he “just never gave it a thought” for teaching. His idea that pupils would figure it out or just do it was supported by his thinking that it took “natural ability” to judge perceptual aspects of the skills:

If you don’t have somewhat of a little natural ability, it’s hard to be involved because for that third-grade class, it does take some coordination, you know, to judge that ball and get under it. So I think you do have to have some natural ability.

*Learning Skills Best Done One on One.* Ted’s conception that teaching skills meant telling and reinforcing decontextualized, molecular knowledge (as opposed, for example, to having children explore more holistic individual/environment interactions) was linked to his conception that learning skills was best done one on one. With one-on-one instruction Ted could tell each child what changes to make and give positive reinforcement. Consequently, to enable himself to give individual attention at the elementary school, he tossed the ball to one child at a time in the first bump drill and had them play a full-class game:
I thought it was a good drill for the very beginning of the lesson because you could watch each kid and then show them a little bit of what they—some of them were keeping their arms too wide and they weren’t keeping the elbows locked—you could give them specific changes that they need to make.

I think kids like it when their teacher watches them in a way, you know, I can watch everyone, and they like to have positive reinforcement. So I think that is why I stuck to one game. They want to know when they are doing good.

Although his task organization limited the number of practice trials for each child, Ted thought that one-on-one instruction was best. His university supervisor, however, told him that he was not providing enough practice. He then put the children in four to six circles to practice continuous bumps and found he had problems observing:

Ted: I knew . . . some of the students would have a little bit of a problem with hitting the ball over, so I wanted to make sure I could watch each individual. Without getting with the whole class I couldn’t watch everyone.

Researcher: You didn’t feel when you had them in four circles that you could watch everyone?

Ted: Ah, it was kind of hard because, you know, I was trying to keep them within their circle, and I was going around trying to observe each circle, you know, like 30 seconds or so but then, when I turn my back, the circle on the other side needed me, so I would have to go over and instruct them.

Ted used four circles for four lessons and then changed to one large circle:

The main thing I thought about that circle was, I guess, if I saw somebody hit it, even if they didn’t hit it successfully I’d still say, “Good try.” So I was giving positive feedback to each individual. And in the game . . . I was just talking directly to the kids that were hitting it, and you know sometimes the kids in the back weren’t being involved. So with the circle I could talk to each kid, and that gave it an individual touch.

Convinced of the importance of one-on-one teaching, Ted changed to one large group so he could talk to each child. I asked him what he thought about trading the number of practice trials for individual attention. Ted responded as follows:

I guess there has to be kind of a balance. You have to give up a little bit of individual attention to have a lot of practice, and to have a lot of individual attention you have to give up a little bit of practice.

Play Games

On one hand, Ted’s approach to skill content was molecular in that he focused on components of the biomechanically efficient body position and did not teach the contextual aspects of skills. On the other hand, his use of 18 application tasks, including a full-class game every lesson, reflects a more holistic approach to subject matter knowledge because games, by their very nature, have
a greater range of content. Ted gave two explanations for his reliance on application tasks: (a) rallies, rules, and routines were essential components of the subject matter of volleyball and badminton games and (b) competition facilitated learning.

The Three Rs: Rallies, Rules, and Routines. A central aim of Ted's units was for the pupils to have good rallies: "My goal is hopefully to give these kids enough drill time where they can learn to bounce the ball back and forth so they could have, you know, a fun rally and make the game enjoyable." Similarly, he said to the children,

This is what we're going to do today: a couple of bump drills (other classes have had fun) and learn how to keep the bump going as long as you can. This helps make the games better. If you have longer rallies in the game, it makes the game more fun.

His goal for good rallies contributed to why and how he modified the rules and skills of volleyball. He lowered the net and relied on bumping with one bounce to enable children to "use their technique better. That means they will have longer rallies, and that means they will enjoy the game more." He called this "the domino effect."

Ted also wanted children to be "familiar" with the volleyball routines and rules and get a feel for "real volleyball":

My goal would probably be for them to learn a couple of basic techniques, like we did... (not go too far into blocking or spiking or setting or anything like that) and just get them a little bit familiar with the volleyball routine.

He included rules as long as these rules did not jeopardize the children's chances of having good rallies:

I think I use some of the regular rules to let them get a feel for what real volleyball is actually about and these [pointing to my written summary] are some of the rules [three hits a side, boundaries, regulation balls] that aren't really going to hinder how they are going to perform. When I use these rules, they can still maintain a rally.

Ted's goals for children to have fun (which meant having long rallies) and to be familiar with volleyball influenced his decision to limit content to the one-bounce bump and underhand serve and to give, predominantly, positive general feedback to the children. From his perspective he had two choices: to correct children, which would stop the game and their fun and also hurt their confidence, or to let the game continue and rely on positive, general feedback:

Ted: I think if I went too far in depth without modifying the rules then it would definitely take the fun away from them with the amount of time I had with them... . . .

Researcher: How would they lose the fun?

Ted: I think they lose their fun if you have something [pause] like if they didn't bump it the correct way, just as long as they got it over I was pretty happy with it... . . . Every time they did it their own way, I wasn't going to break down and stop the game or tell them, "Hey, that wasn't the right
way.’’ Take away their confidence that they got it over. So, I mean, I wasn’t stopping the game every time there was an infraction that was happening.

Researcher: OK. Infraction? Like?

Ted: In terms of their technique in hitting it.

Ted’s feedback patterns support the interview data. Periodic coding of feedback revealed over 80% of his feedback was positive and general. Field notes consistently summarized that in games Ted said, ‘‘Good hit,’’ or ‘‘Good shot,’’ a few times, but mostly he called the score.

*Competition Motivates Learning.* Another reason Ted used application tasks was that he thought the competition would help pupils learn better. He added competition to the bump drill because he thought that it would help the children ‘‘concentrate’’ more and ‘‘would get their confidence going about starting a game and getting the ball over the net.’’ He thought competition helped the children keep their mind on what they were supposed to be doing when they were getting a little bit bored. Also, competition was what made lessons fun for the children and generated enthusiasm for the high school tournaments: ‘‘I think they like to have a little bit of competitive atmosphere when they are in gym, and I think to let them have fun, they have to see a little bit of the game situation.’’

*Control the Game.* Although his games content was itself more holistic, Ted approached helping children learn during games in much the same, more molecular, way that he approached helping children learn during skill drills. He thought that he should control the game because children needed to be told and reminded what to do. Learning was not exploring individual, task, and environment interactions, but remembering prescriptions. With control over the game, Ted could maintain the rules, make sure the rotation was right, and remind pupils to stay in their area. I asked Ted if he had considered using two nets instead of one as there was ample space in the gymnasium.

Ted: The fourth are OK. The third grade, I don’t think that I can keep control of the game with two nets. They need someone watching them and helping them with the score and rotation. It would be nice if I could go six to a court because they sometimes clump up a when the ball comes over because they all go directly for the ball. I think that it’s more important to have the control aspect because then you can remind them. I try to remind them to stay in their area when they are out there.

Researcher: What is control?

Ted: Just when the ball comes over I remind them: let it bounce. I make sure the proper person, it’s their turn to serve. I think that they would have some problems with that. And every once in a while—they have front, middle, and back row—every so often I make sure they have that formation.

*The Logic of Ted’s Explanations*

Ted defended his practice and provided a rationale for his content decisions and other actions by referring to aspects of his pedagogical content knowledge, in particular, his conceptions of how pupils learn and how to divide and sequence volleyball and badminton content. Many teachers, including myself, would choose
different content for Grades 3 and 4 and would structure elementary and high school tasks and units to provide more instruction and opportunities for practice. Teachers and student teachers also can offer rationales for their content and teaching that more closely resemble curriculum and research literature (cf. O'Sullivan & Tsangaridou, 1992; Rovegno, 1993). From Ted's perspective, however, he made decisions based on what he thought would best facilitate learning subject matter that was divided and sequenced appropriately. He did not think that his units were recreational or developmentally inappropriate. Moreover, Ted's content decisions are common. As Rink (1993) writes about her four stages of game development, "the most neglected stages of development of games skills in physical education programs have been stages two and three... It is not uncommon to see units of instruction established that move directly from stage one to stage four" (p. 253). Although it is easy to criticize Ted's units and to consider his knowledge and decisions as a reflection of inadequate teacher education, one must at least pay attention to the legitimacy he ascribed to his units and the way his conceptions fit together to form a logical explanation.

From Ted's perspective, he was helping children learn worthwhile, appropriate content. Thinking that learning was watching and hearing about the biomechanically efficient body position and without a clear sense of the amount of practice pupils need to develop motor skills, Ted was not highly concerned about the amount of practice provided. Moreover, he believed in one-on-one instruction. He knew that when more than one pupil performed at once there were many trials he did not see, thus he was not watching these children and giving them the "positive reinforcement" they needed. Because he thought that pupils like to be watched and need individual help, the only way to watch and help them on every trial would be to have them go one at a time. Ted's supervisor suggested ways to increase participation, but from Ted's perspective the increased demands on his attention when more than one pupil performed at a time forced him to attend to management and spend less time watching each pupil. The trade-off between the amount of practice and individual attention, Ted suggested, was inevitable.

Although the full-class games limited the number of trials for each child, Ted was able to give more of the "personal touch" and control the game, that is, make sure that children remembered the routines and rules he taught. Ted thought that competitive application tasks motivated learning. Thus he viewed the full-class games as part of the instructional program.

To Ted, successful rallies were the essence of games content. So that the children would be successful, he limited content to only the bump, underhand serve, and one-bounce volleyball with a lowered net. He thought that his drills were adequate preparation for the games and that the modifications he made in the game facilitated successful rallies. If he taught more complex content, he thought he would take away the fun, and if he stopped the game to give corrective feedback, he thought he would take away the children's confidence. He thus set his sights on getting the children "familiar" with (rather than proficient at) the volleyball routines.

Finally, Ted's beliefs that children had to have some "natural ability" to deal with perceptual aspects of skills and that children would figure out how to adjust to strike a ball that did not come directly to them did little to compel him to use extension and refining tasks or to teach open skills as open skills. Teaching
the efficient body position of the mature pattern was sufficient. The children’s
game play did little to dispel these conceptions, as the higher-skilled children
did indeed move to the side to strike balls, and the large number of children on
each side meant that most children, in general, could stand in one place and the
class could still have a rally.

I am not claiming that Ted’s conceptions are representative of the concep-
tions other teachers teaching similar units would hold (although this is possible).
My claim is that his content decisions and other actions were linked to his
conceptions of subject matter knowledge and learning in physical education and
that his conceptions provided what seemed to him to be a logical, adequate
rationale for his decisions. Thus I argue a teacher’s conceptions of knowledge
and learning are factors that can contribute to explanations for that teacher’s
actions regardless of whether these conceptions are in keeping with the scholarly
literature and research.

Scholars have identified a host of factors that help explain teachers’ deci-
sions and actions, including the school context (Templin & Schempp, 1989),
teachers’ value orientations (Ennis, 1992b; Ennis, Ross, & Chen, 1992), the
teacher development process (Bain, 1990), and cultural discourses within physical
education and the broader society (Kirk & Tinning, 1990). Teachers’ conceptions
of knowledge and learning can influence decisions and actions in ways similar
to these other factors. Moreover, conceptions of knowledge and learning within
a subject area can be rooted in broad theoretical perspectives of knowledge and
learning. Theoretical perspectives such as knowledge and learning as molecular
or holistic can be so prevalent in education that they are taken for granted.

The Nature of Knowledge and Learning

Molecular Versus Holistic Knowledge and Learning

As discussed earlier, the issue of whether knowledge and learning are
molecular or holistic (Berlak & Berlak, 1981) underlies how a teacher divides
and sequences content. In Ted’s units, he approached knowledge and learning
as molecular with skill content and was more holistic with some game content.

Ted was more holistic when he modified the children’s games to be one-
bounce, bump-only volleyball because he wanted to facilitate successful rallies
that would be fun for the children. Although fun as an objective for physical
education is often derided in the curriculum literature, the spirit of community
across both teams during a long rally is one of the joys of playing in a volleyball
game. Furthermore, frequent long rallies punctuated by a serving ace or a short
rally ended by a spectacular kill are defining characteristics of a good volleyball
game. Appreciating the excitement and joy of long rallies is part of volleyball
content and is an appropriate affective content objective. In addition, long rallies
enable children to experience, and potentially learn about, continuity of flow.
Thus Ted reduced the complexity of volleyball by making it one-bounce, but
did so to maintain an essential part of the whole, that is, continuity of game flow
and the associated affective content.

The Hegemony of Biomechanics. Ted took a molecular approach with
skill content when he taught only the biomechanically efficient body position of
the mature bump, underhand serve, and all badminton shots and did not attend
to or plan for the development of the perceptual and contextual aspects that make these skills open skills. The way Ted conceived of skills could aptly be called the hegemony of biomechanics; that is, he functioned from an unquestioned, taken-for-granted sense that teaching skill content meant demonstrating and telling the biomechanically efficient body position of the mature pattern.

I am using the term *hegemony* not only to emphasize Ted’s taken-for-granted privileging of the biomechanically efficient position over other knowledge but also because such privileging is pervasive and colors much thinking about motor skill teaching. For example, notions that pupils must be taught the correct technique or they will develop bad habits and that pupils should develop the mature pattern of fundamental skills before developing those skills as game skills or using those skills in game situations are common conceptions about teaching and sequencing content. In addition, the convictions that any movement pattern that is not the mature, efficient pattern is an “error” and that allowing children to explore when learning a skill will lead to errors and is therefore not effective for skill development are widespread and reflect the privileging of the biomechanically efficient body position.

Similar privileging is represented by the idea that students’ movement patterns should be automatic (i.e., there is no need for active cognitive involvement) before they learn to vary that movement pattern in response to environmental demands or decision-making aspects of games (e.g., strategy) and the concern that it is somehow detrimental if children’s developmental level of performing a skill decreases when that skill is put into a game situation. The contrasting ideas that students should develop the ability to adjust accurately to the changing perceptual environment and make appropriate strategy decisions before they develop movement pattern efficiency or automaticity are not prevalent concerns or practices.

The phrase *hegemony of biomechanics* is also meant to call attention to the hidden curriculum. When one privileges the body position of the mature pattern over other content, the focus is on individual movement efficiency, which is considered to have been objectively defined by experts of the sport. In turn, environmental complexity and individual subjectivity and affect are eliminated or controlled. Reflective of modern views of the relations between humans and their environment, the emphasis is on controlling the environment and efficiency not on flexibility and interacting with and adapting to the environment. The hidden curriculum of the privileging of molecular components of the mature body position makes primary that motor knowledge which is efficient, objective, and decontextualized.

Building a progression beginning with the biomechanically efficient position is a molecular perspective on knowledge and learning in the motor domain. This molecular perspective is based on several assumptions. First it is assumed that motor content can and should be broken down into smaller components to enable learners to deal with the complexity of participating in motor activities—an assumption I accept. Second, it is assumed that when a teacher breaks down motor content that the biomechanically efficient mature pattern should be privileged and that contextual factors should be eliminated initially or deemphasized and then added onto the biomechanical knowledge. Learning the efficient body position is assumed to be fundamental in some linear way to the development of perceptual attention, to learning to move within the context of the physical activity, and to
understanding and managing the multiple goals inherent in physical activities. In other words, it is assumed teachers should not control the complexity of performing in a motor activity by controlling the complexity of the coordination and control demands of efficiency; instead, teachers should control complexity by controlling the environmental demands and the multiple individual and group goals. In light of recent research and theorizing, this second set of assumptions warrants increased scrutiny and critique.

Challenges to the Hegemony of Biomechanics and the Add-on Progressions

To date there is too little research on teaching, motor development, control, or learning to suggest that any particular way to break down and sequence content is either supportable or unsupportable. However, there is ample evidence that the process of developing control and coordination is far more complex than a linear, add-on model beginning with the “correct” body position represents.

The most serious challenge to molecular models comes from the broad constructivist, dynamical systems, and postmodern theories of knowledge and learning discussed earlier (Doll, 1989; Ennis, 1992a; Prawat, 1992). Within the motor behavior research community, ecological and dynamical systems approaches to perception and action also reject a molecular perspective and emphasize nonlinear motor control and development processes and a more holistic perspective of knowledge and learning. For example, Newell’s (1986) claim that the interactions among individual, task, and environmental constraints form the irreducible unit for understanding coordination sets up a holistic conception of what should be the fundamental component of knowledge for content analysis. Individual and task goals, for instance, should always be considered fundamental as movement cannot be decontextualized.

Moreover, from an ecological perspective, motor learning is not considered a process of repeating a prescribed movement pattern, but means repeatedly exploring the interactions among the individual, environment, and task constraints (Newell, 1991; Vereijken, 1991). Ecological and dynamical systems researchers consistently characterize the learner as an active explorer, discoverer, or problem solver. These characterizations support that a critical role for the teacher is to structure holistic tasks and to facilitate learners’ explorations. In defending discovery learning over traditional prescriptive accounts (e.g., closed-loop theory, schema theory), Vereijken (1991) writes as follows:

Thus, in not being prescriptive, discovery learning forces the learner to explore the dynamics of the system in which he or she is working in an iterative way. Only when prescriptions take the form of delineating the progression of problems that the learner is required to solve and relate these to the capacity of the learner are they likely to be effective. In this sense, of course, prescriptions have a limited part to play in the sense of merely providing a framework in which discovery learning might optimally take place. Did someone mention that old fashioned3 approach “movement education”? (p. 37)

Research might eventually show that focusing on biomechanically efficient body positions is a sound guideline for promoting motor skill acquisition for
pupils at certain ages or developmental levels or with particular physical activities. Nevertheless, there is enough theoretical support for holistic, nonlinear perspectives of motor knowledge and learning to suggest that molecular guidelines for dividing and sequencing content should not be taken for granted.

*Raising Questions About Motor Knowledge and Progression*

Many of us have turned to more subjective, holistic, nonlinear perspectives of knowledge to guide our research on teacher education, curriculum, teaching, motor control, learning, and development. The results have given us not only alternative ways to think about coming to know as researchers but also a deeper and richer understanding of physical education and physical activity. These results, alone, suggest that it is worthwhile to consider what a more subjective, holistic, nonlinear view of knowledge and learning might suggest for structuring and sequencing physical education content. Toward this end I raise the following questions:

If we, as educators, need to use smaller stepped progressions to facilitate skill learning (French et al., 1991; Rink et al., 1992), and if we assume that for beginners we need to limit, in some way, the environmental, coordination, control, perceptual, decision making, or all of the above demands of physical activities, the issue becomes: how can we best divide, structure, and sequence content to enable pupils to learn complex motor content? Is the tendency to privilege the efficient body position ever theoretically supportable? If so, when? (And, its widespread use suggests that it will prove to be supportable at the very least with some content at some age and experience levels.)

If we assume, which I do, that more than one model for progression will work to help students learn physical activities, what other issues should we consider in choosing a personal model? Is the hidden curriculum important? What is the effect of an emphasis on the efficient movement pattern? Does this “objective” emphasis automatically privilege students who are able to achieve efficient movement over others who cannot or do not? Would a change to a more subjective, holistic view of knowledge be more equitable or less equitable? Would a matrix model for progression help those who find little success in physical education become more successful or just leave them confused?

Is the focus on controlling environmental factors the hidden curriculum we want to support and, as such, who does it privilege and what are we teaching about the relations between humans and their environment? Should we not also help students view themselves as inseparable from their environment? Should we emphasize being adaptive, interactive, and flexible? Would this come at the expense of control and efficiency? Is it not equally important to help students feel in control of their bodies and environment?

If, as theories suggest, knowledge and learning are holistic rather than molecular and linear, how much complexity can you eliminate before you lose the whole? Must one maintain all of the cognitive, affective, perceptual, social, moral, and motivational components of physical activities to maintain the essence of the whole? How important is, for example, affective content of volleyball such as the feeling of community in rallies, the mystery and excitement of not knowing when the ball will hit the ground, the feeling of power in a spike and tenacity in successfully bumping a spike attempt? Is this appropriate content to
eliminate? Would students learn more if this content was maintained or emphasized? Is it more important to work on keeping your elbows straight or on continuity of flow, the efficient body position, or the perception action coupling? Is affective, social, and perceptual content superfluous or fundamental? These are questions for which there are as yet no answers.

References


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Notes

'I have found that the success and appropriateness of typing participants’ responses on a laptop computer during interviews varies depending on the participant and the purpose
of the research. One benefit is that typing slows the rate of questions, giving the participant more time to reflect. Some participants speak slowly. Others, however, talk fast and are impatient if the typist cannot keep up with their responses.

I view the terms conception and knowledge as interchangeable. To avoid confusion and such phrases as "the student teacher's knowledge of knowledge," I use the term conception to refer to those aspects of pedagogical content knowledge that the student teacher discussed as salient to his content decisions. I use the term knowledge when discussing more public forms of knowledge, such as disciplinary knowledge and theoretical knowledge.

I interpret Vereijken's use of old fashioned to reflect her status as a member of the motor control community and the location of her work at the Free University, Amsterdam, The Netherlands.