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The Contribution of Two Research Programs on Teaching Content: "Pedagogical Content Knowledge" and "Didactics of Physical Education"

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Abstract

Content in physical education has been the subject of research for some years, with most studies being carried out under two scientific programs. One, in North America, concerned primarily with pedagogical content knowledge; the other, in France, studying the didactics of physical education (didactics describes the features of teaching that are specific to the "knowledge taught" and the many changes and transformations that knowledge undergoes at the various stages of its selection and teaching). The purpose of this paper is to describe the theoretical framework, methodology, and principal results of each of these programs. It examines their similarities, differences and the contribution of each to the teaching and learning of content in physical education. Researchers in both fields state that pedagogical content in physical education: (a) is highly domain-specific to the activity being taught; (b) falls within an analysis of the situated-action; (c) undergoes long-term evolution in relation with professional competence; and (d) depends on constraints inherent in the system.

Beyond the specifics of each program, there are some similarities which open up possibilities for fruitful collaboration between researchers in the two communities.

Key-words

Content in Physical Education, Pedagogical Content Knowledge, Didactics of Physical Education.

The Contribution of Two Research Programs on Teaching Content: "Pedagogical Content Knowledge" and "Didactics of Physical Education"

Research into teachers' pedagogical content knowledge (PCK) in North America and research into didactics (the European focus) has been ongoing for about 10 years. These two scientific programs are particularly concerned with content issues in the teaching-learning process of physical education.

The first one, which focuses on teachers' pedagogical content knowledge, is situated in the broader area of teachers' thinking. Pedagogical content knowledge is the basis for the selection, organization and presentation of the content teachers want their students to acquire, and this field of research is undergoing considerable development in the United States. Articles concerning PCK have been published in five journals: Journal of Teaching in Physical Education, Research Quarterly for Exercise and Sport, Quest, Teaching and Teacher Education, and the American Educational Research Journal. Indeed a Portuguese study notes that nearly twenty articles appeared on PCK in physical education between 1991 and 1995 (Graça & Januario, 1996).

At the same time, a research theme called "didactics of physical education" has been developing in France. Didactics studies the features of teaching that are specific to the knowledge taught. This approach points out that the content taught results from numerous transformations that knowledge undergoes at the various stages of its selection and teaching. The first publications in this field date from 1987, with articles being published in Science et Motricité, Revue STAPS [Sciences et Techniques des Activités Physiques et Sportives], Impulsions, Les Sciences de l'Education pour l'Ere Nouvelle and Revue Française de Pédagogie.

The two research programs (PCK and didactics), which came into being and developed from the late 1980s, seem to have a common focus: the content of physical education. The aim of this article is to identify the sets of problems they examine, their themes and their results. It is thus a review that concentrates primarily on research focusing on the content of physical education, which makes it complementary to more general overviews of publications on teachers and teaching.

We seek to describe the differences, similarities and respective contributions of the two research programs. To do this, the article progressively examines the theoretical framework, the methodology and the principal results of each program. While this highlights the similarities and

differences between the two programs analyzed, the desire is to encourage cooperation rather than controversy.

The perspective adopted for this review does not presuppose any strict parallel between these research areas. There are differences that exist independently of the research themes and methods. They stem from the "hard core" of theory at the foundation of each program which constitutes the conventional elements on which the researchers adhering to the trend agree through a "methodological decision" (Lakatos, 1974). Thus research into PCK is based primarily on theory focusing on teachers' cognition whereas didactics research is based primarily on the structure of the content of the school disciplines as the decisive elements of the teaching-learning process. Obviously, research within the two programs develops through theoretical borrowings, as well as heuristic and concept additions. The intention in this review is less to propose an epistemological debate than to describe the state of the art and the contributions of each of the programs to the study of content in physical education. For this reason, the present article does not discuss the development of their theoretical structures. Moreover, such an ambition would oblige us to widen the debate to include research carried out in various academic disciplines (mathematics, biology, physics, language, etc;). Indeed, in PCK and didactics, the first studies concerned the teaching of sciences before research was conducted in other subjects including physical education. The term "program" used in the title of this article suggests the breadth of the domain encompassed by these two research trends, which extends beyond their individual productivity in the field of physical education. We hold the idea that research into teachers' PCK and research into the didactics in physical education have developed sufficiently for it to be worthwhile to look into the results they have produced apart from their roots in other disciplines.

Research on Physical Education Teachers' Pedagogical Content Knowledge

Research on the pedagogical content knowledge of the teacher was introduced by a team of educational researchers (Feiman-Nemser & Parker, 1990; Grossman, 1989; Gudmundsdottir, 1990; McDiarmid, 1990; Marks, 1990; Shulman, 1986, 1987). It was Shulman who initially defined the problem. He put forward the thesis that teachers' PCK was a field of investigation that had been left virtually untouched, "the missing paradigm" in teaching research (Shulman, 1986, p.7). In his opinion, this situation made the development of systematic research imperative.

PCK: Definition

Shulman defines PCK as "that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding" (Shulman, 1987, p.8). It is a configuration of specific knowledge (sometimes tacit) based on experience and strongly embedded in action. A teacher's PCK is what enables content problems and knowledge to be adapted to the abilities and interests of the learners. Shulman's co-workers specified the concept on which research workers now agree. PCK integrates different forms of knowledge, beliefs and values, all of which are essential to the development of professional experience. They are (a) subject matter content knowledge, (b) pedagogical knowledge, (c) curricular knowledge, (d) knowledge of students' understanding (how they understand, their conceptions and usual errors), (e) knowledge of the purposes of teaching, and (f) general pedagogical knowledge.

PCK Program Orientations

There are three major areas in the study of PCK: (a) the study of the specific structure of PCK in the teacher's knowledge base, (b) the study of its elaboration in teacher education, and (c) the study of how knowledge is reorganized during action and pedagogical reasoning.

PCK Research in Physical Education: Problems Investigated.

Research started into the professionalization of teachers and their education and tried to investigate the nature of teacher's knowledge (Schempp, 1993a). The explicit goals were to set up curricula in teacher education fitting the profession's requirements as closely as possible (O'Sullivan, 1990). Thus three types of publications can be identified in the literature:

- The initial research on teaching cognition in physical education concerned itself with teachers' knowledge and decisions, based on the traditional model of comparing experts vs. novices (Griffey & Housner, 1991; Housner, 1993; Housner & Griffey, 1985; Housner, Gomez & Griffey, 1993a, 1993b; Riff & Durand, 1993). Later publications were centered more specifically on the structure of pedagogical knowledge (Dodds, 1994; Ennis, Mueller, & Zhu, 1991; Rink, French, Lee, Solmon & Lynn, 1994). Content was included in these studies, but PCK was not the focus.

- These were followed by papers reporting on how teachers acquire, elaborate and transform their PCK. The questions examined were related to: How is pedagogical content knowledge developed? How does experience in the school context and the teacher's personal

history influence PCK? (Doolittle, Schwager, & Mitchell, 1996; Graber, 1995; Romar, 1995; Rovegno, 1992a, 1993a, 1994, Rovegno & Bandhauer, 1997a, 1997b; Sebren, 1995).

- A final group of publications on PCK discuss the pertinence of university curricula with respect to the professional training of physical education teachers. These articles, intended for practicing teachers and teacher educators, have been presented at conferences and in professional journals (Dodds, 1995; Fernandez-Balboa, Barret, Solomon, & Silverman, 1996; Griffin, Dodds & Rovegno, 1996; Locke, Mand, & Siedentop, 1981; O'Sullivan, 1990, 1996a, 1996b; O'Sullivan & Doutis, 1994; Rovegno, 1995a; Schempp, 1993b; Tinning, 1992;). This review will be concerned primarily with first two types of publications, those that have focused on teacher content knowledge and decisions, and those describing how PCK is elaborated and transformed.

Structure of the Physical Education Teacher's Knowledge

Research in Teachers' Cognition

The roots of current research on teacher cognition can be found in a number of publications about teachers' thinking, their implicit theories, and the structure of their knowledge base (for an overview, see Housner, 1993 and Perez & Saury, in press). The need to deepen the knowledge base connected with practice, particularly beyond general pedagogical knowledge and content knowledge, became clear (Griffey & Housner, 1991; Housner, 1993; Siedentop & Eldar, 1989.) Beyond confirmation of earlier results on the way in which planning was carried out, it appeared that expert physical education teachers were more focused on the content to be acquired by students and better anticipated the transitions between activities (Griffey & Housner, 1991; Siedentop & Eldar, 1989). They had more flexible control over the learning tasks in relation to the aims of the lesson than did the novices, who changed activities on impulse, with no objective reason (Dodds, 1994; Griffey & Housner, 1991). The research underscored the complexity of the teachers' professional knowledge and suggested its procedural, highly contextualized character (Siedentop & Eldar, 1989). In experts, this knowledge is connected to rich, diversified sources (Dodds, 1994; Ennis & al., 1991; Griffey & Housner, 1991; Housner & al.,1993a, 1993b). Generally speaking, these earlier studies opened the way to research on the structure of knowledge useful in the practice of teaching.

Structure of Knowledge Useful to Physical Education Teachers

Research on teachers' cognition evolved by progressively narrowing the focus of the initial studies from the structure of knowledge in the widest sense to the structure of pedagogical

knowledge, and finally to the structure of PCK. In the early articles, the traditional categories of declarative, procedural and strategic knowledge were used as a framework for the study of teachers' knowledge (Housner, 1993). The concepts of cognitive architecture and cognitive mapping were at the heart of these studies, which confirmed the results obtained in research on other subject areas. Studies increased and reported on sophistication of teachers' knowledge from student level to expert level (Ennis et al., 1991; Griffey & Housner, 1991).

Studies then focused on the structure of pedagogical knowledge (i.e. the principles and strategies for managing the class). The conceptual network of the teacher relative to pedagogical knowledge seems to depend on the type of education received. Its level of complexity and retention increases with education (Housner, 1993; Housner et al., 1993a, 1993b; Dodds, 1994; Rink et al., 1994), particularly if the process is supported by reflective practice (Sebren, 1995). The results of these studies opened up perspectives for the systematic exploration of pedagogical knowledge in relation to PCK.

Within the framework of knowledge structure of teachers, current research is concerned with the structure of PCK (Graber, 1995; Sebren, 1995). The results show that the degree of integration of pedagogical knowledge into practice appears to be contingent on the context of experience, assistance from a mentor, the level (elementary or secondary) and reactions of the students (Housner, 1993, Graber, 1995; Sebren, 1996). The acquisition of PCK seems to be more problematic. Research confirmed the results of early work that assert that teachers beginning their careers show deficiencies in the knowledge of the subject matter to be taught and thus in the pedagogical content knowledge. There is some evidence that the level of integration of subject matter knowledge and PCK into practice is quite poor (Siedentop et al., 1989, 1990; Housner, 1993; Dodds, 1994; Graber, 1995; Sebren, 1995).

Another study on PCK examines the influence of subject matter expertise on teacher’s PCK irrespective of the amount of experience in teaching (Schempp, Manross, Tan, & Fincher, 1998). Schempp and al. studied ten teachers ranging from beginning teachers to teachers with 26 years of experience. Differences were found between teachers teaching subjects in which they had expertise and teachers teaching subjects in which they had little or no expertise. Findings point out that expertise in subject matter knowledge helps teachers: (a) better recognize problems in student learning, (b) plan more easily and in greater detail, (c) develop instructional strategies, and (d) have an increased level of comfort and enthusiasm.

Elaboration and/or Reorganization of PCK in Initial Teacher Education

To understand the difficulties students and student teachers of physical education experience in acquiring and incorporating PCK, researchers examined the effects of initial teacher education (Rovegno, 1992b, 1993a; Graber, 1995; Romar, 1995). These analyses broke away from the traditional methods for studying teachers' knowledge using, instead, case studies and observations in the natural setting. Data were collected using various qualitative techniques, interviews, class documents, log books, observations with or without participation, and notes from practice. Terminology evolved and instead of contrasting experts against novices, the specific competencies of teachers with little experience (i.e. students, student- teachers, and newly qualified teachers) were compared relative to those of their more experienced colleagues (i.e. experienced teachers, mentors, teacher-educators). Theoretical references also shifted. Gibson's "perception-action" model explicitly supports Rovegno's work (1992a, 1992b, 1994). Reflective approach was used as a theoretical base of teaching in different studies (Sebren, 1995; Griffin et al., 1996; Paré, 1995; Tsangaridou & Siedentop, 1995).

This descriptive research on the competencies of teachers with various levels of experience suggests four major findings: (a) the uncertain role of early field experience, (b) the difficulties in implementing what was taught in the teacher education program, (c) the challenge of teacher education regarding the complexity of PCK, and (d) the link between PCK and professional development.

The Uncertain Role of Early Field Experiences.

The research reported that in early first field experience the undergraduates had a knowledge deficit in the subject to be taught and the associated pedagogical content. Young teachers realized how difficult it was to acquire PCK. They soon discovered that rich, diversified PCK was essential for the development of their teaching competence (O'Sullivan, 1990; O'Sullivan & Tsangaridou, 1992; Rovegno, 1991, 1992a, 1992b; Graber, 1995; Romar, 1995, Sebren, 1995).

Nevertheless, the acquisition of PCK remained problematic. Research explored how early field experience contributed to building up this professional competence (Rovegno, 1991, 1992a, 1992b; Sebren, 1995). These studies described how students restructured their PCK, that is, they experienced major qualitative changes in their knowledge in field-based method courses. The researchers underscored the extent to which this restructuring is connected with action, hence the interest in early field experiences. Rovegno (1992b, 1993a) observed a marked simplification by

undergraduates of content taught in the university, however. It was the surface features that were retained and generalized. Although there was an overall understanding of the content to be taught, which made it possible to organize the learning tasks, the student-teachers did not succeed in teaching in a way that favored motor acquisition by the students. Early field experiences thus highlight the difficulties the students encounter, providing a pertinent motivation for education in PCK.

Problems Associated with Implementation of Teaching

Young teachers' progressions juxtapose technical exercises and activity in global situations (Rink, 1993). A study of twelve beginning teachers in teaching ball games reported that skills were presented out of context, and the beginning teachers did not teach game strategies, as if the children could learn these strategies by themselves (Rovegno, 1993a, 1994, 1995a). A lack of knowledge of the way students learn was the origin of these problems. The student teachers underestimated the time and practice necessary for motor learning. They thought that good explanations and demonstrations were enough. When failures occurred, they tended to blame the students for poor understanding, lack of attention, or laziness (Rovegno, 1993a, 199b).

In another study of a student teacher, the teacher taught primarily the “biomechanically efficient body position” (Rovegno, 1995b, p.292). The new teacher attached more importance to surface features of motor techniques than to the perceptual aspects of the skills. These conceptions persisted in spite of the education received. There was a difference between what the student teachers actually taught and what they stated about the beliefs, values and aims that they had learned at the university (Rovegno, 1993a, 1993b).

When content is transmitted through discovery or problem-solving situations, difficulties of a different nature appear. The beginning teachers think that the children should never be given an answer. They thus deprive children of feedback. This inaccurate conception of the constructivist approach limits their intervention, which would not be the case for experienced teachers (Rovegno, 1993a, 1993b; Rovegno & Bandhauer, 1994, Griffin et al., 1996).

These findings suggest limitations on the findings established by research on the structure and retention of knowledge at the end of teacher education (see above). Although teacher education may transform the structure of PCK as measured out of practice, this newly acquired knowledge is not easily transferred into practice.

PCK and Teacher Education Challenges

Researchers have also examined the influence of previous knowledge, personal beliefs and the effects of field experience on developing PCK. Undergraduates may resist incorporating new approaches in physical education, due to stereotypes of the profession and conceptions of the content, but theoretical and practical training may enable the initial conceptions to be partially transformed and new beliefs to be integrated. The impact of field experiences seems to be decisive. For some undergraduates, observing experienced teachers improves their understanding, but other undergraduates reported that it was experience and reflection on their action which helped them better understand and integrate the innovative curricular approaches they were taught in their classes (Rovegno, 1992a, 1993b; Sebren, 1995).

Graber (1995) tempers this optimistic view of teacher education programs making a difference in the acquisition of PCK. She wonders how student teachers bring the knowledge learned during their education into play in their lessons. Graber interviewed 20 students, seven teacher-educators and eight cooperating teachers from two universities. Her results reveal that the effect of a teacher education program seem to need qualifying according to the type of knowledge (pedagogical knowledge or PCK, see above). The students of both universities mentioned major difficulties in understanding pedagogical content. They recognized that they had to combine their knowledge of subject matter and their pedagogical knowledge, but the absence of a specific approach to this integration in their courses led them to proceed by trial and error, imitating a colleague or reproducing what they experienced as students. Difficulties were accentuated when their knowledge of the subject matter was sparse or minimal. Each of the students interviewed said he or she had been marked by a teacher or mentor who had had a decisive impact on his or her beliefs and practices. In summary, the author considers that it would be a naive position to think that novice teachers, with the education they receive, could have complex strategies for combining content knowledge and pedagogical knowledge .

Thus, results are conflicting on the effect of education on the development of PCK. Rovegno (1992a, 1992b, 1995a) reports transformations in knowledge and practice even if they remained superficial, whereas Graber (1995) qualifies the effects of initial training because of the many and varied influences and experiences affecting each student. Without having an idyllic view of the training, the authors draw attention to the fact that when the teacher educators and mentors develop strategies in common and work together on planning the curriculum, reflective

practice can positively effect the acquisition of PCK. Field experiences, however, may have a positive or negative impact. The choice of schools for application and of mentors is particularly important for a positive experience (Rovegno, 1992a, 1993b, 1994; Siedentop & Locke, 1997). A study of two student teachers teaching basketball and volleyball units highlighted the effects of the context (i.e. elementary school versus senior high schools in which physical education was not highly regarded) (Rovegno, 1994). Certain school situations (characterized by low regard given to physical education) obliged the young teachers to confine their content to a "curricular zone of safety" which allowed them to survive professionally but limited their professional development. The school where field experiences takes place is thus of great importance in the elaboration and development of PCK, which confirms its contextualized character.

PCK and Development of Professional Competencies

The complexity of the structure of PCK leads certain authors to call into question Shulman's distinction between subject matter knowledge and pedagogical content knowledge (McEwan & Bull, 1991; Rovegno, 1992a). Rovegno considers that the development of knowledge related to pedagogical content consists of an increase in its differentiation in terms of individuals, tasks, and environment relations. In her opinion, the essential difficulty lies in the fact that PCK is encapsulated in the practical actions at the source of its emergence. The problem of its generalization is thus posed (Rovegno, 1992a). Moreover, content knowledge is highly specific to the domain concerned. The question of acquiring a considerable number of professional content competencies in physical education remains an obstacle to their integration into teacher education syllabuses (Rovegno, 1995a, Dodds, 1995; O'Sullivan, 1996b).

Conclusion

All the publications underscore the complexity of PCK and the resulting difficulty in acquiring it during initial training. The difficulties are thought to be connected with the nature and structure of PCK knowledge: (a) more procedural and experiential than declarative (Rovegno, 1991, 1992a, 1993b; Dodds, 1995; Sebren, 1995), (b) eminently specific to the field of content, or even to each skill taught (Rovegno, 1991, 1992b; Rovegno and Bandhauer, 1994; Dodds, 1995; Rovegno, 1995b), (c) embedded in the practice of teaching (Rovegno, 1994; Sebren, 1995; Griffin et al., 1996), (d) composed of intimately linked and integrated knowledge, beliefs and experience (Rovegno, 1991, 1992b, 1993a, 1995b; Dodds, 1995; Graber, 1995), and (e) dependent on contextual and institutional constraints (Rovegno, 1994; Graber, 1995).

Repeated observations of this type lead researchers to go more deeply into the question of knowledge transformation through the study of experienced teachers.

PCK of Experienced Teachers

Early research examined the influence of PCK on the efficiency of teaching measured in terms of teacher feedback and students' practices (Schempp, 1993b; Walkwitz, 1993). Experience modifies teachers' conceptions of teaching and is accompanied by an enrichment and diversification of PCK (Rovegno & Bandhauer, 1994; Griffin et al., 1996). One focus of these studies was to examine the conditions for PCK enrichment by studying the "pedagogical reasoning and actions" (Shulman, 1987, p.12) of highly experienced teachers. Case studies have tried to pinpoint the source of new advances in PCK. These analyses favor the observation and follow-up of experienced teachers over long periods. On these studies numerous data are triangulated and interpreted using life histories and ethnographic observations, interviews and field notes. The biography of an atypical dance teacher and the analysis of her way of working shows how the mutual influences of experience and knowledge gained throughout her career combine to generate pertinent and innovating professional knowledge in action (Fortin & Siedentop, 1995). The study leads us to believe that it is because of the depth and the variety of the dance teacher's theoretical knowledge of the field that her PCK develops in the long term.

Two other studies report complementary findings regarding the role of school context and individual teacher characteristics to the development of PCK. The effects of the school context on professional change are underlined in a longitudinal study (over 3 years) of an experienced teacher (Rovegno & Bandhauer, 1997b). This first study examines the evolution of the PCK of the second author and her adoption of a new curriculum. The status of physical education in the school and the support of the school community (principal and colleagues) appear to be decisive in encouraging teachers to persevere with innovations. This research confirms the school context effects demonstrated in earlier research. While difficult conditions in the school compel teachers to limit their content to a "curricular zone of safety" (Rovegno, 1994), favorable contexts have positive repercussions on the development of professional knowledge. The second study points out that PCK enrichment and development also depend on the individual personal frame of mind and attitudes of the teacher, essential to maintaining innovation over a length of time (Rovegno and Bandhauer, 1997a). These findings stress the extent to which PCK, at the heart of

professional competence, develops through a long process in which "norms of school culture" and "psychological dispositions" play a critical role.

Conclusion on the PCK Program

PCK in physical education is essentially situated knowledge specific to the skills taught. It is developed through the integration of theory and practice in initial teacher education but long-term development is related to professional experience. It only has meaning in its utilization, which is why the context variables and subject variables are decisive in the evolution of this knowledge. The professional competency which is characteristic of experienced teachers is difficult for beginners to attain and this partly explains the simplifications and "curricular zone of safety" they use when elaborating the content of their teaching, so as to survive in the profession.

It should be noted, however, that the concept of "Pedagogical Content Knowledge" in current research in physical education has gradually become a generic term to signify teachers' professional knowledge. This interpretation might differ from the one commonly accepted but emphasizes the implicit evolution of the concept in recent literature in physical education. Furthermore, certain perspectives opened up by Shulman have remained under exploited in North American research. A study of the didactics literature in the second part of this paper will situate its full pertinence.

Research on Didactics in Physical Education

In this section French research in didactics is reviewed. Some examples or comments are written in brackets to help North American readers to understand key concepts and findings of the didactic program.

The didactics of disciplines was born, in France, from the unsatisfactory way in which general pedagogical research reported teaching practices. The researchers postulated that teaching phenomena cannot be studied or understood without specifically taking the content of the discipline into account. The first research in didactics was conducted in mathematics and, then, experimental sciences before spreading to other school disciplines (Brousseau, 1986; Martinand, 1987; Chevallard, 1991).

In our opinion, the foundation article in didactics of disciplines should be attributed to Brousseau (1986, English translation, 1997). It is presented as a first attempt at a theoretical synthesis, forming the conceptual basis of the research domain after ten or so years of empirical

work on the teaching of mathematics. The author supports the idea that didactic research concerns itself with the functioning of the "didactic system" defined as the irreducible three-way relationship linking teacher, students and knowledge taught. According to Brousseau “an inversion is operated with respect to the traditional tendency which consists of studying independently the subsystems of a didactic system: the student, the teacher and the task regarding a body of knowledge, then trying to derive learning or teaching behaviors from these studies. The object of didactics studies [is] the description and explanation of activities connected with the communication of knowledge and the transformations, intentional or not, made by the protagonists in this communication, and the transformations of the knowledge itself" (Brousseau, 1986, p.34). These arguments are restated and developed by Chevallard (1991).

The specificities of school disciplines lead researchers toward a wider definition of the word "knowledge." A consensus has emerged that didactics research assumes responsibility with respect to the content of the school disciplines (Martinand, 1987). A common conceptual framework (which we shall not develop in this paper) ensures the theoretical consistency of the field. It is organized around the concepts of "didactic transposition, didactic contract, theory of didactic situations, learners' conceptions, etc." (Raisky & Caillot, 1996, p.11).

Orientations of the Didactics Program

Didactic studies confirm that the knowledge to be taught and the knowledge actually taught undergoes complex transformation processes at various stages of selection and teaching, which fundamentally distinguishes this knowledge from its origins in academic knowledge. According to each school discipline the academic knowledge, which legitimates the content taught, could be either "social practices taken as a reference" or "scholarly knowledge". Those two concepts in the didactics program express the idea that all school disciplines must have legitimacy. The roots of this legitimacy lie in the amount of recognition given to the type of social activities chosen [e.g. sports and/or dance in physical education curriculum] and/or the type of scientific knowledge that is claimed to support each school discipline [e.g. physical education curriculum based on motor learning research]. Didactics research studies the transformations from the academic knowledge to the knowledge taught, their effects on practice and their possible improvement in teaching. Researchers in didactics approach their research on three scales: a macro, a meso and a micro level.

At the macro level, researchers examine curricula and pay attention to the transformations that knowledge and social practices undergo when the institution designates them as subject matter to be taught: from the "academic discipline" to the "school discipline" [i.e. from sport knowledge (both empirical and research based) to sport knowledge designed to enter in physical education curricula]. At the meso level, researchers study the way knowledge in a discipline is reshaped into knowledge accessible to the students. The teacher's conception of the content is the source of a number of adaptations, but this reorganization also takes the characteristics of the students into consideration (their school level, their conceptions): from the school discipline to what is elected to be taught, namely the "teaching content" [In this review "teaching content" can be understood as task focus]. At the micro level, studies in didactics are concerned with implementation in the classroom. Continual, inevitable changes are observed in teaching content and knowledge when they are brought into play in situations and activities. This occurs through negotiation (often implicit) between the students and the teacher: from "teaching content" to the "content really taught" [e.g.: from a volley-ball serve reception as tactical cooperation between players, to the details of the content really taught through the feedback and comments that the teacher gives to students when they are performing the serve reception task, for examples : "call ‘mine’" ; "move" ; "pursuit and save" ; "flat platform on the forearm pass" etc..].

Pedagogical Reasoning and Action versus "Didactic Transposition" and "Didactic Contract"

We have highlighted the fact that the distinction between subject matter knowledge and pedagogical content knowledge draws a fundamental line through the theoretical debates of the PCK program. For some authors, this demarcation is arbitrary (Marks, 1990) or even not pertinent (Mc Ewan & Bull, 1991). Shulman (1987) and Gudmunsdottir (1990), however, consider that pedagogical reasoning and action presuppose "a transformation, a commutation" which makes a distinction between subject matter knowledge and PCK. The aim is then to understand how teachers, starting from “being able to comprehend subject matter for themselves, become able to elucidate subject matter in new ways, reorganize and partition it, clothe it in activities and emotions, in metaphors and exercises, and in examples and demonstrations so that it can be grasped by the students" (Shulman, 1987, p.13). It seems obvious that the concept of pedagogical reasoning is close to that of "didactic transposition", that is to say the inevitable phenomena of transformation, elaboration and reconstruction of the knowledge to be taught [e.g.

serve reception in volleyball could be taught as a tactical problem to a team or as an individual ball skill (forearm pass). In both cases the "teaching content" won't be the same even though some activities planned look common, or, in other words, the focus to the tasks won't be equivalent]

Moreover, we believe that the term "pedagogical reasoning and action" expresses the embedding of this transformation process within practices themselves. Thus, there are also points of theoretical overlap between the concepts of "pedagogical reasoning and action" and "didactic contract." Researchers in didactics consider that the "didactic contract" - the set of negotiations, more often than not implicit, between teacher and students about the knowledge taught in a given situation - is the continuation in action of the didactic transposition. Didactic contract is the result of tacit and implicit negotiations among students, an instructional environment and a teacher about the knowledge to be taught and learned (Brousseau, 1986). Thus the didactic contract specifically concerns the content taught and cannot be confounded with all what is involved in class management. To be more precise, the didactic contract is primarily the part of the class management that concerns specifically the content embedded in the task. The concept of didactic contract has also probably theoretical connection with "accountability" as described into the ecological model (Doyle, 1986; Hastie & Siedentop, 1999) but this is not the purpose of this review. Didactic contract is studied at the micro level, when the content is brought into play during the academic work conducted by the teacher (Amade-Escot, 1996a, 1996b, 1999). Figure 1 shows a specific example.

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Insert Figure 1 about here

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We therefore suggest that the concepts of "didactic transposition" and "didactic contract" shed new light from the didactic program on the questions raised by Shulman about pedagogical reasoning and action, which are not taken into account by researchers working on physical education in the PCK program. This review will discuss some of the findings of the didactic program.

Research in physical education: Problems investigated

The didactics of physical education investigates the specific phenomena of transmission and appropriation of knowledge and know-how. It cannot be reduced to looking for the right way

to teach fixed knowledge or know-how. On the contrary, it tends to throw back into question the theoretical and practical content of physical education teaching and the associated methods and procedures. The research is organized around two main orientations (Marsenach & Amade-Escot, 1993a): to design new content in physical education and to better understand how work the "didactic system" of physical education.

The first orientation is to develop new approaches and design of content in physical education. The aim is to transform teaching practices by proposing new curricula. The methodology of these studies consists in the design, production, trial and validation of didactic sequences. This research orientation does not come within the scope of the present review and will therefore not be discussed.

The second research focus is to study the "didactic system" of physical education thoroughly in the aim of better understanding how it works. Research questions seek to grasp the modes of selection, elaboration and treatment of content, the difficulties of transmission, the conditions in which the students appropriate content, and the constraints operating on this double process. Qualitative methods have been widely used in this orientation. Data sources include documents (official instructions, syllabuses, innovation reports, professional publications, lesson plans, etc.) and case studies (interviews, class observations, observations of didactic sequences, etc.). Some studies cover populations of students or teachers through questionnaires and tests, using multivariate descriptive statistics (Amade-Escot, 1991, Carnel, 1994, David, 1993).

Research on the didactic system

Four major themes have emerged from research on the didactic system: (a) knowledge at the origin of the content to be taught, (b) teachers' didactic conceptions, (c) students' conceptions, and (d) didactic interactions in class.

Knowledge at the basis of the teaching content

The objective of research on the origin of the content is to study "didactic transposition". In physical education, the academic knowledge at the origin of content is not developed in the same way as knowledge is developed in the scientific disciplines. In physical education it is built by trial and error and takes various elements into account: (a) the evolution of sport as a social practice, (b) the custom of professional practice, and (c) the complex interplay in sport between scientific knowledge and empirical knowledge (Léziart, 1997).

Some researchers examine the genesis of the knowledge to be taught. A study of the spread of sporting knowledge in swimming helps to explain the evolution of teaching content in this field (Arnaud, 1986; Terret, 1994). Another approach consists of looking back at the history of techniques and sports rules from the point of view of physical education in order to open up possibilities for didactic transposition (Goirand & Metzler, 1996). Studies of the national curriculum and professional publications characterize various modes of didactic transposition in swimming, boxing and judo before they are taught (Pelayo & Terret, 1994; Terrisse, 1994, 1996). The conclusions of this research described the variability of the content knowledge designed to be taught in physical education.

A second group of studies examined expert knowledge in swimming and rhythmic gymnastics. Contributory sciences (neuroscience, motor learning and biomechanics) and movement analysis are used for modeling athlete skill performance and identifying key content that must be taught (Bos, 1996; Loquet, 1997, 1999). Similarly, research on tactical knowledge in team sports is studied from a constructivist perspective for the purpose of giving content guidelines for teachers and students (Gréhaigne & Godbout, 1995; Gréhaigne, Godbout & Bouthier,(1999).

Other studies shed light on the "didactic transposition" at the implementation level. Three models of didactic transposition emerge from studies of student-teachers' lesson preparation or the observation of in-service teachers: (a) a model centered on decontextualized gestural forms to be reproduced, (b) a model presenting a set of principles of action and action rules drawn from high level activity (for definitions of these concepts see Gréhaigne & Godbout, 1995, p.495-496); (c) a model for discovering operative action rules according to the context, the problem set up and the students' level (Amade-Escot, 1989, 1991, Genet-Volet & Desrosiers, 1995). A North American article sees PCK as the result of a treatment of the subject matter (Rovegno, 1995b). This author distinguishes three forms of "dividing and sequencing of the subject matter": (a) a “linear and hierarchical model” which divides the contents into decontextualized units; (b) a “spiral and less linear model” in which exercises become progressively more complex; (c) a “matrix model” centered on the connections between the various elements of the content and the meanings they have for the students (Rovegno, 1995b, p.286-288). A point of convergence appears among these three research works, the first two of which were carried out in didactics and the third under the PCK program. The treatment and sequencing of content in physical

education seems to favor decontextualized models of technical gestures rather than more complex models centered on operations to be performed or problems to be solved. This trend is more marked in student-teachers (Amade-Escot 1991, 1998; Rovegno, 1995b) whereas diversified modes of transposition may be used side by side by experienced teachers (Genet-Volet & Desrosiers, 1995).

Didactic conceptions and knowledge of teachers and teacher-educators

The didactic conceptions of teachers and teacher educators reflect the way the teaching content to be presented to the students is designed. Studies underscore the heterogeneity of didactic conceptions (Amade-Escot, 1991; Brau-Antony, 1998; Carnel, 1994; Robin, 1996). The latter work examines the forms of rationality that structure the didactic proposals of four teacher-educators in school gymnastics. It contributes to a better characterization of the professional publications useful to teachers.

The study of the didactic conceptions of beginner and experienced teachers has identified a number of dominant features related to the transposition processes described above. Transforming the didactic conceptions of teachers is not easy (Amade-Escot, 1991; Amade-Escot & Léziart, 1996; Brau-Antony, 1998; Marsenach & Mérand, 1987; Refuggi, 1994). The role of teacher education cannot be identified precisely. However, it seems possible to improve certain aspects of the beginning teacher's didactic conceptions in initial teacher education through reflective practice (Amade-Escot, 1998; Euzet & Méard, 1996). Another series of studies completes these analyses, highlighting the extent to which teachers' choices and the way they classify or order learning situations are connected to didactic knowledge specific to the physical activity being taught (Ade & Amade-Escot, 1997; Dufor, 1996; Soler, 1994;). Moreover, the conceptions of the content to be taught vary by school level: junior or senior high school (Marsenach, Dhellemes, Canvel & Mirabel, 1993). A study on athletics reveals that teachers use two forms of knowledge in relation to the circumstances: planning or teaching (Barrué, 1994). The research lends credit to the idea that the transformation of didactic conceptions depends on a long-term process involving the professional knowledge of those concerned. The evolution is complex and new teaching content cannot be introduced without having repercussions on the whole (Léziart, 1992, Marsenach, 1994; Amade-Escot & Léziart, 1996).

In our opinion, research into the didactic conceptions of physical education teachers reports similar findings as PCK research: complexity of the elaboration and transformation processes,

embedding of practices, specificity regarding the subject matter, and the importance of the context and the level of the class.

Students' conceptions

Research on students' conceptions is scarce despite the presence of considerable literature devoted to it (e.g., Clément, 1996). This is no doubt a particularity of physical education with respect to other school disciplines, which can be explained by the nature of the content. One study done by David (1993), underscores the complexity of the "student's conception" variable as soon as the teacher-educator or teacher seeks to take it as a basis to construct teaching projects at different levels. A second publication establishes that some students' conceptions are an obstacle to the acquisition of economical, efficient long-distance swimming (Refuggi, 1999; Refuggi & Chifflet, 1996). What comes out of these studies as a whole is that students' conceptions could be at the origin of teaching difficulties.

Observation of didactic interactions in the classes

The analysis of didactic interactions in actual classes is the oldest sector of research on the didactics of physical education. The studies performed over ten years or so at the Institut National de la Recherche Pédagogique (French national institute for pedagogical research - for a describtion see Marsenach, 1994; Amade-Escot & Marsenach, 1995) focus on the teaching of physical activities and sports most commonly found in high school curricula. This research produced a descriptive knowledge base on common practice in schools. The observation of volunteer teachers recognized for their experience, and the decoding of their interventions shows that content is transmitted in the form of instructions for execution during students' motor performance. More often than not, these instructions are gestural forms taken from technical descriptions (sometimes obsolete) that are poorly suited to the students' level of motor development. The teachers' interventions are mainly aimed at reducing the difference between the student's performance and the standardized model taken as a reference (Amade-Escot, 1993; Marsenach et al., 1991; Marsenach et al., 1993; Marsenach & Mérand, 1987). These results, specified according to the physical activity taught, characterize the functioning of the didactic system of physical education. They point out consistencies in the difficulties encountered in day-to-day teaching.

It seems to us that there is a relation between the authors' conclusions and those developed by North American researchers under the PCK program with respect to the content taught by

student teachers (Rovegno, 1992b, 1993a, 1994, 1995b). There are also similarities with the conclusions of research on the dominant curriculum in the United States (Hastie, 1996; Siedentop, Doutis, Tsangaridou, Ward, & Rauschenbach, 1994; Rink, 1993). A marked similarity appears in the teaching of physical education in both countries, notably at the level of how content is structured and managed by the teachers, that is to say simplifying the content to surface features of motor techniques, reducing the time of practice, juxtaposing technical exercices and global situation, and limiting teaching intervention because of inaccurate conception of the constructivist approach or inaccurate subject matter knowledge. These regularities, reported by researchers from various theoretical horizons, suggest we should look more deeply into the reasons for these similarities.

Other findings produced by research in the didactic program showed that when difficulties arose during the lesson, teachers limited the options that they initially presented to the student. An analysis of critical didactic incidents (i.e. relative to the content taught) showed a reduction of task requirements and, thus, a reduction of the student foci to a few surface features [for instance in the above example (figure 1), instructions given by the teacher: "get ready", "remember to say ‘mine’ before hitting the ball", "arms up"]. Other findings show that teachers constrain the task so that the expected student response appears quickly. The disadvantage of this is a loss of the meaning and context, and hence the sense, of what is taught (Marsenach et al., 1991; Marsenach & Amade-Escot, 1993b, Refuggi, 1994). There is evidence that there are critical moments in the teaching process. Entry into a situation is decisive: on the one hand because the students have a tendency to change the initial conditions of the exercise [for instance, like described in figure 1] and on the other hand because the teacher often intervenes too early without giving the students time to make the motor adaptations necessary for learning. In questioning phases, teachers tend to acknowledge the one part of the answer that they wanted to hear, and to ignore the others. Thus students' gave back only what they think the teacher wants to hear. These implicit negotiations of the "didactic contract" emerge in action and continually change the content taught. Most of the time teachers are not aware of these critical moments, and thus they are not under the teacher's control (Amade-Escot & Léziart, 1996; Dhellemmes, 1995; Loquet, 1996; Marsenach, 1995; Marsenach et al., 1993).

The regularity with which these prominent features of teaching have been observed (in both beginner <u>and</u> experienced teachers' teaching) leads us to think that they indicate constraints, or

even determinations, that affect the teaching process under study. Current hypotheses, which are common to various school disciplines, suggest the existence of constraints inherent in the didactic system. That means that the working of this system is also constrained by the subsystem of the knowledge which is at the heart of the transmission. Thus knowledge, its transposition and the successive didactic contracts governing how it is brought into play, are all constraints that cannot be avoided since they weave connections at the very foundation of the didactic relation (for a treatment in greater depth, see Amade-Escot & Marsenach, 1995, 131-139). It is because of these constraints that a subtle process of transformation and elaboration of content emerges during action. These constraints thus are one part of the indissoluble substance of the teaching-learning process and depend on the content taught and the situated teaching context.

General conclusion

This review has highlighted a number of common concerns and findings between investigations into PCK and didactics. Despite their different theoretical frameworks, a common set of themes (understanding the processes at the origin of the elaboration and implementation of teaching content) lies at the heart of the studies. Their methods are virtually the same and, in the present period, favor qualitative analyses. The findings are consistent and underscore the fact that teaching content in physical education: (a) is highly specific to physical activities and sport and to the domain being taught, (b) comes within the scope of an analysis of action in context, (c) evolves in the long term in relation to the professional knowledge of which they form an important part, and (d) is dependent on constraints inherent in the system.

Certain aspects of the two research agenda, however, are different. While the North American results establish a difference of quality, richness and efficiency in the PCK of experienced and novice teachers, didactics research tends to show that the content of physical education depends less on experience than on specific competence in terms of didactic knowledge of the physical activity taught. These conclusions are confirmed by recent research carried out in the theoretical framework of PCK (Hauw, 1997; Schempp, Manross, Tan & Fincher, 1998; Soler 1994). Some expertise in subject matter knowledge and the ways to bring it into play during the didactic interaction might be necessary to develop a high PCK whatever the experience of the teacher.

The PCK program stresses the teachability of pedagogical content knowledge as an element of improvement for the teaching processes of physical education, whereas the didactic program - without prior assumptions on this teachability - tries to identify the conditions in which it is possible to change practices. The studies suggest the existence of constraints limiting the students' and teachers' room to maneuver. They lead researchers to put forward the existence of equilibrium states in the system, the sensitivity of which should be investigated if the system is to be improved.

An important difference between the two agendas is the focus of didactics research on the content itself and its major role in the teaching system, whereas PCK research focuses on the "teachers' cognitions" variable.

These concluding remarks as a whole sum up the specificities and the points of convergence of the two research programs we have described. Each sheds light on the question of teaching content in physical education from its own point of view. This comparison of the two approaches, intended to provide mutual information through an overview of the research, gives a glimpse of the prospects for dialog, for closer contact or even joint work, which, in our opinion, would be fruitful for both research communities.

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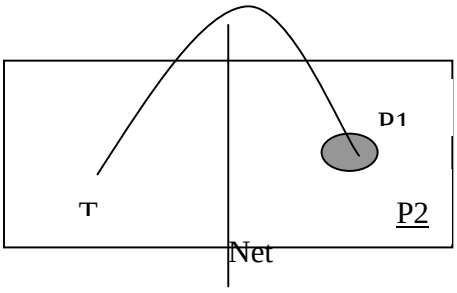
Volleyball, middle school, 12 years old.

Task: two players serve reception (initiated by a rainbow toss from the opponent)

Tactical problem to solve: players must distinguish the ball player's role from off ball player's role in an uncertain context, when the ball arrives between the two players.



T : Server vith a raibow toss
P1 : Player one
P2 : Player two
: Zone of serve

Goal: the two players must anticipate and cooperate so they can play with two hits of the ball before throwing it over the net.

Success clue expected: One of the players calls "mine", while the other moves ready to cooperate.

Teaching content: construction of common information that allows anticipation for both players.

Observation of the implicit negotiations: in most of the groups that succeed (T) throwed the first ball to the highest skilled player (P1 or P2) and not between the players. The teacher does not comment on the task modification. Instructions are given to the lower skilled students ("get ready"; "remember to say "mine" before hitting the ball": "arms up"; "go, go").

Consequences on the content really taught: students achieve the goal of the task, but they do not learn how to distinguish both roles (who receives the ball is not uncertain between the players, but clearly goes to one of the players). The teacher appears to not be aware of the change in the content taught.

(from Amade-Escot, April 1999, Teacher's role in didactic interactions. Paper presented at AIESEP World Congress, Besançon, France)

Acknowledgments

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