

Spectrum Research Reconsidered

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The Spectrum of Teaching Styles is one of the most important conceptual frameworks in physical education teaching. Research on the Spectrum has been conducted for over thirty years and numerous studies have been published. The purpose of this paper is to discuss specific issues concerning Spectrum research. Three areas of discussion are identified: First, an overview of Spectrum research in the 1970s is given and conclusions about this early research are reached. Second, Spectrum research in the 1980s and onwards is discussed with respect to certain methodological and theoretical concerns; namely, examining Reproduction styles against Production styles, comparing landmark objectives of one style against a different style, inappropriate subject matter selection, focusing solely on subject matter objectives, and lack of reliable and valid observation tools. The final section addresses the above issues and suggests reconsidering the idea of conducting valid Spectrum research.

key words: *Teaching, Teaching Styles, Pedagogy, Spectrum*

Introduction

The *Spectrum of Teaching Styles* is a conceptual framework which helps to describe and organize the process involved in teaching as well as serving as a repository for gathering results. According to Mosston & Ashworth (2008), the Spectrum consists of a continuum of 11 styles, each of which emerges as decisions shift between teacher and learner. Each style has a specific name as well as a corresponding letter of the alphabet: namely, the Command Style (A), the Practice style (B), the Reciprocal style (C), the Self-Check style (D), the Inclusion style (E), the Guided Discovery style (F), the Convergent Discovery style (G), the Divergent Production style (H), the Individual Program (I), the Learner-Initiated style (J), and the Self-Teaching style (K).

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According to Spectrum theory, the 11 styles can be clustered into either Reproduction (styles A-E) or Production (styles F-K) teaching styles. When Styles A-E are used, the purpose of the instruction is the replication of specific known skills and knowledge. The teacher specifies the subject matter of the lessons, indicates the learning conditions by identifying the teaching style, and defines the criteria for correct task completion. The class climate is one of performing the model, repetition, and reduction of errors. Feedback is specific, often corrective, and there is an acceptable way to perform the selected task.

The Production cluster of styles F-K invites the discovery of new information by the student. In some styles within this cluster the production of ideas may even be new to the teacher. In styles F-K, students are engaged in cognitive operations such as problem solving, inventing, comparing, contrasting, and synthesizing. The class climate favours patience, tolerance, and individual cognitive and emotional differences. Feedback refers to the production of new ideas.

As early as 1973, Nixon & Locke (1973) declared the Spectrum of Teaching Styles as “the most significant advance in the theory of physical education pedagogy in recent history” (p.1227) even though it needed additional empirical testing. Scholarly interest in the Spectrum resulted after their statement. Goldberger (1995) concluded that the early enthusiasm expressed by Nixon and Locke appears warranted as empirical evidence did support the theory underlying the Spectrum.

Although scholarship has acknowledged the contributions of the Spectrum theory to physical education pedagogy (Goldberger, 1992; Graber, 2001; Sicilia-Camacho & Brown, 2008), Mosston’s work is open to criticism. Some scholars have attempted to expand or clarify Mosston’s original theory (Crum, 1995; Digelidis, 2006; Hurwitz, 1986; Krug, 1999) while others have identified problems related to it. The following are some of the problems traced by a number of sport pedagogists (Hurwitz, 1985; Metzler, 1983; Sicilia-Camacho & Brown, 2008; Williams, 1996).

Overemphasis on teacher behavior. Mosston’s model focuses solely on teacher’s behavior by describing in detail what the teacher is supposed to do when a certain teaching style is in use (Metzler, 1983). This results in not attending to student process behavior which affects, to a great extent, achievement and instructional effectiveness.

Lack of sequential descriptions of student and teacher behaviours. The Spectrum

does not describe the sequence in which teacher and student behaviour are planned to occur within any teaching style (Hurwitz, 1985). According to Hurwitz (1985), knowing the sequence in which such behaviours occur is important to planning.

Difficulties in verifying the styles. The ecology of a class dictates that the teacher uses more than one teaching styles in varying degrees. This makes it difficult to describe the overall behaviour of the teacher according to the Spectrum (Metzler, 1983). Under the circumstances, verification of styles is problematic which does not help to demonstrate differences between styles to pre-service teachers (Metzler, 1983).

Ignoring the context of learning. Learning styles are not taken into account by Spectrum theory (Williams, 1996). Learning is more effective when the teaching style used is consistent with the preferred learning style of the student (Williams, 1996).

The problematic nature of the shift from the versus to the non-versus reality of Spectrum theory. The shift from the versus to the non-versus notion signifies an endorsement of technocratic orientations in teaching. This orientation is problematic because it reduces professional reflection to decisions about choosing from a universalized menu rather than why and how given teaching styles are relevant to a particular cultural context (Sicilia-Camacho & Brown, 2008).

Despite the criticism and the problems associated with the Spectrum theory, the Spectrum of Teaching Styles has been adopted and presented around the world (Franks, 1992; Krug, 1999). In particular, it has served as a framework for delivering instruction at schools (Chatoupis & Emmanuel, 2003; Gerney & Dort, 1992) and for designing physical education teacher education programmes (Ashworth, 1990; Mueller & Kuchinski, 2007). Additionally, it has provided authors with a framework to systematically study teaching and learning (Byra & Jenkins, 1998; Pieron, 1995).

The main purpose of this paper is to discuss specific research issues that relate to Spectrum theory. An overview of issues will be presented in three areas: (a) Spectrum Research (SR) in the 1970s, (b) SR in the 1980s and onwards, and (c) concluding thoughts.

SR in the 1970s

In an attempt to determine what effective teaching is, researchers employed the process-product research paradigm to investigate relationships between teacher behaviour and learner achievement or the efficacy of different teaching methods (Silverman, 1991). SR is based on that process-product paradigm: testing the hypothetical relationships between particular teaching styles and certain learning outcomes.

The first attempts to test those relationships were made in North America in the 1970s. Six doctoral dissertations (Boschee, 1972; Chamberlain, 1979; Dougherty, 1970; Jacoby, 1975; Gerney, 1979; Virgilio, 1979), two unpublished projects (Bryant, 1974; McCleary, 1976) and one research paper (Mariani, 1970) were completed during that period. These studies continued the tradition of comparing the effectiveness of disparate teaching methods (Nixon & Locke, 1973) in order to investigate the claims set forth by Mosston.

The main characteristic of that early research was (a) the implementation of two or more teaching styles from the Reproduction cluster (the Self-Check style was not researched), (b) measurement of fitness/motor skill development related to various sports (gymnastics, alley soccer, softball, hockey, archery, tennis), social/self-concept development and attitude, and (c) data analysis. The pretest-posttest group design predominantly involving elementary school children fifth to sixth grades. The duration of those studies was three to six weeks. In one case the duration was fourteen weeks (Dougherty, 1970). Table 1 provides further information on each Spectrum study. Four general conclusions about the above studies can be drawn:

First, they suffered from methodological and statistical flaws. These flaws have been highlighted by a number of Spectrum researchers (Goldberger et al., 1982; Griffey, 1983; Metzler, 1983). The interested reader is referred to Byra (2000) for an overview.

Second, they produced no significant differences between the contrasting styles and, thus, they failed to establish connections between theory and action (implementation).

Third, they did not focus on aptitude treatment interactions, that is the interactions between individual aptitudes, personality, and traits of students and teaching styles (Chatoupis, 2000). Under the circumstances, the effects of teachers are masked making it almost impossible to establish empirical relations between teaching behavior and student outcome (Berliner, 1976).

Table 1. Summary table for early SR

Title	Author	Date	Teaching Styles used	Participants	Variables tested	Duration
A comparison of the effectiveness of the command method and the task method of teaching the forehand and the backhand tennis strokes	Tom Mariani	1970	Command Style, Task Style	30 male college students	Forehand and backhand stroke achievement	6 weeks
A comparison of the effects of Command, Task and Individual Program Styles of teaching in the development of physical fitness and motor skills	Neil Dougherty	1970	Command Style, Task Style, Individual Program Style	115 male college students	Five physical fitness components, seven motor skills related to gymnastics	14 weeks
A comparison of the effects of Command, Task and Individual Program Styles of teaching on four developmental channels	Floyd Boschee	1972	Command Style, Task Style, Individual Program Style	221 fifth grade boys and girls	Skill in alley soccer, game knowledge, personal adjustment, social adjustment	Not given
Comparison of the practice and reciprocal styles of teaching	W. Bryant	1974	Practice Style, Reciprocal Style	-	-	-
A comparison of the effects of Command, Reciprocal, and Individual Program Styles of teaching on the development of selected sport skills	David Jacoby	1975	Command Style, Reciprocal Style, Individual Program Style	10-13 year old students	Knowledge of softball, skill in pitching, accuracy in throwing, attitudes towards physical education	5 weeks
A comparison of the task and problem solving styles in teaching kindergarten and first grade students	E. McCleary	1976	Task Style, Problem Solving Style	Kindergarten and first grade students	-	-
The effects of Mosston's Practice Style and Individual Program-teacher design on motor skill acquisition and self-concept of fifth grade learners	James Chamberlain	1979	Practice Style, Individual Program Style	32 fifth grade boys and girls	Accuracy in hockey, self-concept, prediction ability	60 trial treatment

The effects of direct and reciprocal teaching strategies on the cognitive, affective, and psychomotor behaviour of fifth grade pupils in beginning archery	Stephen Virgilio	1979	Command Style, Reciprocal Style	46 fifth grade boys and girls	Archery knowledge, self-concept, archery skill	6 weeks
The effects of Mosston's practice styles and reciprocal style on psychomotor skill acquisition and social development of fifth grade students	Philip Gerney	1979	Practice Style, Reciprocal Style	32 fifth grade boys and girls	Accuracy in hockey, ability to give and receive feedback	60 trial treatment

Note. The above information was retrieved from the Dissertation Abstracts International index. Bryant's and McCleary's research projects are not retrievable any longer, and therefore, very little information about them is given.

Fourth, early SR led current researchers to (a) more accurately and thoroughly understand the theoretical premises underlying the teaching styles and (b) conduct more valid research in terms of appropriate research questions about the Spectrum and appropriate research methods (Byra, 2000; Goldberger, 1992).

SR in the 1980s and Onwards

Many Spectrum studies conducted in the last two decades share common characteristics with early SR in terms of teaching styles used or student outcomes measured. However, they address more diverse and varied questions concerning multiple human dimensions and domains of learner development than in the 1970s (Chatoupis, in press-b). Additionally, teaching styles are examined with learners of different age groups and abilities. Furthermore, researchers have begun to cross the discovery threshold and investigate teaching styles from the Production cluster (Chatoupis, 2009).

As noted previously, early SR led current researchers to design more valid SR studies in the 1980s and onwards. Unfortunately, there remains current studies that have not addressed specific issues about conducting well designed SR which make

one reconsider the above contention. The current design issues that invalidate SR results are: (a) examining Reproduction styles against Production styles, (b) comparing landmark objectives of one style against a different style, (c) inappropriate subject matter selection, (d) focusing solely on subject matter objectives, and (e) lack of reliable and valid observation tools. A discussion of these issues follows.

Examining Reproduction Styles against Production Styles

There are a few Spectrum studies which examine the effectiveness of teaching styles from the Reproduction cluster (the Command or the Practice style) against teaching styles from the Production style (the Guided Discovery or the Convergent Discovery style) on motor skill acquisition (Derri & Pachta, 2007; Hein & Kivimets, 2000; Neetz, 1987; Sadiq, 2008; Salter & Graham, 1984; Sanmuga, 2008; Simpson, 2003; Sunay et al., 2004). Unfortunately, this kind of research is invalid. Theoretically, teaching styles from the Production cluster primarily emphasize discovery. Cognitively the Convergent Discovery style highlights the acquisition of concepts, principles, rules or laws whereas the Divergent Discovery style encourages the production of alternative divergent solutions (Mosston & Ashworth, 2008). Examining these styles for motor skill acquisition, which relies on teaching styles from the Reproduction cluster, is incongruent with Spectrum theory and leads to invalid and misleading conclusions. Mosston and Ashworth (1994) state: “examining styles from one cluster against learning outcomes that belong to the other cluster will yield inappropriate and inaccurate results” (p.254).

Comparing Landmark Objectives of one Style against a Different Style

Some research lacked accurate or thorough understanding of the theoretical premises underlying the teaching styles under scrutiny. That was evident by the fact that inappropriate connections between styles and landmark objectives were made. For example, some Reciprocal style studies examined learning outcomes from the psychomotor domain which demonstrates a lack of Spectrum knowledge (AlMulla-Abdullah, 2003; Johnson, 1982; Moore, 1996; Oosthuizen & Griesel, 1992; Sadiq, 2008; Virgilio, 1984; Wilson, 1997). Although the Reciprocal style provides conditions for learning motor skills, particularly in the early stages of learning and particularly learning the “form” of the skill (M. Goldberger, personal communication,

January 28, 2008), the landmark objectives of this style are developing social skills and cognitive skills (Mosston & Ashworth, 2008).

Also, certain Guided Discovery style studies employed a knowledge test to measure knowledge gains (Derri & Pacht, 2007; Salter & Graham, 1984; Simpson, 2003). However, that knowledge test required students to recall past knowledge of subject matter. It is contradictory to Spectrum theory to examine the effects of the Guided Discovery style on learners' basic recall of factual information. The Guided Discovery style engages learners in the process of sequenced guided discovery and not in cognitive operations that rely exclusively on memory and recall (Mosston & Ashworth, 2008).

Inappropriate Subject Matter Selection

Matching the content with the appropriate style is critical for effective teaching experiences and essential when conducting valid research (Mosston & Ashworth, 2008). In several Command style studies, the subject matter and the style selection were incompatible for precision performance practice. The following subject matter topics, as described, are physically challenging for introductory precision performance experiences and, therefore, not conducive for novice performers in the Command style: Volleyball (bump, serve, dig pass, and spike) (Harrison et al., 1995; Neetz, 1987; Sunay et al., 2004), gymnastics (cartwheel) (Hein & Kivimets, 2000), golf (Salter & Graham, 1984), basketball (dribbling) (Sadiq, 2004) or tennis (strokes against the wall) (Patmanoglou, Mantis, Digelidis, Tsigilis, & Papapetrou, 2008). Body positioning is possible in this style but not group performance. According to Spectrum theory the Command style is appropriate for teaching activities which require synchronization, precision, and a high degree of uniformity (dance patterns, aerobic routines, karate movements, synchronized swimming experiences) (Mosston & Ashworth, 2008).

Another example is studies that select the Self-Check style when introducing to novice students new material that has multiple parts. In these studies, physical tasks, like badminton (short-low serves) (Abd Al-Salam, 2004) or tennis (strokes) (Patmanoglou et al., 2008) were taught. The Self-Check style requires the learners to engage in self-assessment. This behaviour is not appropriate for the novice learners who do not demonstrate some degree of success in the task. It is premature to ask inexperienced learners to make self-assessment decisions when they do not have the basic competence in performing the skill (Mosston & Ashworth, 2008).

The newer learners are to a complex physical task, the more inappropriate the Self-Check style is (Mosston & Ashworth, 2008).

Focusing Solely on Subject Matter Objectives

A few Spectrum studies looked at subject matter objectives by asking questions like: Which style will best improve motor skill performance? (Abd Al-Salam, 2004; Almulla-Abdullah, 2003; Johnson, 1982; Moore, 1996; Patmanoglou et al., 2008; Virgilio, 1984; Wilson, 1997). This comparison is invalid between or among styles on the Reproduction side of the Spectrum. All styles on the Reproduction side are designed to support achievements in the psychomotor domain (subject matter objective) (Mosston & Ashworth, 2008). Generally, differences will not be significant when only one broad variable is used that is common to all styles. According to Spectrum theory, all Reproduction styles can achieve motor skill attainment but each style emphasizes different behaviour attributes/objectives (self-assessment and feedback, beginning of independence, examining self-perceptions) (Mosston & Ashworth, 2008). It is the decisions and therefore the behaviour attributes/objectives that are highlighted that make each style different from another. It is inappropriate for a research question to ask: Which style will best improve motor skill performance?

Lack of Reliable and Valid Observation Tools

Observing process behaviours in the class is a prerequisite for conducting valid process product research. Without systematic observation it is difficult to say whether or not the independent variables are accounted for in changes in the dependent variables (Metzler, 1983). An analysis of SR (Chatoupis, in press-a) revealed that of the 53 reviewed Spectrum studies, ten studies did not use systematic observation while in another 17 it could not be ascertained whether observation techniques were used or not because this information was not given (Bournelli, 1998; Boyce, 1992; Christodoulidis et al., 2001; Harrison et al., 1995; Hein & Kivimets, 2000; Griffey, 1983; Neetz, 1987; Oosthuizen & Griesel, 1992; Patmanoglou et al., 2008; Proios & Proios, 2008; Sunay et al., 2004). This raises concerns about the validity of this research because there was no treatment verification or no information about the fidelity of the teacher-learner behaviours to the theory.

Also, Chatoupis (in press-a) found that of the remainder 26 Spectrum studies,

which used systematic observation, some of them used observation systems developed by the researchers themselves and no information was given about (a) their validity and reliability and (b) whether or not these observation tools were Spectrum-specific in the sense that they complied and corresponded with Spectrum theory (Digelidis et al., 2003; Goudas et al., 1995; Mouratidou et al., 2007; Morgan et al., 2005; Reppa, 2007; Simpson, 2003).

Conclusion

In the early 1980s a number of scholars brought researchers' attention to methodological and theoretical issues concerning conducting valid SR in an attempt to help them avoid problems found in early SR. Despite Goldberger's enthusiasm about the sound knowledge current researchers have about SR (Goldberger, 1992), this enthusiasm is not reflected in research completed in the last two decades. This is not to say that valid and good SR has not been conducted so far. The work of Mike Goldberger (Goldberger et al., 1982; Goldberger & Gerney, 1986; Goldberger & Gerney, 1990), Mark Byra (Byra & Jenkins, 1998; Byra & Marks, 1993; Ernst & Byra, 1998; Jenkins & Byra, 1997), and Francis Cleland (Cleland, 1994; Cleland & Gallahue, 1993; Cleland et al., 1999) is considered to be exemplary not only because it has verified Spectrum theory and has helped us to understand this theory, but also because it has addressed issues raised by the present paper as well as by other scholars (Griffey, 1983; Metzler, 1983). However, much has to be done by current or future researchers to continue to produce sound and valid SR. In this section the issues discussed earlier are addressed.

Comparing teaching styles from the Reproduction cluster with teaching styles from the Production cluster is inappropriate for reasons mentioned in the previous section. Pitting one style against another to determine which style accomplishes one set of fixed objectives and learning focus is invalid SR. "This implies that styles do not compete with each other for supremacy. Research that seeks to find which style is best is theoretically and practically futile" (Mosston & Ashworth, 1994). Therefore, more attention to investigating the theoretical assumptions within any teaching style will be welcomed in the field.

It appears that some investigators did not appreciate the theoretical premises of

the styles under scrutiny. Their philosophical position resulted in inaccurate claims about the subject matter or the objectives these styles can achieve. Spectrum theory is precise about the objectives each teaching style can achieve and which subject matter focus is more desirable in different styles. It is necessary that researchers have a thorough understanding of the theoretical basis of the Spectrum before they start doing research. Carefully reading the chapter in Mosston & Ashworth (2008) on the teaching style they will investigate is a prerequisite. In addition the Spectrum Institute for Teaching and Learning (www.spectrumofteachingstyles.org) sponsors a variety of different types of workshops and seminars to promote utilization of the Spectrum theory. Spectrum researchers are advised to attend these seminars.

Mosston & Ashworth (2008) state that there are always two sets of objectives to be reached in any teacher-learner interaction: subject matter objectives (dribbling the basketball, kicking the football, performing the bench press, shooting) and behavior objectives (cooperation, self-assessment, honesty, replication, designing). Behavior objectives cannot be excluded from the learning experience; they are always embedded and result from the decisions made by the teacher and learners. Behaviour objectives are always made either deliberately or by default. The majority of the reviewed SR has focused on subject matter objectives (Chatoupis, in press-b). Researchers, who will look at the effects and influence of disparate teaching styles on behavior objectives, will provide a window into knowledge that is essential for all teachers and for all grades.

Lastly, internal validity requires that the classroom pattern of decisions by the teacher and learners be congruent with the theoretical style expectations. Researching the contributions or limitations of different teaching styles requires that the degree of authenticity and fidelity to the theory be determined. Because the governing principle of the Spectrum is that decisions are the underlying element that establishes the teaching and learning experience, it is imperative that researchers acknowledge the pattern of decisions that teachers and learners are making to determine the actual learning experience as compared to the anticipated experience. The employment of systematic observation can help towards this end. However, the observation tool must be valid and reliable and distinguish the teacher behaviours of various styles along the Spectrum. In other words it must be developed in such a way as to adhere to Spectrum theory. Two such observation systems have been identified in the literature (Goldberger, 1989; Sherman, 1982). Unfortunately, they have not been used extensively by Spectrum researchers.

The idea of conducting sound SR in terms of methodology, fidelity between theory and action, and a rational relationship between style and outcome must be seriously considered. Following are some suggestions for conducting sound SR and expanding the field.

As noted earlier, there is the need to employ systematic observation during the study. A major drawback of studies, which do not use some kind of systematic observation, is that the treatment is not verified (Silverman, 1985). Thus, there is no way of knowing whether or not it was implemented accurately. In other words, these studies suffer from a weak treatment effect which biases the results of the research. The employment of systematic observation necessitates the development of valid and reliable observation tools that comply with Spectrum theory. Without this development, SR will be idiosyncratic and unreliable. Also, attention needs to be given to reducing deficiencies observed in some studies: (a) Non-compliance to Spectrum theory (ignoring the decision patterns, comparing the landmark objectives of one style against a different style), (b) inappropriate style comparison (Reproduction styles against Production styles), (c) inappropriate subject matter selection (teach dribbling in basketball with the command style), and (d) short duration of the fieldwork. Lastly, SR that begins to show the human/behavior contributions of using teaching styles should merit the attention of the pedagogical community. An example of such research can be found in the work of Mark Byra (Byra, 2006; Byra & Jenkins, 1998; Byra & Marks, 1993).

After reviewing the literature spanning 28 years of SR, Chatoupis (2009) concluded that the field of SR has increasingly expanded since the 1980s but despite the considerable number of publications, research on the effects and influence of the Spectrum to teaching and learning is far from being exhausted. The Spectrum still provides a concrete model both for the systematic generation of research questions and as an organized repository for research results (Chatoupis, 2009) and as such it can provide ample opportunities for conducting relevant research.

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