An Analysis of Spectrum Research on Teaching

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Abstract

Spectrum research on teaching has been conducted since 1970s. The purpose of this study was to identify, categorize, and analyze research in this area. Fifty three Spectrum studies conducted between 1970 and 2008 were included in this study. Each paper was coded for (a) decade the study was published, (b) publication outlet/dissertation research, (c) country of origin, (d) teaching styles used, (e) population, (f) focus, (g) general methodology employed, (h) type of class, (i) observation used, and (j) aptitude treatment interaction effects. The results showed that Spectrum research has increased in number over the years, focused mainly on the psychomotor domain, used teaching styles from the Reproduction cluster most frequently, and was quantitative. Although there were methodological flaws, some of the reviewed studies met the minimum demands of good research in the area.

Physical education (PE) research focuses on three areas: teaching, teacher education, and curriculum (Silverman, 1991; Silverman, 1996). Teacher education research focuses on the development of preservice and inservice teachers while research on teaching looks at what teachers and students do and how this affects and relates to learning and social dynamics (Silverman, 1991).

A conceptual framework which has been used in research on teaching and teacher education is the *Spectrum of Teaching Styles* (Mosston & Ashworth, 2002). The Spectrum consists of 11 landmark teaching styles. Each style has its own decision-making amalgamation, 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).

A governing principle of Spectrum theory is that decisions are the unifying element that connects the teaching and learning experience. By identifying specific sets of decisions to be made by the teacher and the learner, significantly different learning conditions are produced. According to Spectrum theory, the 11 styles can be clustered into either Reproduction (styles A-E) or Production (styles F-K) teaching styles (Mosston & Ashworth, 2002).

The Reproduction cluster is more akin to direct, didactic, or teacher-centered instruction (Goldberger, 1983; Goldberger, 1984). 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 and tolerance and individual cognitive and emotional differences. Feedback

refers to the production of new ideas.

It has been stressed that Spectrum research has grown and prospered over the past three decades (Byra, 2000; Goldberger, 1995). According to Silverman and Skonie (1997), one way to understand the prosperity and growth of research in an area is to analyze its research. Research analysis refers to identification of research and its categorization on a variety of factors such as research focus, design, population, method, and variables used. This type of analysis allows for getting information and drawing conclusions about those factors (Silverman & Skonie, 1997).

So far one review study on Spectrum research has been published (Byra, 2000). However, reviewing the literature is something different from analyzing research in that the former focuses on synthesizing the results while the latter on categorizing research. In PE pedagogy four studies have analyzed published or dissertation research on teaching in physical education. Silverman (1987) found that most dissertation research on teaching was quantitative, focused on comparisons between teaching methods, occurred in school settings, and did not utilize systematic observation. Silverman and Manson's (2003) study provided 15 years of follow-up to Silverman study (1987) and found similar results. When published research was analyzed (Silverman & Skonie, 1997) the results were interesting: most studies focused on motor skill acquisition, used an observation instrument to collect data and employed intact classes. Byra and Goc Karp (2000) found that there was an increase in qualitative methods used in pedagogy research between 1988 and 1997. However, no study has focused on analyzing Spectrum research.

Analysis of Spectrum research can provide anyone, who is interested in conducting such research, with insights into research trends and directions for planning Spectrum research. Also, it shows the progress of the field and serves as a resource for those conducting research in the field. The main purpose of this study was to identify, categorize, and analyze Spectrum Research on Teaching (SRT) conducted since 1970. Thus, the study provides a basis for reporting changes and capturing trends in SRT over a period of 38 years. In addition, given that the "Spectrum can help identify areas of omission in the body of research on teaching in physical education literature" (Goldberger, 1991, p. 372), this paper comes to complement Silverman & Skonie's (1997) and Silverman & Manson's (2003) analyses.

Method

The focus of this paper was on SRT. SRT includes studies which use Spectrum theory to focus on the effects of one or more teaching styles on learning outcomes. Spectrum research related to teacher education and curriculum was not included in the analysis. Furthermore, Spectrum research where the focus was on teachers' use of or attitudes towards teaching styles was excluded. The review was delimited in order to provide an in-depth analysis of SRT over a number of years.

Identifying Research

The author undertook an exhaustive literature search utilizing electronic databases (ERIC, Sport Discus, Dissertation Abstracts International, ISI Web of Science, Google). The search used specific keywords (e.g., *the Spectrum of Teaching Styles*) to identify all data-based SRT completed from 1970 to December 2008, inclusive. Dissertation abstracts and research papers in books, journals, or conference proceedings were investigated. In the first place paper titles or abstracts were reviewed to decide which studies met the criteria of focusing on SRT. Then, those studies which met the criteria were examined in greater depth. In cases where the original article was not available, the investigation was based on the abstract. In cases where journals were an outlet for the doctoral dissertations, only the dissertations were considered for inclusion in the analysis.

The investigation resulted in 53 studies which

met the criteria of SRT. To determine reliability of the papers the author and an assistant re-reviewed them. Interobserver agreement for the two sets of decisions was 92%. It should be noted that five studies (two dissertations and three research papers) could not be located or retrieved and, therefore, they were not included in the analysis.

Categorizing Research

Categories were developed based on previous research analyses in PE (Silverman & Skonie, 1997; Silverman & Manson, 2003). The draft with the initial categories was piloted coded on 20 randomly selected papers to make sure that the instrument was usable. As a result, some coding categories were not used at all, others were modified, new ones were added and the instrument was finalized.

The final draft included the following categories: (a) Decade the study was published, (b) publication outlet/dissertation research, (c) country of origin, (d) teaching styles used, (e) population, (f) focus, (g) general methodology employed, (h) type of class, (i) whether observation was used, and (j) whether Aptitude Treatment Interaction (ATI) effects were examined. The reader should bear in mind that an ATI occurs when one or more characteristics of the learner (e.g. gender or initial ability) and one treatment variable (e.g., teaching style) interact to affect at least one dependent variable (e.g., achievement) (Snow, 1987).

Each study was categorized on each of the above dimensions. All categories and subcategories are listed in Figure 1. In some few cases, papers did not provide sufficient information to code all the above variables. Prior to actual coding, coding reliability was determined by randomly selecting 20 papers and recoding them. The percentage of agreement for each category and for all categories combined was around 90% and 85%, respectively.

Data Analysis

All studies were analyzed for each category to provide summary information. In particular, statistical analysis provided frequencies and percentages for each category. Two-way frequencies were tabulated for the year and the publication outlet/dissertation research categories. The SPSS (version 16.0) was used for all calculations.

Results

Trends by Decade of Publication Outlet/Dissertation Research

The number of SRT studies has grown over the years and great variability can be seen across decades and publication outlets. As noted in Table 1, only six research projects were identified in the 1970s, whereas 21 papers were published in the 2000s which seems to be a prosperous period for Spectrum research. In each decade the majority of research was published in journals while little research could be found in proceedings. Also, it was found that one out of five dissertations completed in the 1970s was submitted for publication. Another three out of five dissertations completed in the 1980s were submitted for publication and one dissertation completed in the 1990s and in the 2000s was submitted for publication. All 15 dissertations were completed in North American universities. A complete breakdown of publication trends/dissertation research per decade is provided on Table 1.

Country of Origin

SRT that has been located has been primarily conducted in the USA (n=32). Then, followed by Greece (n=11), UK (n=3), Jordan (n=3), Estonia (n=1), South Africa (n=1), Bahrain (n=1), and Malaysia (n=1).

Teaching Styles Used

Teaching styles from the Reproduction cluster have been used in many studies except for the Self-check style (n=5). In particular, the

Figure 1. Coding categories for SRT studies.

- Decade
  - 1970-1979
  - 1980-1989
  - 1990-1999
  - 2000-2008
- Publication outlet
  - Journal
  - Proceeding
  - Book
  - Dissertation
- Country of Origin
  - America
  - Europe
  - Asia
- Focus (more than one, if appropriate)
  - Psychomotor domain
  - Affective domain
  - Cognitive domain
  - Social domain
  - Moral domain
- General Methodology
  - Quantitative
  - Qualitative
  - Both
- Type of Class
  - Intact
  - Random
- Observation Used
  - Systematic observation
  - None
- Teaching Style Used
  - Reproduction
    - A, B, C, D, E
  - Production
    - F, G, H, I, J, K
- Population
  - School-aged
    - Preschool
    - Elementary
    - Middle school
    - High school
  - College/University
- ATI effects
  - Gender
  - Initial ability
  - SES
  - Companionship
  - Teaching Experience
  - None

Table 1
Trends by decade of publication outlet/dissertation research

Decade	Journal	Dissertation	Proceeding	Book	Total
1970-1979	1(1.89)	5(9.43)	0(0.0)	0(0.0)	6(11.32)
1980-1989	2(3.77)	5(9.43)	1(1.89)	2(3.77)	10(18.87)
1990-1999	10(18.87)	3(5.17)	3(5.17)	0(0.0)	16(30.18)
2000-2008[a]	13(24.53)	2(3.77)	6(11.32)	0(0.0)	21(39.62)
Total	26(49.05)	15(28.30)	10(18.87)	2(3.77)	53(100.0)

Note. Values enclosed in parentheses represent percentages.

[a] 2008 data is included for the whole year.

Table 2
Teaching styles used

Teaching style	Number of studies	Percentage of total
Reproduction cluster		
Command style	20	37.73
Practice style	26	49.05
Reciprocal style	28	52.83
Self-check style	5	9.43
Inclusion style	20	37.73
Production cluster		
Guided Discovery style	7	13.21
Convergent Discovery style	1	1.89
Divergent Production style	4	7.55
Individual Program	0	0.0
Learner-Initiated style	0	0.0
Self-Teaching style	0	0.0

Note. Each of the 53 studies investigated more than one teaching style. Therefore, they have been tallied more than once on the above table.

Table 3
Population of study participants

Population of study participants	Number of studies	Percentage of total
School-aged children	43	81.13
Preschool	0	0.0
Elementary	28	52.83
Middle school	4	7.55
High school	11	20.75
College/university	10	18.87
Total	53	100.0

Reciprocal style has been researched in 28 studies followed by the Practice style (n=26). On the contrary, teaching styles from the Production cluster have not been researched to a great extent. For example, the Divergent Discovery style and the Convergent Discovery style have been studied in four and one studies respectively. Table 2 presents the teaching styles used in full detail.

Population

Twenty eight studies were conducted with elementary school-aged children. No research occurred in preschool education settings. College/university students were included in 10 studies. It was not possible to ascertain which age group was used in two studies. The population is presented in Table 3.

Focus

Twelve studies exclusively focused on the affective domain with another 11 studies focusing exclusively on the psychomotor domain. Studies that exclusively focused on the cognitive, social, and moral domains represent a small proportion of SRT (n=5, n=1, and n=1, respectively). Research focusing on multiple domains is very well

represented (*n*=23) (see Table 4). It should be noted that all 23 studies focused on motor skill acquisition and another domain (i.e., affective or cognitive).

General Methodology

Thirty five studies used quantitative research methods to collect data. Qualitative research methods were used in 14 studies and both quantitative and qualitative methods were used in four studies.

Type of Class

Slightly over half of the reviewed studies used intact classes (*n*=28), as opposed to randomly assigning students to treatments (*n*=25). In addition, 25 studies used control group and about the same number of studies did not (*n*=28).

Observation Used

Systematic observation to verify teaching style implementation was used in 26 studies. In 10 studies it was not used at all whereas in 17 studies it could not be ascertained whether observation techniques were used or not because this information was not given.

ATI Effects

Around one third of the studies considered ATIs (*n*=21). Students' initial ability was studied by 11 studies, followed by gender (*n*=6), socioeconomic status (*n*=2), companionship (*n*=1), and teaching experience (*n*=1). Table 5 shows students' aptitudes in detail.

Discussion

It is apparent from Table 1 that the number of studies has gradually increased since 1970s. This growing trend in SRT reveals that the influence and benefit of the Spectrum theory continues to contribute to the classroom learning process. This is in line with the scholarship's contention that the Spectrum of Teaching Styles is a concrete model for conducting research in PE (Goldberger, 1992; Graber, 2001; Sicilia-Camacho & Brown, 2008).

It is noteworthy that the majority of SRT studies was published in journals which is consistent with a previous analysis (Silverman & Skonie, 1997). This is may be due to the fact that publishing in refereed journals is a prerequisite for taking a position or a promotion in research-oriented higher education institutions. Publication of research in a refereed journal suggests a more unbiased, professional investigation and presentation and allows the individual to become academically recognized as contributor to scientific knowledge.

Another interesting thing is that of the 15 dissertations located, only six were submitted to a journal for publication. It is difficult to say whether the remainder were submitted for publication and not accepted in a journal. Considering that many students who complete dissertation research on teaching in physical education are not interested in academic jobs (Silverman & Manson, 2003), the above information makes sense.

Tracing authorship from all over the world is important in reaching conclusions about the spread of Spectrum knowledge globally. The present analysis revealed that a few countries have conducted SRT (i.e., USA, Greece, UK, Jordan, Estonia, South Africa, Bahrain, and Malaysia). It is obvious that although SRT started in the USA, other countries have incorporated the Spectrum framework in their teaching and research. The premise that the Spectrum is a universal theory is reinforced by the fact that so many countries have adopted and investigated this framework. This worldwide adaptability is encouraging and promising for the future of the Spectrum theory.

It should be noted, however, that Spectrum colleagues from other countries such as Finland, Portugal, Czech Republic, Israel, South Korea, Japan, and Australia have also conducted SRT. This research has been published but is perhaps not easily accessible or conveniently retrievable

Table 4
Focus

Domains	Number of studies	Percentage of total
Psychomotor	11	20.75
Affective	12	22.64
Cognitive	5	9.43
Social	1	1.89
Moral	1	1.89
Multiple domains	23	43.39
Total	53	100.0

Table 5
ATI interactions

Aptitudes	Number of studies	Percentage of Total
Initial ability	11	20.75
Gender	6	11.32
Socioeconomic status	2	3.77
Companionship	1	1.89
Teaching experience	1	1.89
Total (studies with ATIs)	21	35.85
Total (studies without ATIs)	32	64.15

(S. Ashworth, personal communication, December 23, 2007). Unfortunately, it was impossible to retrieve evidence of this SRT on any commonly searched database. If researchers want to make their work more available to others, they need to publish their work on internationally renowned journals and on the official Spectrum web site *(http://www.spectrumofteachingstyles.org)*.

Research investigating different aspects of the various Reproduction styles has been and continues to be the primary focus of most SRT (see Table 2). Currently some researchers are beginning to cross the discovery threshold and investigate teaching styles from the Production cluster by asking questions related to the Production teaching styles. The predominant research focus on the Reproduction styles is probably due to two reasons: (a) It is much easier and requires less time to design research examining issues related to the Reproduction rather than the Production teaching styles, and (b) the Reproduction teaching styles are more familiar to and more frequently used by PE teachers (Curtner-Smith, Todorovich, McCaughtry, & Lacon, 2001; Kulinna & Cothran, 2003).

Although, teaching styles were examined with learners of different age groups (see Table 3), in 39 out of 53 studies the participants were elementary or high school students. Analyses of research on teaching in physical education yielded similar results (Silverman, 1987; Silverman & Skonie, 1997; Silverman & Manson, 2003). Given that SRT addresses issues relating to teaching style effectiveness the above information makes sense. It can be argued that research conducted with school-aged children is encouraging in that it can offer answers related to physical education teaching practices and issues (Silverman & Skonie, 1997).

Like other analyses of research on teaching in physical education (Silverman, 1987; Silverman & Skonie, 1997; Silverman & Manson, 2003), the

overwhelming majority of SRT focused on the psychomotor domain (motor skill acquisition or fitness). This is probably because it is possible to design Spectrum short-term studies in an area that is considered a primary objective in physical education. These studies are regarded as traditional research in physical education teaching. Research focusing on multiple domains represented almost half of the sample. The focus of these studies indicates that Spectrum researchers are interested in investigating students' feelings and cognition while also investigating the developmental effects of motor skills. This research has enhanced our understanding about the comprehensive, complex, and integrative nature of human development - the whole child. In other words, SRT has addressed diverse and varied questions concerning multiple human dimensions and domains of learner's development. Unfortunately, few SRT studies have examined the social and moral domains. Considering that Spectrum theory has implications on these two domains, it is necessary to answer questions regarding these domains.

On a negative note only one quarter of the studies used qualitative methods as opposed to quantitative methods. Similarly, Silverman (1987), Silverman & Skonie (1997), Byra and Goc Karp (2000), and Silverman and Manson (2003) found that only a small percentage of research on teaching in physical education employed qualitative methods to collect data. The attention of Spectrum researchers on quantitative methods may be due to their being more appropriate for answering questions related to the effectiveness of instruction (Shulman, 1986). In addition, Rink (1993) has argued that qualitative research is not easy to conduct and much training and time is required to gather useful data for the investigator. However, qualitative methods can be very useful in answering questions related to the meaning of events to teachers and students. Although the quantitative paradigm is the dominant mode of inquiry in the analysis of teaching, other paradigms should be used as well to move research on teaching in physical education further on (Schempp, 1987).

Almost half of the reviewed studies did not use an equivalent control group design. In many of these instances Spectrum researchers were not concerned about the extent to which their study establishes that the teaching styles in use have actually caused the effect that is found (internal validity). An equivalent control group design is considered a very valid scientific approach to the investigation of research problems and its big advantage is the tight control it exercises on the threats to the internal validity (Gall, Borg, & Gall, 1996; Robson, 1996).

Like Silverman and Skonie's (1997) research, in most studies the treatment was verified by means of systematic observation. The studies which did not use observation tools suffer from a weak treatment effect which biases the results of the research. Silverman (1985) holds that a major drawback of studies, which do not use some kind of systematic observation, is that the treatment is not verified. Thus, there is no way of knowing whether or not it was implemented accurately. The employment of systematic observation necessitates the development of valid and reliable observation tools that comply with Spectrum theory. Without this development, SRT will be idiosyncratic and unreliable.

The minority of Spectrum studies represented ATI research. Teacher behaviour accounts for less than 20% of variance in student achievement (Snow, 1987) and teaching/learning is fraught with interactions (Griffey, 1981). Given this, the studies which did not use ATIs failed to explain the remaining 80% of the variance, thus, giving inconclusive results. "If we are to come to a finer understanding of the instruction process, we must conduct research on how student aptitudes mediate the spectrum of teaching styles" (Griffey, 1983, p. 274). ATIs, where individuals high in some aptitude profit most from an instructional method whereas individuals low in the same aptitude profit from another instructional method, seem to be a fertile area for investigation

(Chatoupis, 2000). This calls for focusing on which instructional approaches work best for subgroup of students with different characteristics within the classes.

Although Mosston`s theory is open to criticism (e.g., Hurwitz, 1985; Metzler, 1983; Sicilia-Camacho & Brown, 2008; Williams, 1996), the field of SRT has increasingly expanded since the 1970s. SRT has addressed many different questions concerning multiple domains of learner's development. Additionally, teaching styles are examined with learners of different age groups. Furthermore, researchers have begun to cross the discovery threshold and investigate teaching styles from the Production cluster. Unfortunately, current SRT is still being conducted that has methodological deficiencies (i.e., absence of equivalent control group design and systematic observation) making it difficult to accept Byra's (2000) position that investigators conducted more valid SRT in the 1980s and 1990s than in the 1970s.

Despite the considerable number of publications on SRT, research on the effects and influence of the Spectrum to teaching and learning is far from being exhausted (Byra, 2000). The results of this study represent some critical considerations in the design of SRT as well as showing areas of omission of SRT on which Spectrum colleagues should concentrate when they design future research.

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