Title: An Historical Overview of Spectrum Research in Physical Education

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Research on Mosston's (1966) and subsequently Mosston and Ashworth's (1994) Spectrum of Teaching Styles has been conducted for more than three decades. The Spectrum has provided PETE researchers with a framework to systematically study teaching and learning in physical education. Spectrum research that has been completed over the past 30 years is presented in this paper. The studies are grouped and organized around two time periods, those studies conducted prior to the early 1980s and those studies conducted after the early 1980s. I have titled these time periods the "early era" and the "recent era." Grouping the studies as early and recent will help to describe how Spectrum research has evolved over the past 30 years.

Early Era of Spectrum Research

During the 1970s and early 1980s, numerous dissertation studies were completed specific to the Spectrum of Teaching Styles (Ashworth, 1983; Boschee, 1972; Bryant, 1974; Chamberlain, 1979; Dougherty, 1970; Gerney, 1980; Jacoby, 1975; McCleary, 1976; Virgilio, 1979). Teaching styles from the reproductive cluster were examined in the majority of these studies. In all of the dissertations, the doctoral students studied the effects of two or more teaching styles on learner skill acquisition, social development, and/or cognitive development. An underlying research question for many of these researchers was, which style or styles produce the best results (e.g., the greatest amount of learning). Few significant results were revealed in these dissertation studies.

In the late 1970s and early 1980s concerns about research on teaching physical education were being voiced by several scholars in the field (Locke, 1977; Metzler, 1983). Issues raised by Locke and Metzler included (a) inadequate definition of experimental treatment and inadequate control over treatment applications; (b) the adoption of abbreviated treatment periods, often too short to promote any change in student learning; (c) the use of college students as study participants rather than elementary and secondary school students; and (d) research being conducted by graduate students rather than experienced university researchers. The two scholars suggested that these problems in combination likely contributed to the numerous methodological problems associated with early research in teaching physical education, and within Spectrum research, the frequent absence of significant differences between teaching styles on learning.

The issues identified by Locke (1977) and Metzler (1983) have also been raised more recently by Michael Goldberger, the foremost scholar in Spectrum research, and advisor to many of the graduate students who completed the early Spectrum studies. In his review of the early Spectrum research, Goldberger (1992) found that the researchers (a) failed to systematically verify style implementation, (b) lacked in knowledge of Spectrum theory, (c) made claims that were illogical according to the style specific learning conditions being studied, and (d) failed to provide treatment periods sufficiently long enough to produce learning outcomes.

Although the early research was fraught with methodological problems, it seems to have served an important function in the overall evolution of Spectrum research. Goldberger (1992) suggests that "this early work was necessary for us to learn how to better conduct Spectrum research" (p. 42). The truth of this statement is reflected in the most recent Spectrum research, studies that have been conducted since the early 1980s. It seems safe to say that without the first 10 years of Spectrum research we wouldn't be where we are today.

Recent Era of Spectrum Research

A second era of Spectrum research emerged during the early 1980s following the publication of Locke's (1977) and Metzler's (1983) articles. The issues raised by Locke and Metzler, and later by Goldberger (1992), about the employment of inadequate research methodologies were addressed by investigators from the onset of this second era of Spectrum research. Michael Goldberger led the charges during the first decade of this second era.

Reproductive Teaching Styles.

Goldberger, Gerney, and Chamberlain completed several Spectrum studies of three "reproductive" teaching styles during the first half of the 1980s. In two of these studies, middle school children learned popular motor tasks

while receiving instruction within their regular intact physical education classes (Goldberger & Gerney, 1986; Goldberger, Gerney, & Chamberlain, 1982). The purpose of these studies was to examine the effect of the Practice, Reciprocal, and Inclusion styles of teaching on motor skill acquisition. The fifth-graders showed skill gains in all three styles, but those who received instruction in the Practice style consistently produced the highest rates of change. In the practice style of teaching the learners work at their own pace and complete teacher-designed tasks in the order they choose. Often the class is organized around stations; while a small group of students completes the task(s) at a given station, the teacher provides individual feedback to the learners.

The results from several additional studies in which the Practice style was examined reflect the findings revealed in Goldberger's research. The Practice style of teaching was found to be effective in promoting skill changes in college-aged students as they performed soccer-ball-juggling (Beckett, 1990) and rifle shooting (Boyce, 1992), and in school-aged children as they performed striking with a racquet (Jenkins & Byra, 1997). These researchers have ascertained that the instructional approach employed in the Practice style is effective in promoting motor skill changes in school-aged and college-aged learners.

In a recent study of the Practice style of teaching, Goldberger and Gerney (1990) examined the effect of two different organizational "formats." Under one format, students rotated from station to station, in a specific order, every few minutes on the command of the teacher. Under the second format, the learners decided the order in which to rotate (from station to station), the amount of time to spend at each station, and when to rotate (from station to station). Although both formats were found to be effective, the second format was more effective for low-ability students than high ability students.

The Reciprocal style was also examined by Goldberger, Gerney, and Chamberlain (Goldberger & Gerney, 1986; Goldberger, Gerney, & Chamberlain, 1982). In this style learners form partners, and as one learner (doer) performs, the other (observer) gives specific feedback to the doer based on information provided by the teacher, in the form of a criteria sheet. When the doer completes the task(s), the doer and observer switch roles. The extent of peer teaching in the Reciprocal style is specifically the provision of feedback from one learner to another. In addition to improved skill performance, Goldberger, Gerney, and Chamberlain found that learners in the Reciprocal style "provided more feedback, expressed more empathy, offered more praise and encouragement to each other, and requested more feedback from each other when compared to the control group" (Goldberger, 1992, p. 43).

Byra and Marks (1993) examined the effects different learner pairings had on learners while engaged in the Reciprocal style of teaching. The results showed that learners gave more specific feedback to partners who were friends and learners felt more comfortable receiving feedback from friends over non-acquaintances. Byra and Marks also found that grouping by ability had no effect on amount of feedback given or received or the comfort level of either the observer and the doer.

In an attempt to examine how student learning (physical, cognitive, and social) might best be facilitated in the Reciprocal style of teaching, Ernst and Byra (1998) paired 60 junior high school learners by skill ability during an eight lesson unit on juggling. All learners improved their juggling scores from pretest to posttest (except those in the control group). The greatest amount of skill achievement was accomplished by low-ability learners regardless with whom they were paired. In terms of knowledge gains (ability to identify skill elements of the movement), all learners (except those in the control group) improved their score from pretest to posttest. Once again, who you were paired with made no difference. Level of comfort working with a partner was perceived to be high by all students, regardless of the pairing. All of the students reported that giving feedback to and receiving feedback from a partner was a positive experience. For those teachers who value the development of social relationships between pairs and the conditions for immediate feedback, the results of this study, as well as the others (Byra & Marks, 1993; Goldberger & Gerney, 1986; Goldberger, Gerney, & Chamberlain, 1982) support the contention that skill and knowledge gains can transpire while engaging in the socializing process unique to the Reciprocal style.

Goldberger, Gerney, and Chamberlain (Goldberger & Gerney, 1986; Goldberger, Gerney, & Chamberlain, 1982), as well as Beckett (1991), Byra and Jenkins (1998), and Jenkins and Byra (1997) have investigated learner performance and decision making in the Inclusion style, the last in the series Mosston and Ashworth's (1994) reproductive styles. Within the Inclusion style of teaching, learners choose level of difficulty within a task and assess their own skill performance (self-referenced evaluation). In choosing level of difficulty, learners are given the opportunity to compare their aspirations to reality of performance. In assessing their own skill performance, the learners compare and contrast skill execution against the model and then conclude with what is correct and incorrect. As reflected in the preceding statements, thinking and reflecting are critical to the role of the learner in the Inclusion style of teaching.

A primary goal of the Inclusion style of teaching is to provide students opportunity to engage in activity at an appropriate skill level (Mosston & Ashworth, 1994). Given this goal, students who are receiving instruction within

the framework of the Inclusion style of teaching are likely to perceive success more readily, find the task to be more meaningful and interesting, and as a result learn to perform the task at a higher level.

Goldberger, Gerney, and Chamberlain (1982) and Goldberger and Gerney (1986) found the Inclusion style of teaching effective in producing improvement in learner skill performance, but not at the same rate as found with the Practice style. In addition, the authors found the Inclusion style to be less effective for exceptional learners. This finding is inconsistent with Spectrum theory. As identified in the previous paragraph, Spectrum theory suggests that the conditions the Inclusion style provides for the learner should promote success. This premise is also supported by Silverman's (1990) finding that high success rate during practice is closely related to subsequent skill achievement.

So why these results? Goldberger, Gerney, and Chamberlain observed numerous learners making inappropriate decisions for their skill level in their two studies. The learners chose levels that appeared too difficult for them to reach success, and even with encouragement or prompting from the teacher would not change levels. Perhaps self-concept or peer pressure influenced their decision making.

In a study of college-aged students, Beckett (1991) found the Inclusion style to be as effective as the Practice style on learner skill peformance, and as suitable for learners of average and exceptional aptitude for learning motor skills. The findings from this study do not support the conclusions of Goldberger and Gerney (1986). Beckett suggests that differences in students' ages (college students versus fifth-graders), motor tasks learned (soccer juggling versus floor hockey accuracy task), and settings (natural versus laboratory) may have been factors to explain the different findings.

Byra and Jenkins (1998) examined learner decision making in the Inclusion style of teaching. Forty-two fifth-grade students in one school received instruction in striking with a bat for two 30-minute lessons. The learners performed three sets of 10 trials of a batting task each lesson and made decisions about level of task difficulty. Data sources were the lesson task sheets and transcribed post-lesson interviews. The results indicated that the fifth-graders did select different levels of task difficulty when provided the opportunity, and made task decisions regarding level of difficulty according to their perceptions of success, challenge, and curiosity.

Beckett (1991) and Jenkins and Byra (1997) examined gains in learner knowledge in the Inclusion style of teaching. Beckett found that learners who received instruction on soccer-juggling under the conditions of Inclusion style scored significantly higher on a written knowledge test after instruction than learners who received instruction under the conditions of Practice style. Jenkins and Byra (1996) found that learners in the Inclusion and Practice styles made significant gains from pretest to posttest in the number of skill elements identified regarding striking with a racquet, and learners in the Inclusion style reported a significantly greater number of skill elements during posttest than learners in the Practice style. These findings support Mosston and Ashworth's (1994) contention that learners should better understand and recall elements of task performance in a style (like Inclusion) where having to assess ones own skill performance is a condition.

Productive Teaching Styles.

Until recently, little research has been conducted within the "productive" cluster of Mosston and Ashworth's (1994) Spectrum of teaching styles. In a productive teaching style the teacher invites learners to engage in cognitive operations like problem solving, creating, inventing, or critically thinking to discover new movements. Six teaching styles are identified in the productive cluster: Guided Discovery and Convergent Discovery, two styles that require convergent thinking from learners; and Divergent Production, Individual Program-Learner Design, Learner Initiated, and Self-teaching, four styles that require divergent thinking from learners. Of these six styles, Guided Discovery, Convergent Discovery, and Divergent Production seem to be the most frequently employed by teachers in school settings.

The Divergent Production style has been researched more than any other teaching style from the productive side of the Spectrum. However, it has only been in the 1990s that this scholarship began. McBride's (1992) scholarly writing on critical thinking has been as much of a stimulus for the development of this research as has the Spectrum itself. Fran Cleland has taken the lead in studying the Divergent Production, Guided Discovery, and Convergent Discovery styles. In her first study (Cleland & Gallahue, 1993), Cleland studied the divergent movement patterns of 40 children aged 4, 6, and 8 to establish baseline information about children's divergent movement patterns, and to examine different factors that might contribute to a child's production of divergent movement. The participants, each tested individually, were instructed to "try to move in as many ways possible using all of the equipment [at the locomotor task, stability task, or ball-handling task]" (p. 538). When asked to engage in the discovery process, the young children demonstrated that they could modify, adapt, or combine fundamental movement patterns to produce divergent movement. Experience and age were found to be factors that contributed to a child's ability to produce divergent movement. Although instruction in this study was not intentionally aligned with Mosston and Ashworth's (1994) Divergent Production style (at least it appears this way

given that there was no reference to Mosston and Ashworth), the participants were given a problem to solve and through their actions demonstrated the divergent thinking process.

In a second study of children's divergent movement ability, Cleland (1994) randomly assigned 50 second- and third-grade children to three different instructional groups (Divergent Production, with content based on skill themes and movement concepts; Command/Practice, with content based on low-organized games; or control, no instruction) to examine the effect of content and specific teaching styles on learner ability to produce divergent movement. The findings were favorable for the learners receiving treatment under conditions of Divergent Production. These students generated a significantly greater number of divergent movement patterns than those who received treatment under conditions of direct instruction or no instruction (control group). Cleland concluded that employing critical thinking strategies in the form of Divergent Production positively effects learner's ability to generate divergent movement patterns. It would be interesting to conduct a follow-up study of children's (e.g., second- and/or third-graders) divergent movement production where content for both treatment groups is constant, based on skill themes and movement concepts (Graham, Holt/Hale, & Parker, 1998), and conditions of instruction different (one group would receive instruction in Divergent Production style and the other in a combination Command/Practice style).

In a year long study of fifth-grader's critical thinking in physical education, Cleland and Pearse (1995) examined how the physical education specialist can structure the learning environment to promote critical thinking. Critical thinking, as defined by McBride (1992), is "reflective thinking that is used to make reasonable and defensible decisions about movement tasks or challenges" (p. 115). Children's divergent movement ability is one aspect of critical thinking. Cleland and Pearse found that critical thinking in children could be fostered via the employment of several of Mosston and Ashworth's (1994) teaching styles, specifically Divergent Production and Convergent Discovery. The teachers in this study employed the Practice style of teaching to deliver domain-specific knowledge (Alexander & Judy, 1988) to the learners relative to lesson content prior to having them engage in problem solving activities. Conditions of the Reciprocal and Self-check styles were used to guide the learners in tasks that involved working individually, or working in pairs or small groups. Based on systematic analysis of videotapes, the investigators concluded that a student's ability to think critically (to produce divergent movement) "depends on the movement task and the teacher's ability to effectively use indirect [Divergent Production and Convergent Discovery] teaching styles" (Cleland & Pearse, 1995, p. 36). According to the student interviews, the learners stated that they enjoyed the critical thinking activities employed in the lessons, that they preferred to engage in tasks that involved small groups, and that written movement problems were more difficult to solve.

The research of Cleland and her colleagues (Cleland, 1994; Cleland & Gallahue, 1993; Cleland & Pearse, 1995) serves to affirm that critical thinking in children, specifically as it applies to the production of divergent movement, can be fostered through Mosston and Ashworth's (1994) Guided Discovery, Convergent Discovery, and Divergent Production teaching styles. Based on this knowledge, Cleland's most recent research effort focused on how teachers could promote critical thinking in children in the physical education setting (Cleland Donnelly, Helion, & Fry, 1999). A group of four experienced physical education teachers participated in a comprehensive workshop that included: (a) instruction on how to use specific teaching styles (Guided Discovery, Convergent Discovery, and Divergent Production) and McBride's (1992) schema of the critical thinking process to promote an atmosphere of inquiry in class; (b) opportunity to implement lesson plans aimed at promoting critical thinking that were designed by the participants and workshop instructors in collaboration; and (c) opportunity to discuss and analyze the practice lessons taught. Three lessons of each participant's teaching was videotaped prior to participating in the workshop. After participating in the workshop, the teachers were videotaped while teaching a unit of instruction in which critical thinking strategies were employed.

The intervention employed in this study enabled the four teachers to structure the environment and frame learning tasks to promote critical thinking in physical education classes. All four participants were able to use conditions of the Guided Discovery, Convergent Discovery, and Divergent Production teaching styles to ascertain specific process and product variables identified within McBride's (1991) schema on critical thinking.

Summary

During the Recent Era of Spectrum Research (1982-1999), a total of 17 data-based research studies have been published in physical education journals. More than 20 different researchers have contributed to this data-based research. Reproductive teaching styles have been examined in 13 of the 17, productive teaching styles in four.

Several research questions have been answered about the reproductive styles of teaching, including: (a) What is the effect of the Practice, Reciprocal, and Inclusion styles on learner skill acquisition?; (b) How are learners of different ability level influenced by the Practice, Reciprocal, and Inclusion styles?; (c) What is the effect of different organizational formats in the Practice style of teaching on learner skill acquisition?; (d) What effect does pairing learners by ability level and companionship have on the frequency of observer feedback and learner-perceived

comfort in giving and receiving feedback in the Reciprocal style?; (e) What factors influence learner decision making in the Inclusion style?; and (f) What is the effect of the Practice and Inclusion styles on learner knowledge?

Questions answered about the productive styles include: (a) Can learners employ critical thinking strategies to produce divergent movement patterns in physical education classes?; (b) What is the effect of the Divergent Production and Practice styles on learner ability to produce divergent movement?; and (c) How can teachers promote critical thinking in children in the physical education setting?

In addition to these research articles on Spectrum teaching styles, more than 20 articles have been published specifically for practitioners in a variety of practically-oriented journals in physical education (e.g., JOPERD, Strategies, Teaching Elementary Physical Education, etc.). The authors of these articles explain how different Spectrum styles can be employed in the school setting.

Are we moving forward with Spectrum research? Goldberger (1992) concluded that "based on 25 years of research and reflection, Spectrum theory has retained its power and significance . . . results to date confirm the theory's power to both describe teaching events and predict learning outcomes" (p. 45). Eight year later, and nearing the millennium, I have to agree with Goldberger's assessment of just how far Spectrum research has advanced. However, many questions still remain unanswered about the Spectrum. For each study completed, three to five additional questions have been raised. Although we have made strides in understanding Spectrum styles, much work remains to be done.

References

Alexander, P., & Judy, J. (1988). Domain-specific and strategic knowledge. Review of Educational Research, 58, 375-404.

Ashworth, S. (1983). Effects of training Mosston's spectrum of teaching styles on feedback of teachers. Unpublished doctoral dissertation, Temple University, Philadelphia.

Beckett, K. (1991). The effects of two teaching styles on college students' achievement of selected physical education outcomes. Journal of Teaching in Physical Education, 10(2), 153-169.

Boschee, F.A. (1972). A comparison of the effects of command, task, and individual program styles of teaching on four developmental channels. Dissertation Abstracts International, 33, 2066A. (University Microfilms No. 72-29, 343)

Boyce, B.A. (1992). The effects of three styles of teaching on university student's motor performance. Journal of Teaching in Physical Education, 11(4), 389-401.

Bryant, W. (1974). Comparison of the practice and reciprocal styles of teaching. Unpublished manuscript, Temple University, Philadelphia.

Byra, M., & Jenkins, J. (1998). The thoughts and behaviors of learners in the inclusion style of teaching. Journal of Teaching in Physical Education, 18(1), 26-42.

Byra, M., & Marks, M. (1993). The effect of two pairing techniques on specific feedback and comfort levels of learners in the reciprocal style of teaching. Journal of Teaching in Physical Education, 12(3), 286-300.

Chamberlain, J. (1979). The effects of Mosston's practice style and individual program teacher design on motor skill acquisition and self-concept of fifth grade learners. Unpublished doctoral dissertation, Temple University, Philadelphia.

Cleland, F.E. (1994). Young children's divergent movement ability: Study II. Journal of Teaching in Physical Education, 13(3), 228-241.

Cleland, F.E., & Gallahue, D.L. (1993). Young children's divergent movement ability. Perceptual and Motor skills, 77, 535-544.

Cleland Donnelly, F., Helion, J., & Fry, F. (1999). Modifying teacher behaviors to promote critical thinking in K-12 physical education. Journal of Teaching in Physical Education, 18(2), 199-215.

Cleland, F., & Pearse, C. (1995). Critical thinking in elementary physical education: Reflections on a yearlong study. Journal of Physical Education, Recreation, and Dance, 66(6), 31-38.

Dougherty, M. (1970). A comparison of the effects of command, task and individual program styles of teaching in the development of physical fitness and motor skills. Dissertation Abstracts International, 31, 5821A-5822A. (University Microfilms No. 71-10, 813)

Ernst, M., & Byra, M. (1998). What does the reciprocal style of teaching hold for junior high school learners? The Physical Educator, 55(1), 24-37.

Gerney, P. (1980). The effects of Mosston's "practice style" and "reciprocal style" on psychomotor skill acquisition and social development of fifth grader students. Dissertation Abstracts International, 41, 154A-155A. (University Microfilms No. 8014535)

Goldberger, M. (1992). The spectrum of teaching styles: A perspective for research on teaching physical education. Journal of Physical Education, Recreation, and Dance, 63(1), 42-46.

Goldberger, M. (1983). Direct styles of teaching and psychomotor performance. In T. Templin & J. Olson (Eds.), Teaching in physical education, (pp. 221-223). Champaign, IL: Human Kinetics.

Goldberger, M., & Gerney, P. (1990). Effects of learner use of practice time on skill acquisition of fifth grade children. Journal of Teaching in Physical Education, 10(1), 84-95.

Goldberger, M., & Gerney, P. (1986). The effects of direct teaching styles on motor skill acquisition of fifth grade children. Research Quarterly for Exercise and Sport, 57(3), 215-219.

Goldberger, M., Gerney, P., & Chamberlain, J. (1982). The effects of three styles of teaching on the psychomotor performance of fifth grade children. Research Quarterly for Exercise and Sport, 53(2), 116-124.

Graham, G., Holt/Hale, S.A., & Parker, M. (1998). Children moving: A reflective approach to teaching physical education (4th ed.) Mountain View, CA: Mayfield.

Jacoby, D. (1975). A comparison of the effects of command, reciprocal and individual styles of teaching on the development of selected sport skills. Dissertation Abstracts International, 36, 7272A-7273A. (University Microfilms No. 76-10, 310)

Jenkins, J., & Byra, M. (1997). An exploration of theoretical constructs associated with the Spectrum of Teaching Styles. In F. Carreiro da Costa (Ed.), Research on teaching and research on teacher education: What do we know about the past and what kind of future do we expect? Lisbon, Portugal: AIESEP.

Locke, L. (1977). Research on teaching physical education: New hope for a dismal science. Quest, 28, 2-16.

McBride, R.E. (1992). Critical thinking --- An overview with implications for physical education. Journal of Teaching in Physical Education, 11(2), 112-125.

McCleary, E. (1976). A comparison of the task and problem-solving styles in teaching kindergarten and first grade students. Unpublished manuscript, Temple University, Philadelphia.

Metzler, M. (1983). On styles. Quest, 35, 145-154.

Mosston, M. (1966). Teaching physical education. Columbus, OH: Merrill.

Mosston, M., & Ashworth, S. (1994). Teaching physical education (4th ed.). New York, NY: Macmillan.

Virgilio, S. (1979). The effects of direct and reciprocal teaching strategies on the cognitive, affective, and psychomotor behavior of fifth grade pupils in beginning archery. Dissertation Abstracts International, 40, 5367A. (University Microfilms No. 8008631)