Young Children’s Divergent Movement Ability: Study II

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Young children’s ($N = 50$) divergent movement ability (DMA), which is one aspect of critical thinking in physical education, was examined in this study. Treatment Group A received 20 physical education lessons based on skill themes using indirect teaching styles ($n = 16$). Twenty lessons based on low-organized games content using direct teaching styles were provided to Treatment Group B ($n = 17$). No treatment was provided to the control subjects in Group C ($n = 17$). No significant DMA pretest differences were determined, and the independent variables (i.e., gender, intelligence, creativity, and background of movement experience) examined were not significantly related to subjects’ pretest DMA. A two-way ANOVA and post hoc Scheffe test revealed that Group A’s posttest DMA scores were significantly higher than those for either Group B or Group C, $F(2, 47) = 11.7, p < .0001$.

Young children’s ability to generate different movement patterns (i.e., DMA), therefore, was significantly improved in response to employing critical thinking strategies in physical education.

Young children’s ability to move divergently is an aspect of motor behavior involving their capacity to create and perform different fundamental movement patterns (i.e., locomotor, manipulative, and stability patterns). Wickstrom (1983) defined fundamental movements as “general skills that form the bases for the more advanced and more specific motor activities, such as sport skills” (p. 7). Young children, ages 4 through 10, are typically within the fundamental movement phase of motor development and are in the process of refining fundamental movement patterns (Gallahue, 1989). Children’s efforts to produce different fundamental movement patterns on movement problems or tasks—that is, divergent movement ability (DMA)—involve aspects of both critical thinking and motor creativity.

Critical thinking has been well established as an educational goal. Research on the critical thinking of students in elementary and secondary schools has been published for over 50 years (see Arnold, 1938; Barlow, 1937; Hyram, 1957; Thelen, 1944; Ulmer, 1939; White, 1936). However, recent declines in student achievement and changing social forces have sparked a renewed interest in critical thinking, reinforcing its importance in today’s schools (Sternberg, 1985). Critical thinking tests (e.g., Ennis & Millman, 1985), programs designed to teach children

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how to think (Covington, 1985), and acceptable criteria by which to evaluate these programs have been developed (Sternberg, 1983). Moreover, critical thinking strategies are becoming an important part of primary education, and research on children’s ability to use critical thinking strategies also abound (see Hudgins & Edelman, 1988; Owen & Sweller, 1985).

With this increased interest in promoting critical thinking, several views and definitions of critical thinking have been generated. Ennis (1987) defines critical thinking as “reasonable and reflective thinking that is focused on deciding what to believe or do” (p. 10). Lipman (1988) states that critical thinking is “skillful, responsible thinking that facilitates good judgment because it (1) relies upon criteria, (2) is self-correcting, and (3) is sensitive to context” (p. 39). He compares critical thinking to “cognitive accountability.” This type of thinking involves the ability to estimate, note relationships, make comparisons based on a set of criteria, or offer opinions with reasons.

McBride (1992) has been the first physical educator to define critical thinking relative to the psychomotor domain. He defined critical thinking in physical education as “reflective thinking that is used to make reasonable and defensible decisions about movement tasks or challenges” (p. 115). He proposes a four-phase model that “serves as a schematic representation linking critical thinking to physical education” (p. 117). These phases include cognitive organizing, cognitive action, cognitive outcomes, and psychomotor outcomes. McBride’s schema, although not yet substantiated by research, may be used as a model for examining critical thinking in the psychomotor domain.

Using McBride’s critical thinking schema, DMA (or the ability to produce different fundamental movement skills when performing locomotor, manipulative, and stability tasks) is hypothesized to be a combined product of several critical thinking components. First, when children are asked to produce different or divergent movement responses they must “focus on the problem,” an element of cognitive organization (McBride, 1992). The task of focusing may refer to listening to the teacher’s verbal explanation, observing a physical demonstration, or reading a task card. “Focusing” may provoke children to ask appropriate questions, another aspect of cognitive organization.

In addition, the production of alternative or different movement responses (i.e., psychomotor outcomes) requires utilizing previous information (i.e., cognitive action—knowledge of how to execute and modify various locomotor, stability, and manipulative patterns). Making judgments about whether or not a movement response is different than another and using criteria (e.g., knowledge of movement concepts: space, effort, and relationships; see Graham, Holt/Hale, & Parker, 1993) to design new movement patterns or variations of movement patterns is also demanded.

Although DMA does not encompass all elements of McBride’s critical thinking schema, it is representative of several essential critical thinking components. Since the process of critical thinking involves numerous dispositions (e.g., 14 are described by Ennis, 1987, p. 12) and abilities (e.g., over 70 are depicted by Ennis, 1987, pp. 12–14) it is highly unlikely that all are utilized simultaneously. Similarly, all of the components that are represented within McBride’s (1992) four-phase model may not be evoked during a movement task designed to promote critical thinking.

DMA is also preceded by and related to the study of motor creativity. Motor creativity has been defined as the combination of perceptions into new
and fresh motor patterns that can be either a solution to a preestablished problem, or the expression of an idea or emotion by means of the human body (Wyrick, 1968). Criterion measures of motor creativity (i.e., fluency: total number of responses; flexibility: number of thematic changes; and originality: uniqueness of the response in comparison to the sample) were used to judge subjects’ movement responses in previous motor creativity studies (Irvin, 1976; Johnson, 1977; Wyrick, 1968).

DMA is an amalgam of two motor creativity measures: fluency and flexibility. Fluency is a dimension of DMA because subjects are asked to execute as many movement responses (i.e., fundamental movement patterns) as possible on three fundamental tasks (i.e., a locomotor obstacle course, a manipulative/ball-handling task, and a balancing/stability task on a bench). Flexibility is an aspect of DMA since, by definition, each movement response must be different than any previous motor response. Flexibility is often achieved when the aspects of movement (i.e., space, effort, and relationships) are used to modify fundamental movement patterns (see Graham et al., 1993). Movement patterns can be modified by changes in the effort exerted (e.g., slow, fast, percussive, or sustained), by changes in the spatial aspect (e.g., level, direction, and pathway), or by changes in one’s relationship to another person or object (e.g., under, over, through, alongside, on, or off).

DMA does not evaluate originality, the third component of motor creativity. Originality has been defined as statistical rareness or uniqueness of a motor response in comparison to the population sample. To measure originality, one subject’s responses must be evaluated and compared to the movement responses of all other subjects in a sample (Wyrick, 1968). Originality measures have been conducted with small samples. W. Wyrick (personal communication, October, 1988) substantiated that originality may not be reliably and objectively measured within a large sample (i.e., greater than 10 subjects) of children. Hence, divergent movement ability is a measure of only two motor creativity components.

It is important to note that definitions and views of critical thinking do not exclude creative thinking. Ennis (1987, p. 10) states that formulating hypotheses, alternative ways of viewing a problem, questions, possible solutions, and plans for investigating something are creative acts that also come under the definition of critical thinking. Swartz (1987) emphatically states, “There is danger, though in separating critical thinking from creative thinking, and separating each into sets of skills, then structuring lessons that involve students in using these skills piecemeal” (p. 120). Several theorists therefore suggest that we should view creative and critical thinking holistically and describe them as complementary constructs. For example, creative thinking promotes the generation of ideas, whereas critical thinking skills enable the learner to operate on cognitive attitudes towards those ideas; thus, both modes of thinking can be used in combination (Swartz, 1987, p. 121). Likewise, DMA is a composite measure of both motor creativity and critical thinking skills. When children solve fundamental or divergent movement tasks in as many different ways as possible, they must not only generate alternative ideas (i.e., creative fluency) but also act on those ideas (i.e., judgments/critical thinking) using specific criteria to modify and change each movement pattern.

Though there are several definitions, views, and substantial research about critical thinking, “most research has addressed critical thinking only within the
context and domains of traditional classrooms” (McBride, 1992, p. 112). Critical thinking, thus far, has been examined in relationship to students’ cognitive performance. Several scholars support physical education programs that are designed to challenge children across the domains of learning (i.e., cognitive, affective, and psychomotor). Some suggest that young children should be encouraged to explore a range of movement possibilities and to be involved in problem-solving movement activities (Bressan, 1990). Scholars also suggest that young children be exposed to movement education programs that support the ability to be a critical thinker and mover. Buschner (1990), for example, emphasizes the need for critical thinking within the psychomotor domain and provides practical suggestions for promoting critical thinking (see pp. 58–59). He concluded that there is a need for empirical data to be generated about young children’s critical thinking in the psychomotor domain. Research related to critical thinking and its significance within the movement setting offers a relatively new source of information about children.

Cleland and Gallahue’s (1993) investigation of divergent movement ability within the psychomotor domain provided baseline data about young children’s (ages 4, 6, and 8; \( N = 40 \)) ability to produce divergent movement responses on three fundamental movement tasks (see Figure 1). The findings of this preliminary study revealed developmental differences about young children’s DMA. First, older children (ages 6 and 8) were able to produce significantly more movement patterns than younger children (age 4). Second, background of movement experience (i.e., movement instruction by a trained specialist, past participation in family recreation activities, and youth sport experiences) was also determined to be a significant factor contributing to the children’s DMA. Gender and level

![Figure 1 — Divergent (fundamental) movement tasks.](image-url)
of gross motor development (Ulrich, 1985) were not significantly related to young children's DMA.

Based on the previous research, additional factors were investigated in the present study to gain a more thorough understanding of young children's DMA. Elementary physical education content and specific teaching styles were examined because they have been found to affect children's psychomotor and social skill development (see Goldberger, Gerney, & Chamberlain, 1982). It has also been demonstrated that gender and movement experience affect young children's motor development (see Branta, Haubenstricker, & Seefeldt, 1984; Nelson, Thomas, Nelson, & Abraham, 1986). Figural creativity (i.e., the production of a quantity of unique and elaborate drawings in response to visual stimuli) was examined because it is a similar type of divergent ability, although, within the cognitive domain. Gender differences in children's figural creativity have been found, and it has also been determined that different school environments affect children's figural creativity (Thomas & Berk, 1981). Finally, the relationship of intelligence to young children's divergent movement ability was explored based on previous findings about the relationship of creativity and intelligence (see Torrance & Tzhui, 1981).

The purposes of this study, therefore, were twofold: (a) to examine the relationship of gender, background of movement experience, figural creativity, and intelligence to young children's divergent movement ability, and (b) to investigate the combined effect of physical education content and specific teaching styles on one component of young children's critical thinking in the psychomotor domain (i.e., divergent movement ability).

Methods

Subjects

Fifty second- and third-grade children from one elementary school (28 girls and 22 boys, \( M \) age = 99.5 months) participated in this study. The subjects attended a parochial school in a small urban community. The subjects were of middle-class socioeconomic status and were predominantly Caucasian. All subjects \((N = 50)\) receiving parental permission were randomly assigned (i.e., subjects were each given numbers and subsequently drawn from individual pools of female second graders, male second graders, female third graders, and male third graders) to one of three groups (i.e., two experimental and one control group). Assignment, therefore, was balanced by gender and grade so that each group had approximately the same number of boys and girls, as well as second and third graders. The present investigation was conducted during the academic school year.

Procedures

Design. For the duration of the study (i.e., 20 weeks) all 50 subjects participated in the school's regular physical education program. The school provided one 30-minute physical education class per week, and these classes were taught by a generalist (a teacher who does not have a degree in physical education). The school's regular physical education program was based on "traditional" lesson content, meaning the curriculum consisted of large group, low-organized games, relay races, and sport-related activities such as indoor soccer
and basketball. Direct instruction (Mosston & Ashworth, 1994) was employed within these physical education classes.

Subjects within experimental Groups A and B participated in a second 45-minute physical education class once per week for 12 weeks during the first semester (October to latter December) and 8 weeks of the second semester (mid-January to mid-March). The total number of weeks (i.e., 20 weeks) was interrupted by both university and school calendars, thus treatment was not administered during consecutive weeks. The classes were taught by a physical education specialist.

Treatment (i.e., experimental) Group A’s (n = 16) lesson content was based on the fundamental movement skill themes (e.g., striking, kicking, rolling, balancing, dribbling, jumping, and locomoting) and movement concepts (e.g., space: level, direction, pathways, range; effort: fast, slow, bound-flow, free-flow; relationships: on, over, under, through, between, alongside) identified by Graham et al., 1993). Treatment Group A was taught using an indirect teaching style, divergent production (Mosston & Ashworth, 1994). Subjects were encouraged to ask questions, compare and contrast movement responses, evaluate movement responses based on given criteria, and analyze mechanical aspects of skill performance. Direct teaching was utilized solely for completion of organizational and managerial tasks (e.g., equipment distribution, lesson protocol, partner and group selection).

Treatment Group B’s (n = 17) lesson content was based on low-organized games (e.g., soccer, basketball, kickball, baseball, and traditional Olympic-style gymnastics) and was taught using a combination of two direct teaching styles, command and practice (Mosston & Ashworth, 1994). Control Group C (n = 17), received only the school’s regularly scheduled 30-minute physical education class, taught by a generalist, once per week.

Validity of Content and Teaching Styles. The teacher (i.e., physical education specialist) of Treatment Groups A and B was videotaped. Two experts in the area of children’s physical education and systematic observation independently analyzed these tapes, checking for the definitive characteristics of both elementary physical education content designs. Structural congruency checklists were also used to confirm that the critical elements of each teaching style were being employed (Mueller & Mueller, 1992). It was determined that the teacher was congruent with both the content design (96% agreement) and teaching styles (98% agreement). The teacher (i.e., generalist) of the regular physical education program was also videotaped. It was determined that the generalist used direct teaching styles, and physical education lessons were based on traditional content (e.g., relay races and large group, low-organized games).

Instrumentation and Data Collection. Four independent variables were examined in this study: gender, intelligence, creativity, and background of movement experience. The dependent measure, divergent movement ability, was evaluated using a pre- and posttest.

1. Intelligence. The Otis-Lennon Mental Ability Test (OLMAT), a measure of abstract thinking and reasoning ability, was used to assess intelligence (Otis & Lennon, 1982). The OLMAT was administered by the subjects’ school administration during the semester prior to the onset of the present investigation. The raw scores were used in the data analysis.

2. Creativity. The figural creativity test (i.e., Thinking Creatively With Pictures) was administered in the subjects’ classroom during the second semester (i.e., latter March, after completion of treatment) of the investigation (Torrance,
1990). This was a 30-minute test in which the subjects used crayons to design pictures and write word titles for the pictures they drew. Standardized instructions were provided to all subjects. Five creativity dimensions were measured, and the tests were professionally scored by the Scholastic Testing Service (Torrance, 1990). The raw scores on the standardized tests measuring creativity were used in the statistical analysis.

3. Background of movement experience. Background of movement experience was evaluated using a Movement Experience Questionnaire. Information was gathered about each subject's background of movement experience at the beginning of the study (i.e., September). The questionnaire was evaluated for content relevance and scoring protocol by three scholars with expertise in assessment, motor development, and elementary physical education. Three questions were asked of parents on this form: (a) What recreational/sport activities does your family participate in together? (b) What type of structured movement activities or movement lessons does your child participate in? and (c) Does your child participate in any youth sport activities? A definition of the term structured was provided on the form, and examples of activities in response to each question were provided. Parents also reported the number of weeks, months, and years that their child participated in each individual activity.

This information was evaluated and quantified. If a subject participated in an activity for a minimum period of 12 weeks, he or she was awarded one point. For every subsequent 3 months of experience in the activity, the subject was awarded one additional point. The subject's total number of movement experiences in each category of fundamental movement (i.e., locomotion, manipulation, and stability) was calculated, and this raw score was used in the statistical analysis.

4. Divergent movement ability. Pre- and posttest scores of the dependent variable, divergent movement ability (DMA), were collected. Pretests were administered during the first semester prior to treatment (i.e., September) and posttests were given during the second semester after the completion of the treatment (i.e., latter March and April) of the investigation. Both testing sessions took approximately 20 minutes and were administered in a multipurpose room at the school site. Subjects were individually tested, and performances were videotaped. The investigator and an assistant were present during all testing.

Pre- and posttest sessions began by familiarizing each subject with the environment. The DMA tasks were then administered. Standardized verbal instructions were provided and described what the children should do on the three fundamental movement tasks. Next, the investigator introduced the first task and demonstrated one movement response on the task. The same procedure was followed for the second and third tasks. Two-, 1-, and 1/2-minute trials, totaling 3 minutes, were administered for each task. Total movement time for all three fundamental movement tasks was 9 minutes. This protocol was based on previous investigations about motor creativity (Johnson, 1977). Rest periods of 1 minute in length were provided between each of the trials. Rest periods of 2 minutes were provided between each of the three DMA tasks.

The first task used to investigate critical thinking through DMA responses consisted of five stations. Each station in this play area was designed to afford a variety of locomotor movement patterns (Gallahue, 1989, pp. 18–19), as well as changes in direction (see Figure 1).
The second DMA task evaluated the subject’s ability to make shapes on, below, beside, or at the end of a bench (see Figure 1). The task was designed to measure how many body parts the subject used to execute a variety of stability movements. This task emphasized shape and level, which are both elements of the movement concept of space (Graham et al., 1993).

The subject’s ability to manipulate a red playground ball, nine inches in diameter, was evaluated in the third task. Each subject was instructed to play with the ball within the multipurpose room (see Figure 1). Subjects were also told they could use one wall. The task was designed to elicit a variety of manipulative movements using different body parts.

The videotaped data of the subjects’ performance on the DMA tasks were analyzed by two trained observers. The investigator and an assistant independently analyzed each subject’s performance on the three movement tasks. Training procedures for scoring the DMA tasks involved observing the videotaped performances of two subjects (who are not included in the formal investigation) on the three movement tasks designed to measure DMA. Each subject’s ability to produce divergent movement responses was calculated by summing the total number of different fundamental movement patterns recorded on scoresheets designed for evaluating each of the DMA tasks.

The scoresheets were designed so that the observer could record each subject’s movement response by checking the appropriate category. If a subject performed a variation of a fundamental movement pattern not included on the scoresheet, that variation was written on the subject’s scoresheet (see Figure 2).

![Figure 2 — Sample scoresheet—locomotor play area, Task 1.](image-url)
The number of different responses were totaled for the two 90-second trials. Each different fundamental movement pattern (see Gallahue, 1989) and the variations of these, represented a "different" response. The total number of different responses on all three divergent movement tasks (a total of 9 minutes) represented the subject's score and was operationally defined as the subject's DMA. Each subject's performance was independently scored twice by each observer, using the scoresheets designed for each task (see Figure 2). A conservative estimate of reliability (intraobserver agreement; van der Mars, 1983) was used with a criterion level set at 80%. A 91% intraobserver and 87% interobserver agreement level was obtained. The formula for determining reliability is as follows:

$$\% R = \frac{n \text{ agreements}}{(n \text{ agreements} + n \text{ disagreements})} \times 100.$$  

Validity of the tasks and accompanying scoresheets was established by having six professionals review the content, design, and analysis of the divergent movement tasks. All evaluators were recognized professionals with doctoral degrees in the related areas of movement education, motor development, or elementary physical education. Preliminary scoresheets and the design of the divergent movement tasks were sent to each professional. Their comments, through agree/disagree categories and written suggestions, were then used to finalize both the scoresheets and task designs. Only those categories marked agree by all evaluators were incorporated into the final scoresheet and task designs; therefore, a 100% level of agreement was attained.

Results

The ANOVA performed on the subjects' pretest DMA revealed nonsignificant differences among the three groups, $F(2, 47) = .569, p = .5705$. The mean DMA scores for Group A (skill theme/indirect teaching style) were $M = 33.812, SD = 9.254$; for Group B (traditional/direct teaching style) were $M = 34.765, SD = 10.189$; and for Group C (control group) were $M = 31.412, SD = 8.818$. Based on a regression analysis, the four independent variables investigated did not contribute to a significant portion of the variance in the subjects' pretest divergent ability scores.

A two-way ANOVA (Group x DMA Posttest Scores) was conducted to examine posttest results. Findings revealed significant differences among the three treatment groups' DMA scores, $F(2, 47) = 11.718, p < .0001$. A Scheffe's post hoc procedure determined that Treatment Group A's DMA scores ($M = 47.5, SD = 9.107$) were significantly greater than those of both Group B ($M = 36.294, SD = 9.143, p < .01$) and Group C ($M = 31.941, SD = 10.152, p < .001$).

Discussion

The effect of physical education content and specific teaching styles on young children's ability to subsequently solve three fundamental movement tasks in as many different ways (i.e., DMA) as possible was examined in this study. McBride (1992) suggests that generating multiple responses is one aspect involved in the critical thinking process. Four factors (intelligence, creativity, background
of movement experience, and gender) were also investigated in relationship to the children’s pretest DMA.

Research has demonstrated that the use of specific teaching styles promotes motor skill acquisition and the development of specific social skills among young children (see Gerney, 1980; Goldberger & Gerney, 1986, 1990; Goldberger et al., 1982). Similar to the positive results of these early spectrum studies (see Mosston & Ashworth, 1994), this study demonstrated that indirect teaching styles, creative thinking skills, and critical thinking strategies significantly improved children’s ability to generate different movement patterns (i.e., DMA). The physical education lessons designed for Treatment Group A in this study encouraged the children to think of different ways to solve, through movement, a variety of movement problems. Children were also encouraged to employ critical thinking strategies. These strategies included asking questions, comparing and contrasting solutions, evaluating solutions based on criteria provided by the teacher, and analyzing the quality of their movement responses. This type of instruction led to significant improvements in Group A’s ability to generate different movement patterns on the three divergent movement tasks (see Figure 1).

This finding may lend support to McBride’s (1992) critical thinking schema. Part of the schema, as conceptualized by McBride, involves focusing on a problem, making judgments, and generating alternative solutions. It may be hypothesized that because the subjects in Treatment Group A were able to generate a significantly greater number of movement patterns on the posttest, they were more focused on the problem than children in Treatment Groups B and C. In addition, the information provided within their physical education lessons may have provided Group A subjects with a greater movement vocabulary. This vocabulary provided these children with previous knowledge and may have helped the children to make judgments necessary for producing different movement responses (i.e., DMA). Using the measurement criteria for motor creativity, the subjects in Group A were more fluent and flexible in their production of movement patterns. Research with more children that is aimed at validating components of McBride’s critical thinking schema is needed to further examine these claims.

A second question asked in this study was “Is there a relationship between children’s intelligence, figural creativity, background of movement experience, and gender and their pretest divergent movement ability?” A multiple-regression analysis revealed no significant relationships.

The range of intelligence scores on the OLMAT (Otis & Lennon, 1982) for the entire sample of second- and third-grade children \((N = 50)\) extended from 73 to 149. In spite of this large range, children with lower intelligence scores were not necessarily less divergent. For example, an across-subject comparison reveals that Subject 1, who had an OLMAT score of 98, produced 44 divergent movement responses on the pretest for divergent movement ability. Subject 2, with a higher OLMAT score of 149, generated only 34 divergent movement responses on the DMA pretest. This comparison may lead us to conclude that the OLMAT is sensitive to traits and abilities that are not particularly congruent with or supportive of the ability to be divergent in the psychomotor domain.

Similarly, the Torrance (1990) test of figural creativity, Thinking Creatively With Pictures, did not contribute to a significant portion of the variance in the pretest divergent movement ability measure. Again we can conclude that the
ability to produce many different drawings and associated word titles is not related to producing different movement patterns. It should be noted that subjects’ figural creativity was evaluated toward the end of the treatment portion of this study. Figural creativity scores, therefore, could have been affected by the treatment protocol within this study (i.e., Treatment A and B). A more valid measure of the subjects’ figural creativity may have been determined if it had been measured at the onset of the investigation, as were the other three independent variables.

This lack of significance may reflect the findings of other investigations that have studied the relationship between various measures of intelligence, creativity, and divergent thinking. Reported divergent thinking and intelligence correlations vary widely, depending on the tests employed, the heterogeneity of the sample, and the testing conditions. Divergent thinking (DT) test scores have often failed to correlate significantly with indices of creative achievement and behavior. Researchers provide several reasons to account for these findings, one being that the many DT abilities are field-specific (for a complete account see Barron & Harrington, 1981). Hocevar (1980) also discusses the fluctuating relationship between measures of creativity, divergent thinking, and intelligence. The nonsignificant relationship between intelligence, creativity, and young children’s divergent movement ability, although logically related, suggests that they are each field specific and represent different cognitive traits.

The subjects’ background of movement experience (BME) also did not contribute to a significant portion of the variance in the dependent measure, DMA. The children in this study were all in the second and third grade; hence, the range of experience scores was small. This lack of dispersion may have contributed to the nonsignificant finding. The subjects’ previous movement experiences may also have emphasized convergent versus divergent production. In addition, the numerical point system employed in this study may not be sensitive enough to discriminate among subjects’ background of movement experience. A more sensitive measure of children’s BME may need to be developed and utilized in future studies.

Gender was not a discriminating factor of young children’s DMA within this study. Other studies have reported superior performance by young males regarding both fitness components and performance of fundamental movement skills (Ross & Pate, 1987; Nelson et al., 1986). Contrary to these studies, prepubescent motor development research reveals no significant gender differences regarding the ability to execute most fundamental movement skills (see Clark & Ewing, 1985; Thomas & French, 1985). Significant differences have been found, however, when one gender receives more experience practicing a specific skill. Young boys, for example, have been found to demonstrate a more mature throwing pattern than young girls. This superiority is a result of more exposure and experience in throwing (see Nelson et al., 1986). Because gender did not significantly relate to young children’s DMA, it may be that neither boys nor girls have received more experience than the other in producing divergent movement responses. This finding is consistent with Cleland and Gallahue’s (1993) earlier study, examining the DMA of 4-, 6-, and 8-year old boys and girls. Gender differences were not significantly related to this sample’s DMA.

In conclusion, divergent movement ability seems to be a highly distinct measure of young children’s ability to generate alternative movement responses
on fundamental movement tasks. Its sensitivity to physical education content and teaching styles suggests that if we want children to be able to employ creative thinking and critical thinking skills, then we must teach them how to do this. Indirect teaching styles and developmentally appropriate lesson content (i.e., lessons based on skill themes and movement concepts) are successful in accomplishing this goal. Subjects in this study appeared to enjoy the challenges involved in solving movement problems and employing critical thinking strategies.

Further studies replicating these findings are warranted. Additional components, other than divergent movement ability, related to critical thinking in physical education could also be examined (e.g., the ability to question, the ability to select criteria to judge or refine movement solutions). It may also be important to modify the testing protocol for evaluating divergent movement ability. Total movement time in this study was 9 minutes (i.e., 3 minutes per task). Subjects may be able to employ more critical thinking abilities if provided with more time or with nontimed trials. We may also question whether teaching young children to employ strategies and helping them to develop dispositions favorable to critical thinking (Ennis, 1987) in physical education might promote their use in the classroom. Collaborative studies in physical education and within the classroom may reveal such insights. Examining how small groups of children can use critical thinking in physical education may also prove interesting. These and other questions provide worthwhile challenges and may help to “unlock the complexities of critical thinking” (McBride, 1992, p. 122) within the physical education setting.

References


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