

A Comparison of Two Instructional Formats on Heart Rate Intensity and Skill Development

Patrick B. Quinn and Brad Strand

In their most recent report, *Healthy People 2000: National Health Promotion and Disease Prevention Objectives*, the U.S. Public Health Service (1991) outlined the public health goals for the United States for the year 2000. This publication is designed to help improve the health of all Americans with objectives directed specifically towards improving the health of children and youth. Although it is not specified that *Healthy People 2000* objectives be achieved during school physical education, it is widely agreed that school physical education provides the best opportunity for addressing the physical activity needs of children and youth (Bar-Or, 1987; Sallis & McKenzie, 1991; Simons-Morton, Parcel, O'Hara, Blair, & Pate, 1988).

There is controversy, however, over the relative prioritizing of objectives in physical education. Some believe that physical fitness should be the most important objective (Johnson, 1985), while others contend that sports and motor skill development have been and should continue to be the primary goal (Seefeldt & Vogel, 1987). McGinnis, Kanner and DeGraw (1991) have summed up the problem by stating, "The challenge facing school physical education professionals is to make effective use of a limited amount of class time to teach the knowledge and skills necessary to be successful in a

wide variety of physical activities that promote health, fitness, skill building, enjoyment of sport and recreation, general well being, self-esteem, and confidence" (p. 141).

Siedentop (1991) defined an instructional format as "the way a teacher organizes and delivers instruction and provides practice for students" (p. 26). He continued by stating that "the effectiveness of any instructional format needs to be judged in terms of student process and outcomes" (p. 227). Through the years physical education teachers have used several instructional formats, what we are calling teaching models, to organize the structure of their classes in order to enhance student learning (Zeff, 1985). For many, the traditional skill-drill model (TSDM) of teaching has been the prevalent instructional format in secondary physical education (Dowell, 1975). This model typically begins with an introduction to a sport on the first day of class. The next lessons are comprised of skill learning followed by drill. After consecutive days of skill-drill, lead-up games are finally incorporated followed by the playing of the actual game and a tournament. A benefit of this model is that it provides ample time to teach skills, a shortcoming, however, is that skills are practiced and developed separate from game play (Zeff, 1985).

Recently, it has been suggested that skill practice should be distributed over time for more learning (Rink, 1993). The skill-play integration model (SPIM) addresses this suggestion by incorporating skill-drill and

Patrick B. Quinn is employed by the Rex Wellness Center, Raleigh, NC. Brad Strand is a faculty member in the Department of HPER at Utah State University.

play into each day's lesson from the first day of class until tournament play. A typical lesson consists of a demonstration of a new skill or review of a previously learned skill, followed by game-type drills to learn the skill. The game-type drills then integrate into a game activity. This model overcomes the separation between skill development and game play which is found in the TSDM (Gustafson, 1980). Research has shown that the SPIM provides as much academic learning time with no sacrifice in skill development as does the TSDM (McManus, 1992; Zeff, 1985). Neither the TSDM nor the SPIM specifically address the issue of cardiovascular development.

In answer to the youth fitness problem in America, writers have suggested the use of a planned fitness component in daily lesson planning (Pangrazi & Darst, 1991). The fitness-skill-play integration model (FSPIM), which is similar to the SPIM with the inclusion of the suggested fitness component, is designed to address this issue. Researchers have demonstrated that school physical education programs that incorporate vigorous physical activity can be implemented, and improvements in the cardiorespiratory endurance component of physical fitness can be achieved by children who participate in such programs (Cooper et al., 1975; Duncan, Boyce, Itami, & Paffenbarger, 1983) and that it is possible to increase the amount of time children are involved in moderate to vigorous activity during physical education (Simons-Morton, Parcel, Baranowski, Forthofer, & O'Hara, 1991). It has not been determined, however, what effect the incorporation of a fitness component has on motor skill development of students.

The purpose of this study was to compare two teaching models—the skill-play integration model (SPIM) and the fitness skill-play integration model (FSPIM)—to determine if there would be a significant difference on the total time above 60% of maximal heart rate for age and the motor skill develop-

ment of male seventh grade physical education students engaged in a football activity unit.

METHODS

Subjects.

Subjects in this study were 60 male students aged 12 to 13 attending seventh grade physical education classes at a northern Utah middle school. They represented two separate physical education classes, one containing 31 students and the other 29 students. Prior to participation, subjects and their parents were informed of the general purpose of the study and were required to sign an informed consent form. Subjects were free to withdraw from the study at any time. This study was approved by the Human Subjects Committee of Utah State University.

Instrumentation.

Polar Vantage XL heart rate monitors (HRMs) were used to collect data on heart rate intensity levels and duration of physical activity. The HRM consists of two components: a chest band with a sensor-transmitter and a wrist monitor. The chest band is an adjustable, elastic belt which secures around the chest of the subject. The sensor-transmitter automatically senses the electrical impulses from the electrodes and transmits that information to the wrist monitor. The wrist monitor is a receiver-microcomputer which receives and stores heart rate readings. The data from the wrist monitor memory can be transferred to a personal computer for analysis by means of a computer Polar interface unit. The use of HRMs in both laboratory and field settings has been shown to be a valid way to measure heart rate intensity during physical activity (Leger & Thivierge, 1988; Treiber et al., 1989).

Skill assessment was measured by three test items selected from the American Alliance of Health, Physical Education and Recreation (AAHPER) Football Skills Test

The study was conducted over a 4-week period. All subjects in the two groups were pretested during the first two days of the study using the three-item football test battery. Beginning the third day a typical class period was conducted as follows. Subjects reported to the locker room and dressed for class after which they read the posted preclass activity instructions for the day and reported to the field. Before departure from the locker room, the subjects scheduled to wear the HRMs for the day reported to the researcher to have the HRMs put on. The researcher ensured proper wearing of the HRMs and proper starting of the wrist monitors. Dressing for class, reporting to the researcher, and reporting to the field took approximately 5 minutes. The preclass activity was generally supervised by the teacher and lasted an additional 5 minutes. Upon the teacher's signal, the preclass activity ended and subjects assembled for attendance. Following attendance, the SPIM group focused on skill development and game play for the remainder of class time—approximately 30 minutes—using the skill-play integration model. At the end of the class period, as each subject reported back to the locker room, the HRMs were turned off and the instrumentation returned.

The FSPIM group was taught using the same method as the SPIM group; however, the time for skill development and game play was reduced to approximately 20 minutes to allow for a cardiorespiratory fitness component to be included for the last 10 minutes of each day's class period. The fitness component consisted of four aerobic activities, each of which was scheduled on a rotation basis in the FSPIM lesson plan. During the final day of the 4-week period, all subjects in the two groups were post-tested using the three-item football test battery.

Following collection, data were downloaded to a Polar program on an IBM notebook computer. The data on the Polar

program were analyzed and then transferred to the statistical package Statview 512 contained on a Macintosh computer.

RESULTS

Descriptive statistics including means, standard deviations, minutes of time, percentage of time, and heart rates were calculated for the two groups. T-tests were used to determine differences on mean time above 60% of maximal heart rate for age and to compare the pretest scores on each of the three football skills test items to determine if there was a significant initial difference between the groups on any of the skills. No significant initial differences were found at the .05 level of significance between the groups for any of the three items; therefore, t-tests were also used to compare the mean gain scores of the two groups for each of the three items at the .05 level of significance.

One hundred and fifty individual heart rate recordings of entire class periods were collected and stored on the HRMs, 84 for the SPIM group and 76 for the FSPIM group. The mean class time for the SPIM and the FSPIM was 35.4 and 35.7 minutes, respectively.

Analysis revealed that when the models were compared over a 4-week football unit, a statistically significant difference ($p < .05$) between the mean time above 60% of maximal heart rate for age was found between the two groups (SPIM $M = 12.1$ minutes, FSPIM $M = 17.7$ minutes). As shown in Table 1, the FSPIM group was above 60% of

Table 1
Time in Minutes of Heart Rate Above 60% of Maximal Heart Rate for Age

Group	No.	Mean	SD	df	t-value
SPIM	84	12.1	6.6		
FSPIM	76	17.7	6.2	158	-5.507*

* $p < .05$

maximal heart rate for age for a mean time of 5.6 minutes longer than the SPIM group.

There was no statistically significant difference in the posttest mean gain scores for each of the three football test items between the two groups. However, as shown in Table 2, compared pretest and posttest scores within groups indicated that SPIM students improved statistically significantly in the zigzag run test ($p, < .001$) and the pass for accuracy test ($p, < .05$ tests) while they decreased in the punt for distance test. The FSPIM students, on the other hand, improved in all three test items but statistically significantly in only the zigzag run test ($p, < .001$).

DISCUSSION

These results support current theory proposed by professionals in pedagogy who assert that school physical education programs that provide a planned opportunity for fitness development in each physical education class period can increase the amount of time children and youth spend engaged in vigorous physical activity during physical education (Lacy & LaMaster, 1990; Pangrazi & Darst, 1991).

The heart rate recordings in this study are consistent with those reported previously. In a recent analysis of individual heart rate recordings in football activity units from two separate studies, Strand and Reeder (1993a; 1993b) revealed subjects were above 60% of maximal heart rate for

age (150 BPM) for a mean time of 15.8 and 20.9 minutes. Strand and Reeder's first study was designed to gather descriptive data while the second study implemented strategies recommended in the first study. The instructional format used in Strand and Reeder's studies was similar to the FSPIM used in this present study; however, the 60% of maximal heart rate for age differed.

The mean class time above 60% of maximal heart rate for age of 17.7 minutes recorded by the FSPIM in this study, is similar to the mean class time above 60% of maximal heart rate for age recorded by the subjects in the Strand and Reeder studies and is consistent with the duration of time recorded by other researchers, as measured by observation, who have modified physical education classes to improve the cardiorespiratory fitness of subjects (Simons-Morton et al., 1991).

One purpose of this study was to determine what effect the incorporation of a fitness component in a daily lesson would have on motor skill development. In essence, we sought to determine if teachers who include a fitness component are sacrificing skill development in favor of fitness development? Based on the results of this study, it appears that the addition of a planned fitness component does not detract from skill development.

One would expect that SPIM subjects would improve to a greater degree than would FSPIM subjects because they received 480 minutes of skill and game play during the four week unit while the FSPIM subjects received 320 minutes. This was not the case however. A look at each test item for each group (Table 2) reveals that subjects improved in five of six skills tests during the four week activity unit. SPIM subjects improved in two of the items while the FSPIM subjects improved in all three items.

Both groups improved significantly in the zigzag run test. Improvement in this test is

Table 2
Within Group Pretest and Posttest Comparisons

Group	Pretest Score	Posttest Score	Mean Change	Significance Level
SPIM				
Zigzag Run	8.71 sec.	8.19 sec.	- 0.51 sec.	.001
Pass	6.34 pts.	8.46 pts.	+2.11 pts.	.05
Punt	71.30 ft.	67.26 ft.	- 4.03 ft.	.09
FSPIM				
Zigzag Run	8.64 sec.	8.30 sec.	- 0.34 sec.	.001
Pass	6.08 pts.	6.83 pts.	+0.75 pts.	.31
Punt	64.16 ft.	65.00 ft.	+0.83 ft.	.69

indicated by a decrease between pretest and posttest times. SPIM and FSPIM subjects improved their times by 0.51 and 0.34 seconds, respectively. Both groups also improved upon their pretest scores in the pass for accuracy test with the SPIM subjects improving by 2.11 points and the FSPIM subjects improving by 0.75 points. In the final test, the punt for distance, SPIM subjects decreased their punting distance by 4.03 feet while the FSPIM subjects again improved, 0.83 feet.

One possible explanation for these scores may relate to how the game of football was played during the play phase of a lesson in this study. Essentially, the subjects played razzle-dazzle football. How razzle-dazzle differs from traditional football may help explain test scores. First, in razzle-dazzle football students are allowed to pass more than once and from anyplace on the field during a down. For example, the ball is hiked, the quarterback runs five yards and then passes to teammate #1, #1 then runs around, spots #2 and passes him the ball, #2 catches the pass and runs. When #2's flag is pulled out, the play is dead and the ball is spotted. There is no limit to the number of passes that may be attempted during a given down. Second, every player is eligible for a pass at any time during a down. In traditional touch football, the center hikes the ball and along with the other linemen, block the charging defensive players. When the quarterback releases the ball or runs beyond the line of scrimmage a lineman's job is essentially done. From then on they stand and watch as the play unfolds downfield.

In reality, razzle-dazzle football allows more players to pass, catch and run with the ball during a given down. However, because the ball is moved quickly down the field, teams very seldom have to punt on fourth down. Results from the test items appear to have some relation to razzle-dazzle football in the following ways. First, all players are constantly running trying to get open for a

pass, thus one would expect that their zigzag run time would improve. Second, rather than one pass per down thrown by one player, any number of passes thrown by any number of players can occur during a given down. Thus, more players are getting a chance to pass the ball and one would expect that passing ability would improve. Finally, because punting very seldom occurs, one would expect punting distances to improve slightly if at all.

One would expect that students who spend more time in skill training and game play, the SPIM group, would improve their skills more than students who spend a lesser amount of time in skill training and game play, the FSPIM group. Both researchers of this study have noticed many instances of student boredom during skill training when students quit doing the drills and simply fool around after a given period of time. Just because students are engaged in the skill phase of a lesson does not mean that they are actually developing their skills.

We believe that the students in the FSPIM model were more cooperative during the skill training phase of a lesson because they knew it was not going to be too long before they could actually play the game. In addition, because they knew their game was shortened by ten minutes due to the fitness run, they actually paid more attention and played harder during the game.

Overall, it appears that both models are almost equally effective in terms of skill development. However, the FSPIM provides significantly greater time in a cardiovascular training zone than does the SPIM.

This is believed to be the first study to look at the effects that instructional formats designed to promote cardiorespiratory fitness in school physical education programs could have on the motor skill development of subjects. The results from this study suggest that using a FSPIM of teaching has the potential for increasing the physical activity and cardiovascular endurance of children

while also improving motor skill development. With the current emphasis by professionals and professional organizations to promote health-related physical fitness in the school settings, the findings from this study may provide practical implications for curriculum developers and physical education teachers as they develop and implement curricula.

Additional studies that replicate this study must be conducted to substantiate these findings. Also, skill and fitness development must be studied using different instructional formats, different activity units, and activity units of varying lengths. In addition, studies that include an analysis of student attitudes should be undertaken. In the present study, FSPIM subjects had to complete a ten minute run every day while the SPIM subjects continued playing. Although the FSPIM subjects spent more time in a predetermined training zone, one may wonder if having to run at the conclusion of a class period affected their attitudes toward physical education or physical activity either positively or negatively.

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