

# Effect of an Ecological-Based Program on Teaching Specific Volleyball Skills to Young Adults with Mild Cognitive Impairments

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## Abstract

The purpose of this study was to examine the effect of an ecological program on teaching young adults with mild cognitive impairments specific volleyball skills. A two-group pretest-posttest experimental design was used. Nine participants in the experimental group were taught volleyball skills in two 60-min teaching sessions per week for a total of 10 weeks, while 11 participants in the control group still participated in general classes. A 2 (group) x 2 (test) analysis of repeated measures on the overall test and its follow-up tests were used to analyze data. Results revealed differences not only on the overall test but also on all follow-up tests at a significant level of .01. The ecological program used in this study was therefore effective in teaching young adults with mild cognitive impairments specific volleyball skills.

**Key words:** ecological program, sport skill training, individuals with cognitive impairments, and volleyball.

With the enactment of the Education for All Handicapped Act (now the Individuals with Disabilities Education Act) in 1975 in the United States of America, physical education services, specially designed if necessary, must be made available to every student with disability receiving a free and appropriate public education (*Federal Register*, August 23, 1977). The specially designed physical education services are required to develop individually for meeting the unique needs of a student with disability. These needs can be determined through the use of appropriate assessments (Ulrich, 1985).

Traditionally, the assessments used to determine the individual needs for developing a program have been norm-referenced standardized assessments in which an individual's scores were compared to the scores of others on the same assessments (Safrit, 1990). Based on the results of these standardized tests, an eligible individual's program could be developed and implemented (Block, 2007). That is, the focus of this program was the poor areas or skills identified through the evaluation such as an individual's balance score being below the 30th percentile, which were taught or trained in the implementation of this program. This is named as the traditional approach in the majority of literature for placement and programming (Auxter, Pyfer, & Huettig, 2005; Block, 2007).

However, this approach has been criticized in teaching skills for the facilitation of including individuals with disabilities in general environments (Block, 2007). This is because the result of standardized assessments used in this traditional approach may not provide the useful information directly regarding critical skills required in general environments. In the traditional approach, the use of standardized assessments makes some practitioners to follow the developmental continuum. With this continuum, deficiencies at the lower level of a developmental continuum become the focus of

a program without regard to how these skills affect the acquisition of important skills required in general environments (Block, 2007).

For example, a middle school student who does poorly on the *Bruininks-Oseresky Test of Motor Proficiency*, a standardized test used by physical educators (Ulrich, 1985), may be locked at the lower level of developmental continuum. If the student does poorly on test items in the sub-test area of balance (e.g., standing on preferred leg on balance beam), then this student would focus on improving his or her vestibular function (i.e., the lower levels of developmental continuum). The focus on the improvement of vestibular function would then result in that the teaching of specific sport skills (i.e., the top level of developmental continuum) were ignored in general middle school settings.

An alternative to the traditional approach in terms of teaching skills for the facilitation of including individuals with disabilities in general environments is the ecological approach (Block, 2007; Sherrill, 2004). The major feature of this ecological approach is that the selection of critical skills based on the interaction between individuals and environments as the target skills of a program. That is, the skills preferred by peers, parents, communities, and institutions are selected as target skills in a program (Voeltz, Wuerch, & Bockhaut, 1982). The use of this ecological approach is believed to be a better approach for teaching critical skills for the facilitation of including individuals with disabilities in general environments (Block, 2007).

Unfortunately, the review of literature revealed that a few of experimental studies have been conducted to examine the effect of ecological approach. Sufficient experimental data could not be located to support that the ecological approach is effective in teaching individuals with disabilities important skills for the facilitation of including persons with disabilities in general physical education. Only was a study located that examined the effect of ecological program in adapted physical education.

Specifically, Zhang and Berkey (2002) examined the effect of an ecological program on teaching the age-appropriate motor skills to individuals with mild cognitive impairments. The program was developed based on an ecological survey (i.e., determine the age-appropriate motor skills based on interaction between individuals and environments). A group of 22 individuals with mild cognitive impairments received two 60-min teaching session(s) per week for 10 weeks. The magnitude of increase of the number of task-analyzed steps between the first session and the last session by the participants was significant after training, indicating that this ecological program manipulated in this study was effective in teaching those important motor skills determined based on the ecological survey.

The effect of the ecological program confirmed in Zhang and Berkey's research (2002), however, is questionable because of its poor research design. The research design used in this study was the one-group pretest-posttest design. Although one can use this

design to determine the improvement between before and after ecological teaching, this design cannot allow the researcher to explain why this improvement occurs (Thomas & Nelson, 2005). Since there was no control group used by Zhang and Berkey (2002), the significant improvement demonstrated by one group of the participants might have resulted from some history of events that occurred over the time when the study was conducted, rather than from the manipulation of an ecological-based program.

The improvement demonstrated by the participants in Zhang and Berkey's study (2002), for example, might be resulted from those similar motor programs conducted in the community of these participants. This indicates that there is a significant need exists to examine the effect of ecological program further with an appropriate research design in which a control group is included. Therefore, the purpose of this study was to examine the effect of an ecological program on teaching young adults with mild cognitive impairments volleyball skills. Specifically, the ecological program used in this study was similar to the one conducted in Zhang and Berkey's study (2002), but the research design included both an experimental group and a control group.

## **Method**

### *Experimental Design*

A two-group pretest-posttest experimental design (Thomas & Nelson, 2005) was used. The two groups were an experimental group and a control group. Participants in the experimental group received volleyball skill training in an ecological program for 10 weeks with two 60-min training sessions per week. In contrast, participants in the control group received physical education classes based on original schedules without volleyball activities over the period during this investigation. Each participant in both groups was administered the pretest and the posttest. The pretest was administered at the first session, while the posttest was administered at the last session.

The purpose of using this design was to control those threats such as history of events to the internal validity of the ecological program used in this study, rather than to compare the effect of ecological program to the effect of traditional approach. Since all the participants had exposed to similar distributed events (e.g., community activities) over the period during this investigation, the increase of skill performance by the participants in the experimental group would result from the manipulation of the ecological program, rather than from the occurrence of other events (e.g., school classes) if the skill performance by the participants in the control group had no changes at the end of this investigation.

### *Participants*

Participants recruited in this study were 20 young adults with cognitive impairments, 11 females and 9 males, ages from 17 to 26 years old ( $M$  age = 21.07). They were sampled from the young adult program in a special post-secondary school conveniently. The staff from this school identified these individuals categorized with mild cognitive impairments. However, specific assessments administered to determine the level of cognitive impairments were not reported by the staff from this school. In the experimental group there were 9 participants, 5 females and 4 males, ages from 19 to 26 years old ( $M$  age = 20.78), while in the control group there

were 6 females and 5 males, ages from 17 to 25 years old ( $M$  age = 21.36).

Participants from four similar classes were conveniently assigned into two groups. Those participants with physical education classes on Monday and Wednesday in their school were assigned into the experimental group; while the participants having physical education classes on Tuesday and Thursday scheduled in their school were assigned into the control group. It should be noted, at the beginning of this investigation, that a total of 23 participants were recruited from this school, including 11 participants in the experimental group and 12 participants in the control group. However, a total of 3 participants were excluded due to their sickness and relocation over the period of this study. This includes 2 dropouts in the experimental group and 1 dropout in the control group.

### *Ecological Program*

Participants in the experimental group were taught in a specific ecological-based program. This program included five programming components used in Zhang and Berkey's (2002) investigation. The five components were (a) the selection of three basic skills from a type of sport for the participants using an ecological survey, (b) the task-analyses of each basic sport skill into meaningful steps employed for the criteria of assessments, (c) the development of the individualized plan for each of the participants based on the result of pretest, (d) the development and implementation of 20 activity plans based on their individualized plans, and (e) the writing of a outcome report based on the result of posttest. Each one of these components is described below.

The target sport for the participants was determined using an ecological approach (Block, 2007). In this approach, a survey was first conducted to determine a type of sport based on the following variables: personal interests, family preferences, popular sports used in communities, sports expected by the school, and age-appropriate sports. The specific sport favored by the largest number of these variables was then selected as the target sport of this ecological-based training program for these participants. The results of this survey revealed that volleyball was ranked as the top one among all the sports listed. Therefore, volleyball was selected as the target sport for the participants in this investigation.

Next all recruited participants' performance was observed on each of the basic volleyball skills. It was determined that none of these participants in either experimental group or control group could independently correctly perform any one of the basic volleyball skills. Three specific volleyball skills were then selected, including (a) serve, (b) pass, and (c) set, as the target skills in this investigation. Those participants in the experimental group were taught to perform the three specific volleyball skills correctly, while those participants in the control group were involved in the pretest and posttest on these skills only in this study.

Each of the three target volleyball skills was task-analyzed into numerous steps based on their natural movement sequence. At the same time, we also considered the self-application and functional ability of participants in task-analyzing these skills. The self-application addressed a participant's self-initiation of a skill; a participant who picks up related materials to perform a target skill would be the first step of a task analysis (Nietupski, Hamre-

Nietupski, & Ayres, 1984). The functional ability addressed the simplification of related step responses based on a participant's functional level (Snell, 1987). We then defined the task-analyzed step responses and used these steps as criteria for evaluating a participant's performance on a target skill. An example of a task-analysis is presented in Table 1.

**Table 1. Serve a Volleyball over the Net: An Example of Task Analyses of Three Volleyball Skills based on Self-Application by Participants, the Natural Sequence of Skills, and the Functional Ability of Participants**

Steps	Definitions
1	Find and pick a volleyball up from the bag or the floor in the volleyball court
2	Walk or run to stand behind the serving line specified on the volleyball court
3	Stand in a ready position with bending knees slightly and eyes on the partner
4	Hold the ball in two hands with placing the hitting hand on the top of this ball
5	Step toward the volleyball net in the balanced foot opposite to the hitting arm
6	Bring the hitting arm backward while keeping the ball on the non-hitting hand
7	Swing the hitting arm forward while dropping the ball in the non-hitting hand
8	Hit the ball toward the targeted partner with a fist made with the hitting hand
9	Follow-through toward the partner by stepping the non-balanced foot forward

During the first session, a participant in the experimental group was tested to determine how many steps of a task-analyzed volleyball skill this participant could complete correctly. The result of this pretest was used to develop an individualized plan for this participant. The plan included 5 components (a) personal information, (b) task analyses of target volleyball skill, (c) testing procedure using task-analyzed steps as criteria, (d) the present level of performance, and (e) the long-term goals and short-term objectives. The individualized plan then served as the basis for developing activity plans for the corresponding instructional sessions.

Each activity plan developed for a corresponding teaching session was required to focus on unlearned steps (i.e., task-analyzed steps on which a participant could not perform correctly). The unlearned steps were taught using several activities but each activity had a short duration (e.g. 3 to 5 min). The use of multiple activities for teaching the unlearned steps with the short duration of each activity was based on the fact that all the participants recruited in this study had a short attention span because of their disability of cognitive impairments. In addition, we also worked on the associated underlining problems that might negatively influence the performance of a targeted volleyball skill.

During the last session (Session 20), each participant was tested again to determine how many steps of a task-analyzed target volleyball skill he or she could complete correctly. An outcome

report form for a participant was required to be completed by the instructor. The report included scores at both the pretest and the posttest to examine the magnitude of increase between the first session and the last session during the period of 10 weeks with two 60-min sessions each week. The magnitude of increase would show how much progress a participant had made during the period of conducting this investigation.

#### *Student-instructors*

A participant in the experimental group was taught by a student-instructor who enrolled in an introductory to adapted physical education course in a one-on-one format. All instructors taught their participants based on a formatted laboratory manual, in which the methods how to develop and conduct the pretest, the individualized plan, the activity plans, the posttest, and the report are presented.

#### *Data Analyses*

Since the participants were conveniently sampled and assigned into the experimental group and the control group, three statistical analyses were used to justify the appropriateness of using these two groups in this study. Independent t test was performed to analyze the difference of ages between the experimental group and the control group. A one-way multivariate analysis of variance design on three dependent variables (serve, pass, and set) was used to analyze the difference of pretest scores between the male participants and female participants. Another one-way multivariate analysis of variance design on three dependent variables was used to determine if there was a difference in the pretest scores between the experimental group and the control group.

Both pretest and posttest data collected on performing each of the three target volleyball skills by each participant in both the experimental group and the control groups were analyzed in a 2 (group) x 2 (test) analysis of repeated measures on multiple dependent variables (serve, pass, and set) for the overall difference between two groups (experimental and control) over two tests (pretest and posttest). After a significant difference was determined on the overall test, the follow-up univariate tests, 2 (group) x 2 (test) analyses of repeated measures on only a single dependent variable, were computed. The procedures provided by Schutz and Gessaroli (1987) and Morgan and Griego (1998) were followed to conduct and interpret our data analyses using SPSS software (SPSS Inc., 2004).

#### **Results**

The independent t test on the difference of ages between the experimental group and the control group was not significant,  $t(18) = 0.46, p = .65$ . The one-way multivariate analysis of variance on the difference of pretest on three dependent variables between the male participants and the female participants collapsed across the experimental and groups was not significant as well,  $F(3,16) = 0.21, p = .89$ . Further, the one-way multivariate analysis of variance on the difference of pretest scores on all the dependent variables between the experimental group and the control group was also not significant,  $F(3, 16) = 0.11, p = .95$ . These results revealed that the groups used in this study were appropriate.

Based on the overall test of a 2 (group) x 2 (test) analysis of

repeated measures involving three dependent variables (serve, pass, and set), there was a significant difference between two groups (experimental and control) over two tests (pretest and posttest) on the three dependent variables,  $LRATIO(3, 16) = 25.28, p = .00, \text{Eta}^2 = .83$ . Based on this finding, both the experimental group and the control group differed in their performance between the pretest and the posttest on at least one of three dependent variables (i.e., three specific volleyball skills).

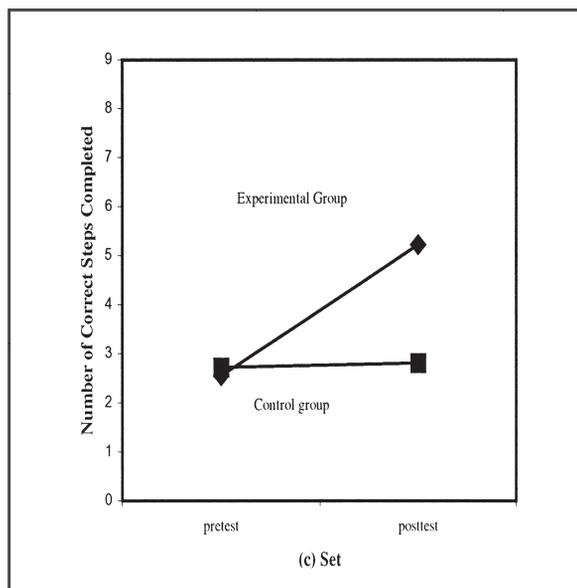
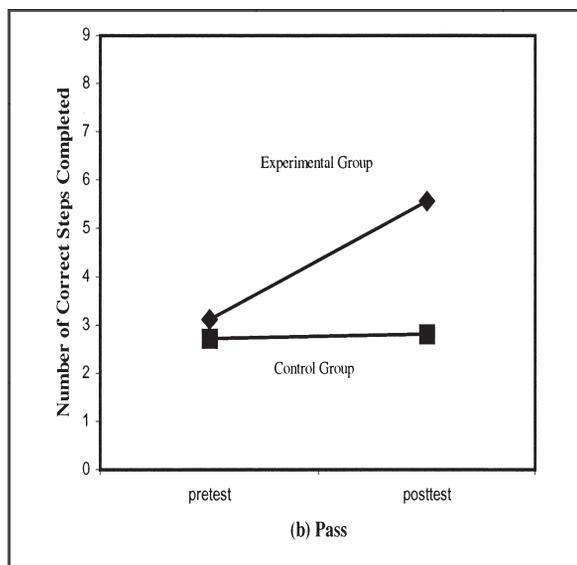
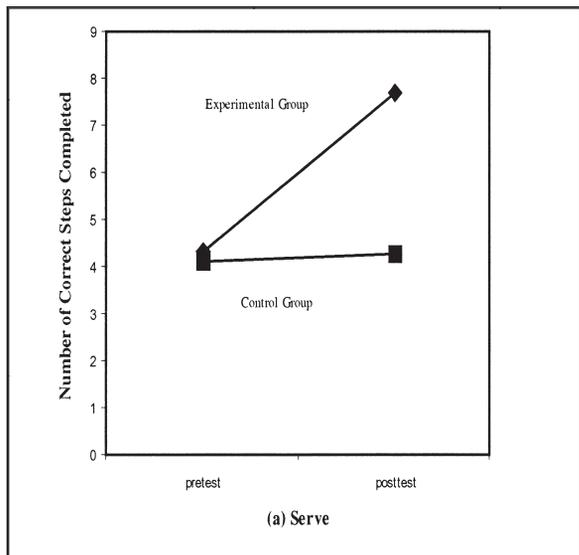
The follow-up univariate tests, using  $2(\text{group}) \times 2(\text{test})$  analyses of repeated measures between the two types of groups over the two types of tests on each dependent variable, also demonstrated significant differences. The follow-up tests demonstrated a significant difference on the serve,  $F(1, 18) = 32.02, p = .00, \text{Eta}^2 = .64$ , the pass  $F(1, 18) = 13.29, p = .00, \text{Eta}^2 = .43$ , and the set,  $F(1, 18) = 39.65, p = .00, \text{Eta}^2 = .69$ . These indicated that the experimental group increased the performance significantly based on the difference between the pretest and posttest scores on each dependent variable, but the control group had no statistically significant changes.

### Discussion

Based on the results obtained in this investigation, the improvement of participants in the experimental group on performing three volleyball skills was resulted from the manipulation of independent variable only. There was no significant difference on the external variables of age, genders, and pretest scores on dependent measures between the experimental group and the control group before the ecological program was initiated. After the ecological program instruction, however, the experimental group only significantly increased their performance (note in Figure 1). Therefore, the ecological program was effective in teaching young adults with mild cognitive impairments three volleyball skills.

Since the ecological program used in this investigation confounded multiple variables, as presented in the method section, the effect of this ecological program would result from all of

Figure 1 - A Graphic Representation of Mean Scores on the Volleyball Serve, Pass, and Set Skills by the Experimental Group and the Control Group between Pretest and Posttest



the programming variables, including the conduction of ecological survey, the task analyses of targeted skills, the measurement of targeted skills, the development of individualized physical education plans, and the development and implementation of teaching activities. The conduction of ecological survey, however, would be a major component to the effect of ecological program because the result from conducting the ecological survey ensured that the target skills selected were critical skills for including persons with disabilities in general physical education classes (Zhang & Berkey, 2002).

Volleyball selected based on the ecological survey is a very popular sport across all the schools and colleges in the state where our participants lived. The participants' schools, teachers, communities, peers, and parents, including the participants, most likely love to play and/or watch volleyball because this sport would be helpful for them to have social interactions with other individuals. Each year, volleyball practices, games, and camps are periodically and continually conducted at high school and college levels in this state, resulting in that most individuals who live in

this state believe the volleyball is an ecologically valid activity because the ability to perform this activity well would enable individuals to function better in the ecosystem (Overton, 2003; Sax & Thoma, 2002). All the volleyball skills taught in this study are thus ecologically valid for the participants.

It should be indicated that based on the model of motor development, specific sport skills for the participants in this study were directly selected from the top level of motor developmental model even though the participants might show problems at lower levels of motor developmental model. Almost all participants employed in this study had some associated problems at the lower levels of motor functions based on our observations. Someone had vestibular dysfunctions, while others showed perceptual-motor problems or poor physical fitness. These problems would have been targeted for the participants if a developmental approach were used (Block, 2007) because three levels of motor functions are developed in a sequence from the neurological function (e.g., vestibular function), to general abilities (e.g., balance), and to specific skills (e.g., a sport skill).

The participants of this study, however, were young adults with an averaged age of 21 years old and they demonstrated slower learning rate because of the specific type of disability. The instructional physical activities selected for these participants based on solving their problems at low levels of motor functions would make them to participant into activities being not age-appropriate. For example, a participant (i.e., a young adult) with vestibular problem at the bottom level of neurological function would be taught using multiple vestibular exercises such as walking on a beam and rolling and standing with a leg for a period of time. These exercises, however, are clearly inappropriate for young adults based on the age.

This study thus selected specific volleyball skills directly from the top level of motor function as the targeted skills for young adults based on the ecological survey. All the physical activities used during teaching in this study were developed and conducted to help all the participants learn three volleyball skills based on the task analyzed steps. It should be noted, however, that physical activities might be also used to help a participant to solve the problems at the low levels of motor functions if the problems were associated with the volleyball skills. For example, forearm image exercises were used for helping a participant to know how to use his or her forearms to pass a ball correctly.

The above discussion reveals that the programming variable of ecological survey played a major role to ensure the target skills trained in this program being ecologically valid. Learning how to perform these targeted skills correctly by participants, however, were also associated with other programming variables. The variable of task analyses established criteria for testing skills, while the variable of assessments determined the unlearned task analyzed steps for a participant. The variable of developing individualized physical education plans set up goals and objectives based on assessment results, while the variables of developing and implementing activity plans trained the participants to perform all steps of task-analyses correctly. Therefore, these variables also made contributions to the effect of this ecological-based program.

In conclusion, the ecological program used in this study was effective in teaching young adults with mild cognitive impairments

three volleyball skills. The ecological survey used in this program was a major programming variable to ensure the target skills were critical for participants to be included in general physical activities. The effect of this ecological program confirmed, however, was also contributed by associated programming variables, including task-analyzing the targeted skills found based on the ecological survey, assessing each of the targeted skills based on the task-analyzed steps, developing individualized plans based on the assessment results, and implementing activity plans developed based on individualized plans.

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