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Effects of a Recreational Workout Program on Task-Analyzed Exercise Performance of Adults with Severe Cognitive Impairments

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***Abstract*—**The purpose of this study was to investigate the effectiveness of a recreational workout program for adults with disabilities over two semesters. This investigation was an action study conducted in a naturalistic setting. Participants included equal numbers of adults with severe cognitive impairments (n = 35) and adults without disabilities (n = 35). Adults with disabilities severe cognitive impairments were trained 6 self-initiated workout activities over two semesters by adults without disabilities. The numbers of task-analyzed steps of each activity performed correctly by each participant at the first and last weeks of each semester were used for data analysis. Results of the paired t-tests indicate that across two semesters, significant differences between the first and last weeks were found on 4 out of the 6 task-analyzed workout activities at a statistical level of significance $p < .05$. The recreational workout program developed in this study was effective.

***Keywords*—**Workout program, exercise performance, adults, sever cognitive impairment.

I. Introduction

THE opportunities for participating in physical activities for individuals with disabilities, either physically or mentally impaired, or both, have been significantly impacted because of the federal legislations. Such legislations as P.L. 94-142, the Education for all Handicapped Children Act of 1975 and PL 93-112, the Rehabilitation Act of 1973, require physical education and recreational programs to be available for individuals with disabilities [5]. This has resulted in that over past 38 years, many different types of physical activity and recreational program were created for individuals with disabilities [13]. Several types of these programs have been effectively practiced in natural teaching and training settings for individuals with disabilities. They are sensory-motor program, perceptual-motor program, ecological-based program, and the program of Unified Sports.

The sensory-motor program is most often referred to as the sensory-motor integration. Its focus is to facilitate the neurological processing of sensory-motor information as a foundation for performance of higher-level skills in either motor or academic area. A participant involved in the program should be intrinsically motivated [13] for achieving the goal of improving the sensory-motor processing to either develop better sensory modulation as it is related to attention and behavioral control or integrate sensory-motor information for better independent function in daily living activities. It is generally carried out in a one-on-one arrangement based on a person's unique need, implying that it focuses on the individualized programming. The interactions among persons with and without disabilities available in the integrated settings, however, are ignored in the implementation of sensory-motor activities.

The perceptual-motor program places the focus on the development of perceptual motor skills, more specifically, the improvement of motor skills in which movement is the center to the essential aspects of human development and growth. This type of program facilitates both cognitive perception and voluntary motor development [7]. Its programming has three phases, including the cognitive stage that focuses on the understanding of what is involved in the task, the associative stage that targets the practice, the autonomous stage that works on the speed and accuracy. The activities selected in this type of program are physical activities that require a person to interact with his or her environment that focuses on the interaction programming. This type of program, however, may be not implemented in ecological-based age-appropriate approach. This is because both age-inappropriate and age-appropriate physical activities could be employed to provide those interactions required in the perceptual-motor program [19], [21].

The ecological program is an alternative that uses a traditional way of teaching physical activities for the simplification of including people with disabilities in general environments [3], [13]. The primary feature of its programming is to select physical activities that are ecologically age-appropriate as target activities based on the interactions between individuals and environments. Those physical activities favored by normal peers, parents, local community, institutions, and individual interests are selected as the target physical activities in this type of program [15]. The ecological age-appropriate programming is definitely emphasized in this type of program. However, the individualized instruction for each individual may be ignored because an ecological program may be conducted in a group where the individualized instruction plan is not employed.

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The program of Unified Sports is a program that combines an equal number of Special Olympics athletes with athletes without cognitive impairments on the sports teams for training and competition. Partners are matched by age and ability specifically defined on a sport [7], [13]. This program is very important as it expands sporting opportunities for all athletes with and without disabilities, which was created and developed by Special Olympics to further the overall mission of creating equal opportunities for individuals with disabilities. Both movement sequence steps and performance outcome levels are employed to train sport skills for the competition in this program. However, self-initiated steps of a sport skill or physical activity for the independent playing or participation are not included in this program of Unified Sports.

As presented above, therefore, it is clear that each type of the above programs practiced for persons with disabilities is programmed based on a unique programming variable, which is an advantage, but ignores some of the other programming variables, which is a disadvantage. Can we develop a program that confounds all programming variables presented above (integration, ecology, self-initiation, and individualization) and evaluate the effective practice of this program? The purpose of this study was to determine the effectiveness of a recreational workout program for adults with disabilities over two semesters in academic year 2011-2012. This workout program confounded four programming variables, including integration, ecology, self-initiation, and individualization.

II. Method

This study was implemented in an accepted research design. Participants in this study were trained with appropriate programming variables. All data about the performance of participants have been collected during the implementation of this study and analyzed after the completion of this study.

A. Research Design

This investigation was an action study wherein adults with and without disabilities were involved in workout activities in a naturalistic setting [2], [10]. These adults participated in this recreational workout program based on the normally scheduled adapted physical activity classes, twice a week in a semester, two semesters of an academic year 2011-2012. In this study, the effect of this recreational workout program for adults with disabilities was evaluated in the naturalistic applicability.

B. Participants

The participants in this study included adults with and without disabilities. Adults with disabilities were served as trainees, while adults without disabilities served as trainers [17]. Over two semesters 2011-2012, 70 participants have involved in this study, including 35 trainees from a special institute and 35 trainers from a university. All trainees were adults with severe cognitive impairments. They were integrated in this workout activity program.

C. Programming

All participants in this study were involved in an integrated recreational workout program specially designed in this study [16]. Primary philosophies that were used to guide the programming of this study were integrated, ecological, self-initiated, and individualized. Based on integrated philosophy, as presented before, the equal numbers of young adults with and without disabilities have been included in this study. In each week over a semester, there were four 50-minute sessions available. Each session included about 20 participants, about 10 trainees and 10 trainers. All program activities were implemented in this integrated setting.

Based on ecological philosophy, all workout activities were selected and targeted with an ecological method [3]. In this method, a survey was conducted to determine a type of workout activities based on such variables as personal interests, family preferences, popular activities used in communities, activities expected by schools, and age-appropriated activities. With this survey, step aerobics, resistance bands, and line jumping were targeted in the fall of 2011, while hamstring stretching, walking and jogging, and medicine ball, were targeted in the spring of 2012 [6].

Based on self-initiated philosophy, each targeted workout activity was task-analyzed into small steps focusing on the self-initiation of an activity. The task-analyzed steps of each activity included three parts. The first part included several self-initiated steps used to set up an activity station. The second part included several movement sequenced steps based on the natural process of a workout activity. The third part included several performance levels based on the outcomes.

It is clear that the task analysis used in this study included a unique part of task analysis, the self-initiation of an activity. This is because we expected our trainees to be able to perform a targeted workout activity independently after the training. An example of the self-initiated task analysis is presented in Table I.

TABLE I
AN EXAMPLE OF THE TASK-ANALYZED RECREATIONAL PHYSICAL ACTIVITY: STEP AEROBICS ACTIVITY

Steps*	Key Words and Definitions
1	*Pick up a step:* Find the cart for equipment in the gymnasium and pick up a step
2	*Find a spot: Carry the step and locate a spot on the floor designated by trainer*
3	*Set the step: Place the step down on the spot of the floor designated by trainer*
4	*Stand by the step: Stand with feet shoulder width apart next to the step*
5	*Take a ready position: Bend both knees slightly and extend both arms out*
6	*Step with right foot: Step up and down with right foot for 4 complete repetitions*
7	*Step with left foot: Step up and down with left foot for 4 complete repetitions*
8	*Step with alternating foot: Perform step 6 and 7 alternately for 4 complete repetitions*
9	*Step 6 minutes: Perform step 6-8 continuously for a total of 6 minutes*
10	*Step 8 minutes: Perform step 6-8 continuously for a total of 8 minutes*
11	*Step 10 minutes: Perform step 6-8 for a total of 10 minutes continuously*
12	*Step 12 minutes: Perform step 6-8 for a total of 12 minutes continuously*
13	*Step 14 minutes: Perform step 6-8 for a total of 14 minutes continuously*
14	*Step 16 minutes: Perform step 6-8 for a total of 16 minutes continuously*
15	*Step 18 minutes: Perform step 6-8 for a total of 18 minutes continuously*

* Steps 1-3 are self-initiated steps. Steps 4-8 are movement-sequence steps. Steps 9-15 are performance outcome levels.

Based on individualized philosophy, an individualized physical activity plan (IPAP) was required to develop for each trainee. An IPAP consists of trainee's information, self-initiated task analysis, assessment procedure, present level of performance, and long-term goals and short-term objectives. It was developed based on the results of assessing self-initiated task analyzed steps of a trainee by a trainer so that the individualized training could be implemented based on the IPAP. As a matter of fact, the IPAP was served as the guideline for developing activity or session plans. Over a semester, a trainee usually participated in two 50-minute workout sessions per week over 10 weeks. Each of the 20 session plans was required to develop for a trainee based on IPAP.

D.Data Collection

At the beginning of each session, each trainee was assessed to determine how many steps of a task-analyzed workout activity the trainee could complete correctly. Each trainer was given data a collection sheet to record the data performed by a trainee in a session basis. A sheet allows to tracking the completion of correct steps based on the given task analysis for an activity. Steps crossed off signify the trainee correctly performed that step observed by a trainer at each session. Steps that are not crossed off indicated that the trainee does not know how to perform these steps that should be trained. Steps circled represent the total number of steps the trainee did a workout activity correctly at a session.

E. Data Analysis

The data collected on the first session and the last session shown on data collection sheets for all trainees were employed for the data analysis. The mean score of performing each workout activity by all trainees on the first session and the last session was calculated in a semester basis. The magnitude of increase on performing each activity by all trainees on the first session and the last session was calculated by subtracting the mean score of the first session from the mean score of the second session. Paired *t*-tests were also completed to analyze if a significant progress was demonstrated between the beginning and the end of a semester for the completion of each of the self-initiated task analyzed workout activity by all trainees. A statistical level of significance $p < .05$ was employed for paired *t*-tests [14].

III. RESULTS

The result of paired t-tests is presented in Table II. In the fall of 2011, trainees as a group show a significant progress from the first session to the last session on performing two targeted sport activity at a statistical significance level of $p < .05$. On performing step aerobics activity, a significant improvement is noted with performing 3.24 more steps correctly by trainees over this semester ($t = 5.72$, $df = 16$, $p = .02$). On resistance band activity, a significant increase is noted with performing 3.71 more steps correctly by trainees over this semester ($t = 6.28$, $df = 16$, $p = .01$). On line jumping activity, however, no significant progress is demonstrated although participants performed 1.35 more steps correctly by trainees over this semester ($t = 1.32$, $df = 16$, $p = .26$).

In the spring of 2012, as presented in Table II, trainees as a group also show a significant progress from the first session to the last session on performing three targeted sport activities at a statistical significance level of $p < .05$. On playing hamstring stretching activity, a significant level of increase is noted with performing 3.28 more steps correctly by trainees over this semester ($t = 5.53$, $df = 17$, $p = .03$). On walking/jogging activity, a significant improvement is shown with performing 2.47 more steps correctly by trainees over this semester ($t = 4.30$, $df = 17$, $p = .05$). On medicine ball activity, however, no significant level of increase is shown although participants performed 2.23 more steps correctly by trainees over this semester ($t = 2.23$, $df = 17$, $p = .14$).

TABLE II
RESULTS OF PAIRED *T*-TESTS BETWEEN THE FIRST AND LAST SESSIONS ON PERFORMING TASK-ANALYZED SELF-INITIATED WORKOUT ACTIVITIES BY ADULTS WITH DISABILITIES IN EACH OF THE TWO SEMESTERS

Semester: Workout Activity	*First session*[1]	*Last session*[2]	*differ*[3]
Fall 2009:			
Step Aerobics	4.47	7.71	3.24*
Resistance Band	5.29	9.00	3.71*
Line Jumping	1.18	2.53	1.35
Spring 2012:			
Hamstring Stretching	6.89	10.17	3.28*
Walking/Jogging	6.61	9.28	2.47*
Medicine Ball	7.94	10.17	2.23
	5.40	8.14	2.74

Note. 1 = The correct steps completed in the first session; 2 = The correct steps completed in the last session; and 3 = The difference between 1 and 2 and "*" denotes a significant difference at a statistical level of $p < .05$.

IV. DISCUSSION

The results from using the paired t-tests provide statistical evidence to document if the program implemented in this study was effective. As noted in Table II, 4 out of the 6 paired *t*-tests on the 6 targeted workout activities are significant at a statistical level of $p < .05$, indicating that the recreational workout program has been effectively practiced in training adults with severe cognitive impairments 67% of self-initiated workout activities over two semesters in the integrated setting. The effectiveness of this program documented in the paired *t*-tests has resulted in the significant improvement of all the trainees on performing the targeted workout activities. Several things included in this improvement are valuable to discuss.

Since the program used in this study were confounded multiple variables, as presented in the method section, the effectiveness of this integrated program would resulted from all the programming variables, including integration, ecology, task analysis, and individualization. The integrated setting developed in this effective practice with the equal number of adults with and without disabilities provided trainees a positive environment to take part in activities [9]. In this setting, trainers who were adults without disabilities participated in sport activities with trainees who were adults with disabilities together. Trainers served as activity models for trainees that facilitated trainees to perform activities in more active, more accurate, and more enjoyable way [18]. This would result in that the targeted activity performances were improved by trainees.

The ecological variable used to select target workout activities would contribute to the improvement of trainees' performances as well. As presented in the method section, all the targeted workout activities were resulted from the conduction of ecological surveys. Since the surveys considered the needs from personal interests, family preferences, community activities, school activities, and age-appropriateness, the selected workout activities were activities all the trainees were willing to participate in [3]. For example, step aerobics is a very popular workout activity over the community in the state where our trainees lived, resulting in that most individuals who live in this state believe that this activity is ecologically valid since the ability to perform this activity well would enables individuals to function better in the ecosystem [19], [21]. Our trainees did show great interests and energy in performing step aerobics activities [17], [18], [20], [22]. This would partially contribute the improvement of the trainees' performance.

The variable of the task analysis also play an important role for facilitating the progress made by trainees. Each of the workout activities targeted in this study, as shown in the method section, was divided into small steps, starting from self-initiated steps, followed by movement sequence steps, and ending in performance outcome levels [16]. These task-analyzed steps were served not only as assessment but also as instructional criteria of the corresponding targeted activity [1], [4]. At the beginning of each session, each of the trainees was assessed based on the task-analyzed steps of each targeted activity. If several steps could not be performed correctly by a trainee, these steps would be instructed based on the instructional criteria of these steps. This would facilitate trainees to improve their performance.

It should be noted that a unique part was included in the task analysis used in this study. This unique part of task-analysis is the self-initiation including several task-analyzed steps for a trainee to initiate a sport activity by himself or herself [16]. For example, as shown in Table I, the first three steps of the step aerobics activity are task-analyzed as the self-initiation steps, including "Pick up a step from the equipment cart," "Find a spot a spot on the floor," and "Set the step on the spot of the floor." These steps are simple but very important for adults with severe cognitive impairments since these adults have a great need for independent participation [12], [13]. In fact, the self-initiation part of task analysis did help the trainees to play workout activities more independently at end of a semester [4].

The variable of individualization was definitely useful for improving the performance of trainees. Although the implementation of this study has been conducted in the integration setting, instructing a trainee to perform a targeted workout activity has been individualized based on the unique need of this trainee. Each of the trainees, as presented in the method section, was required to have his or her own IPAP that was developed based on his or her assessment result and served as the guideline for developing his or her session plans [16], implying that each session of a trainee was individually implemented based on his or her individualized session plan created by following his or her IPAP. In this way, individualization in the inclusive setting [3] has been successfully conducted in this study. This played an important role in the facilitation of the trainees' performances.

A point that should be point out is the magnitude of increase from the first session to the last session made by all the trainees. As presented in Table II, the average of this increase across 6 workout activities over two semesters is 2.74 steps. It seems that increasing 2.74 steps over 20 sessions in a semester is very small and may be not significant enough, which might be true for adults without disabilities, but not true

for adults with severe cognitive impairments. Because individuals with severe cognitive impairments demonstrate a slower rate of learning [8], [11], [12], it is not realistic for us to expect these adults to show similar level of improvement as their normal peers. In fact, our trainees, our trainers, instructors, and the staff from the trainees' local institute believed that the increase of 2.74 steps in a semester was significant for trainees [17], [18].

V. Conclusion

In summary, the recreational workout program created in this study is effective in training adult with severe disabilities self-initiated workout activities when working with their peers who do not have disabilities in the integrated environment. The magnitude of increase over semesters is significant based on the 67% of statistical tests and the rate of learning by adults with severe disabilities. The improvement of these adults obtained from this program are contributed by four types of the workout variables, including integrated environment, ecologically-valid target activities, self-initiated task analysis, and individualized programming. It is recommended that the effectiveness of this program be replicated in the future studies.

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