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OCCUPATIONAL THERAPY WITH KARATE DO

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Abstract

In this text, we present research in which, through individual treatment, we examine the influence and effect of karate on occupational therapy for people with mild mental handicaps. Our primary goal was to set guidelines for people with special needs to be successfully included outside the usual methods of rehabilitation and school activities. The research included an initial control and final experiment measuring reaction time, in which we focused subjects on the mentioned therapy model (group; n = 18) in a group workshop plus additional individual sessions with each individual separately. In addition, the group had additional sessions with other auxiliary activities, and all participants were between 12 and 15 years old, of both genders.
The results confirmed that the occupational therapy model with karate improves the subjects' physical abilities, specific skills, and the ability to pay attention, perception, and motor reaction.

Keywords: reaction time, karate, mental handicap, occupational therapy, optimal performance

Introduction

The term “person with special needs” refers to a person who has been professionally diagnosed and who has a physical or mental deficiency that particularly limits one or more life activities such as: walking, sight, hearing, speech, breathing, self-care and performance of manual tasks, study and work. According to Hrnjica, these are children who, from the earliest age, require special additional conditions for development. (ex. Hrnjica, 1997). They should be seen as partners who have their own autonomy and preserved competences. The mental handicap has no limits, it exceeds the limits of racial, ethnic, educational and social status. It can happen in any family. Statistics show that in one out of ten families there is a mental handicap and the number is constantly increasing and there are about 40 million cases in the world.

Developmental delay in children is manifested by loss or limited opportunity to participate in the normal life of the community under the same conditions as other members of that community due to physical or social barriers. According to UNESCO, (ex. UNESCO, 1981) there are three key terms: Somatopsychic disorders (conditions caused by some pathological processes, injuries or genetic anomalies); Functional impairments (organic mental consequences of organic impairment); Handicaps (interaction of organic and functional impairments on the one hand and social environment on the other hand).

For the purposes of this study, we focused on students with mild disabilities in the psychophysical development, who come from socially and economically disadvantaged families and usually do not have the opportunity to taste life in the way that their peers without disabilities would. The idea was to include, in addition to the standardized educational model, other activities in their lives, and thus, at least for the moment, put them in the position of equal citizens in social life. In the project, we optionally implemented several types of adaptive physical activities such as swimming, elementary games, sports games, mountain climbing, hippotherapy, floorball, work in nature, etc. We put the main emphasis on karate to the skill, first of all, because of the philosophy of living, the correct direction and versatile participation in the psychophysical and social development of the person, and above all the increase of self-confidence. Through

the individual approach, we are trying to adjust the abilities of selected students in the function of their adaptation to the environment. We also thought about their social communication, developing and encouraging those parts of their personality that exist, and which, due to their handicap, have not had the opportunity to develop until now. For the realization of the project, it was essential to include experienced psychologists to determine their mental and motor age and intelligence quotient. A person who was employed in the school where the children from the experimental group came from was the most appropriate person to be hired for this purpose. WISC - Waxler intelligence scale for children, intended for children aged 6 to 16 years was used for that purpose. (ex. Wechsler, 2014). This intelligence scale is divided into many individual tests that aim to give a more complete picture of a child's intelligence. It includes tests for language comprehension, logical thinking, memory performance, and information processing speed. As an illustration, Table 1 shows Terman's classification[1] with the gradation of intelligence with different IQ values (ex.Terman, 1916).

Table 1. Terman - the most commonly used classification of intelligence

VALUES	MEANING
-70	Mental retardation
71-80	Borderline intellectual abilities
81-90	Below average intelligence
91-110	Average intelligence
111-120	Superior intelligence
121-140	Very superior intelligence
140 and more	Genius or close to it

In that gradation, an IQ between 85 and 115 is taken as an average value, since most people are in that range and it is considered a normal range, and only a small part of the population (about 2.15%) has a very low or high IQ.

Table 2. Wechsler's statistical (theoretical) classification of intelligence

Category of intelligence	% of the population
Extremely high intelligence	More than 2.15
Highly above average intelligence	6.72
Above average intelligence	16.13
Average intelligence	50.00
Below average intelligence	16.13
Borderline intelligence	6.72
Subnormal intelligence	Less than 2.15

According to the World Health Organization from 1994, (ex. WHO, 1994), about 156 million people or about 3% of the world's population have an intellectual disability.

Table 3. Classification of mental retardation

CLASSIFICATION OF MENTAL RETARDATION	
51-70	Mild MR
36-50	Moderate MR
21-35	Severe MR
00-20	Very severe (profound) MR

The prevalence by continent is: Africa 20,310,000, Australia 525,000, Asia 97,710,000, Europe 15,390,000, Central and South America 8,610,000.

[1] (Terman IQ is an IQ determined by the calculations and methods of American psychologist Lewis Terman, a psychology professor at Stanford University, who in 1916, building on the previous child development)

Expected Results

Through the implementation of this project, we expected an increase in the level of attention and concentration among students, an increase in self-confidence, overcoming primary fears, an increased level of motivation and aspiration among the respondents in the process of education and socialization, stimulation of sensory-motor development, stimulation of mental development, improving the quality of curricular and extracurricular activities, increasing public interest in students with special needs and their abilities.

Actualization of the Idea and Theoretical Analysis

We first presented the idea through an informative meeting to the Teachers' Council and the Parents' Council at POU Idnina, Skopje, R. Macedonia, after which, with their written consent, we jointly made a decision to start the project. We examined the interest of parents and students in detail through a questionnaire, after which we analyzed the student files, where we first observed the individual conditions of the students, after which we formed a group of students participating in the project.

Fig1. Experimental group

Before taking further action it was necessary to check the health status of the respondents through a set of medical examinations. First, we reviewed their already existing medical files and then organized transport to an appropriate medical institution (Figure 2 - Institute of Sports Medicine – Skopje) where they were given detailed medical examinations, after which we created final files for everyone separately.

Fig2. Details of the medical examination

After completing the files of the participants, we made a plan for the realization of further goals and tasks, which should have included examinations of the initial condition, longitudinal training intervention and assessment of the degree of progress through a set of psychomotor tests and measurement of reaction time.

Goals and Objectives

The main goal of this project was to check to what extent the application of the experimental methodology through a continuous Karate to occupational therapy and the inclusion of additional activities can be used to develop and improve psychomotor skills, attention, social integration, etc. In the preparatory stage, through theoretical analysis, we set the goals and tasks in which we decided to conduct the research with a cybernetic approach, through a closed circle of management. (ex. Milanovic et al. 2002). In the first step, we had to determine the particularity of the necessary daily life activities that had to be raised to a higher level. After determining the particularities of the activities, we first had to scan the initial situation to determine the weak and strong points of the subjects to improve their condition through long-term follow-up and appropriate training intervention. The second step required the creation of a database of model characteristics (indicators of their abilities, traits, knowledge, etc). For this purpose, we decided to use a set of experiments with a group of subjects with mild mental disabilities, which was supposed to determine the degree of the progress of the group as a whole, but also with each individual separately. The intention was to compare the achievements of each individual in all variables with the average achievements of the group and, based on the obtained indicators, to determine the deviations to the group in each individual separately. Ensuring motivated subjects participated in the experiments, in sufficient numbers and for a long period, as well as using appropriate equipment (measuring instruments), was an integral part of the tasks to ensure quality, precision, and validity in the measurements.

After reviewing the already existing student files and the new medical results, we made a selection of diagnostic procedures to examine the degree of sensory and motor development of the students, as well as a selection of diagnostic procedures to examine the degree of mental development. At this stage, with the help of experts in the field of sports psychology, as we described above, each individual was given an intelligence test, to obtain a clear profile for each subject, before starting the specific tests in the experimental phase. Physical and functional abilities were checked with Polar trainer equipment, with the help of experts in the field of sports medicine. Consequently, in the third step, we had to diagnose the current condition and record it in the personal file of each respondent separately. The fourth step required correlational statistical analysis and recording the results of the individual scores. The specific laboratory experiment also required proper organization and technical realization. The experimental methodology was supposed to follow the logic of increasing the complexity of movement actions from general to specific movements, and all the obtained

results of the experiments were to be processed with the help of variational statistical analysis. In the next, fifth step, according to the recorded initial state and determining deviations, a short-term training intervention with goals, tasks, periodization, and conditions adapted for each individual was supposed to be planned. The planning of the training intervention was in the sixth step, which according to the obtained results, was followed by the programming of the individual transformation process with the selection of means, load, and methods according to their needs. After the programming, in the seventh step, there was the realization of the training intervention according to the established plan and program, where the respondent had to move from the current state to the state in which they should be. The next eighth stage was complete control testing to obtain a new condition for each individual, according to which we will evaluate the programming and realization of the transformation process. Then, we set new goals, new planning, and programming, and we started to implement the training intervention until the next testing.

Methods

It is well known that effectively designed and implemented training makes a skill perfect (ex. Schmidt, Lee, 2005). In that context, since we are talking about people with borderline intellectual abilities, an experienced team of experts should be formed who will carefully design karate exercises specially adapted for this type of person with special needs. According to Erakovich, those persons are mentally retarded persons who, due to a delay in their mental development (of primary or secondary origin), are slowed down in their general maturation and damaged in their abilities to learn and adapt to social life requirements, so they need protection, care, upbringing, education and training for work in special conditions. (ex. Eraković 1995).

Fig3. Details of measurement during training

The training approach consisted of the facultative discharge of the activities mentioned earlier and the gradual learning and practice of the karate skill through Kihon, Kata, and part of contracted forms of Kumite2 - known as Gohon Kumite and Sanbon Kumite. (ex. Kanazawa, 2004). By far the most important aspect of any motor skill development training is the amount of quality training. Therefore, we had to make sure that the training of each technique goes according to those standards. To correct the performance of individual techniques, we first identified problematic key movement patterns so that we could then break down each technique into a series of discrete movement patterns and break it down into “target movement mechanics”. In this way, we were able to observe the key mechanical actions that subjects had to perform, making the overall movement pattern ultimately efficient and economical. (ex. Jeffreys, 2006). When practicing the appropriate karate elements, we made a list for each target movement pattern. This analysis was a powerful tool that provided a model against which we could constantly compare the respondent's performance. Once the elementary levels of movement patterns were mastered, the next second step was to identify and integrate these discrete movement patterns into sequences that occur in kata or contracted kumite. A key item was maintaining optimal body posture, without demanding maximum movement speed, with a focus on movement quality and a position from which to start and execute the next movement or

technique. When practicing Kihon2, we asked the participants to constantly repeat the same basic techniques in place and motion, namely:

- Positions (stances): Yoi dachi and Zenkutsu dachi;
- Blocking techniques: In a place and in motion, Age uke, Soto uke and Gedan barai;
- Punching and Kicking techn.: Standing and moving, Oi zuki with hand and Mae geri with foot;

When practicing the most elementary Kata3 - Taikyoku shodan, (ex. P. McDermott, F. Arce 2011) we also constantly repeated the same movements and techniques in stages to more easily adopt the movement patterns. For example, during the kata, we constantly performed the first two elements, then added two more, then 3, etc. until they learned the kata as a whole. When practicing the agreed forms of Kumite4, as well as in kata, we constantly repeated the same movements and techniques in stages. For example, first, we did only the attack techniques Oi zuki jodan, chudan and Mae geri four times each forward and then the defense techniques Age uke, Soto uke, and Gedan barai each separately four times in backward movement and counter strike Gyaku zuki as the fifth technique. After mastering the offensive and defensive roles, they practiced Gohon kumite as a whole. The methodology for the Sanbon kumite consisted of the same way. After the movements were adopted to the point of being able to perform them independently, we assessed specific skills or abilities. The entire procedure was video-recorded for further analysis and comparison. Based on the obtained results and identification of the problem, we planned the occupational therapy for each subject separately, which was followed by control and final measurement at a distance of 3 months. In planning the therapy, we included the setting of short-term and long-term goals that had to be coordinated with the possibilities of the treated group and each individual separately. For the realization of this program with all the changes and conditions among the respondents, we were aware that we were taking serious responsibility for proper planning, programming, and dosage of the activities. Precisely the appropriate dosage as well as the constant modification of the pedagogical tools helped us to establish positive feedback with the respondents who felt comfortable during the implementation of the project.

Kihon2 (基本, きほん) is a Japanese term meaning "basics" or "fundamentals." The term is used to refer to the basic techniques that are taught and practiced as the foundation of most Japanese martial arts.

Kata3 is a Japanese word (型 or 形) meaning "form". It refers to a detailed choreographed pattern of martial arts movements made to be practiced alone.

Kumite4 (Japanese: 組手, literally "grappling hands") is one of the three main sections of karate training, along with kata and kihon. Kumite is the part of karate in which a person trains against an adversary.
Reference: Wikipedia

What should perhaps be specially emphasized was the motivation of the expert team to convey the program to them in an easily understandable way. Thus, the systematically planned and programmed tasks represented a somatomethodical procedure in the organization of stimulating, re-educational, and active psychomotor exercises that were compiled according to the mental and motor age of the participants and were done with careful application of the principle of adequate active rest. The exercises aimed to satisfy the natural, biological and psychological needs of each subject, especially for movement and play, creating optimal conditions for growth and development as well as gradual rehabilitation and development of visual perception and spatial orientation.

Experimental Analysis

Object of Research

After obtaining full consent to participate in the experiments, a group of 18 children participated in the research. The respondents were students in a special primary school from 6-8 grades with borderline intellectual abilities that had difficulty in adopting the educational contents, they had difficulty understanding verbally communicated contents, causes, consequences, connections, and relationships. All subjects in the experiment participated voluntarily and behaved as cooperatively as possible to achieve the best possible results. For this purpose, they had regular 60-minute training, five times a week with additional activities during the weekends, properly adapted according to the individual capacities and needs of each individual. Training and experiments were performed in conditions with optimal temperature and light.

Table 4. Characteristics of the respondents

Number of subjects	Age (years)	Body weight (kg)	Body height (cm)
18	12.4 ± 2.8	58.5 ± 9.5	159.0 ± 5.2

All participants had the satisfactory psychophysical condition. Before each simulation, the purpose and procedures, as well as the measures to protect them from injury, were explained in detail. If there were additional questions, they were explained and practically demonstrated.

Equipment and Stimulators

Adapted display of a karateka in guard with a visual signaling system built into the arms and legs of the image of the karateka (4); PLC (programmable logic controller) stimulator with appropriate software (1), model Unitronics OPLC Jazz JZ10-11–R10, 6 Digital inputs, 4 Relay outputs. A set of laser sensors (3.1; 3.2; 3.3) with a set of retroreflectors (6), models: PRK 318 Retro–reflective photoelectric sensors with polarization filter; 30 W Single Output Industrial DIN Rail Power Supply, set (Tripod) of stands for laser beams especially made for the occasion (3, 1-3, 3); X-ray film with elastic compensation system (5); laptop DELL Vostro 1720(2); meter.

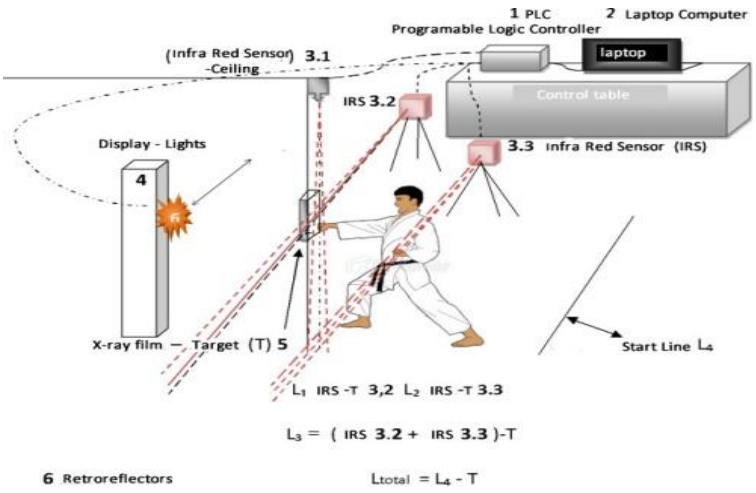


Fig4. PLC measurement scheme

Procedure

With a stimulator that we purposely designed for this research, we measured the total simple reaction time with regional external visual stimuli in the process of performing an appropriate technique with the arm or leg with the dominant side. The reaction was measured by a simple downward swing of the palm and specific karate kicks: Gyaku zuki and Mae geri. To make a precise measurement of the reaction time for the needs of this experiment, specially designed measuring equipment was used, which consisted of a PLC (programmable logic controller) and a set of laser sensors, katadiopters, and light sources (figures 4-7). A special software program was designed for the controller which, according to the requirements of the experiment, measured the times with a precision of 100 parts of a second.

Fig5, 6 and 7. Details of the reaction time measurement

To avoid the possibility of predicting the starting moment, which would have made a better result, the initial launch of the system was done manually by a third party at random time intervals. The person was out of the visual and auditory domain of the respondent. In this way, the subject, who was the subject of measurement, had to pay full attention to the image of the imaginary opponent, and at the moment of lighting the red light placed on the display with the image of a karate fighter in guard to immediately perform the corresponding blow. The endpoint of its impact was monitored by laser sensors, which precisely determined the time from the moment of stimulation - lighting the light bulb to the moment of completion of the execution - cutting off of the laser beam and turning off the light bulb. The number of measurements for each strike was 50 strikes, to provide enough statistical material. Apart from the time of the successful strikes, the errors were also recorded separately. When performing the strikes, the lasers were placed on tripods in a horizontal position, and the height of the beam and the target (X-ray film) as well as the distance were always adapted according to the physical characteristics of the subject. The experiment was performed under normal conditions: the group had a work task during the time of measurement to perform one technique per day, in a karate hall with a wooden lacquered surface (parquetry floor), optimal ambient temperature, and illumination in which the subject had previously had a light training for adaptation. The entire experiment was recorded with a video camera to later analyze the technical performance of the subjects.

Results and Discussion

During the assessment, a set of psychomotor tests were regularly performed, the details of which are not shown for the sake of space in this text. For better control of the process, all psychomotor tests as well as the performance of specific karate elements were regularly checked through video analysis with the Dartfish software. After each check, we were pleased to determine that the subjects had improved their general condition and improved their technical performance from one measurement to another.
Concerning the reaction time, it is interesting to note that, as measured in percent, greater improvement of

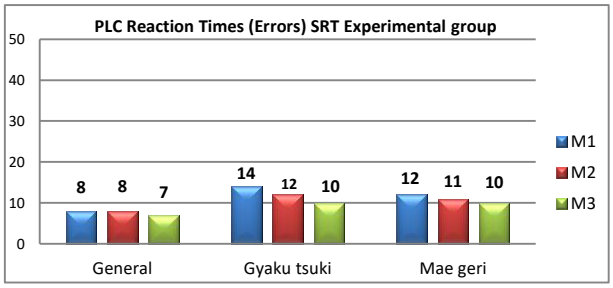
the response was observed when performing the specific karate kicks Gyaku zuki and Mae geri to the general response. We believe that this is due to the motor learning of the mentioned techniques, which allowed the movements to be performed biomechanically justified and with greater accuracy and speed compared to the weaker mastery of the technique done before.

The group as a whole but also each individual separately in each new measurement showed better results when measuring the reaction time and the number of errors. It is due to the regular training activities during the week and the impact on the number of observed techniques as well as the facultative physical activities during the weekends.

This confirms the hypothesis that continuous karate training and additional auxiliary activities can improve the psychophysical condition of people with special needs. Tables 5, 6, and 7 and figures 8-11 show the results of the group as a whole as well as the results of a randomly selected individual to see the deviations.

Table 5. Motor response results from an experimental group

Experimental group M1-M3 PLC SRT	ERRORS Number / SD / %			TIME Sec / SD		
Technique	General Sd / %	Gyaku zuki Sd / %	Mae geri Sd / %	General / SD	Gyaku zuki / SD	Mae geri / Sd
Initial Test -M1	8±3 / 16 %	14±6 / 28 %	12±4 / 24%	0.670 / ± 77	1.010 / ± 87	1.190 / ± 86
Control Test -M2	8±3 / 16 %	12±6 / 24 %	11±4 / 22%	0.590 / ± 62	0.870 / ± 78	0.960 / ± 76
Final Test -M3	7±2 / 14 %	10±4 / 20 %	10±3 / 20 %	0.510 / ± 47	0.710 / ± 62	0.830 / ± 65



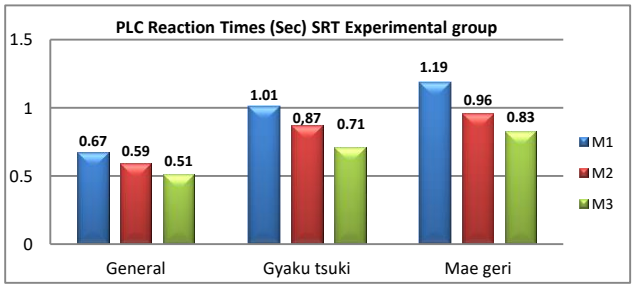


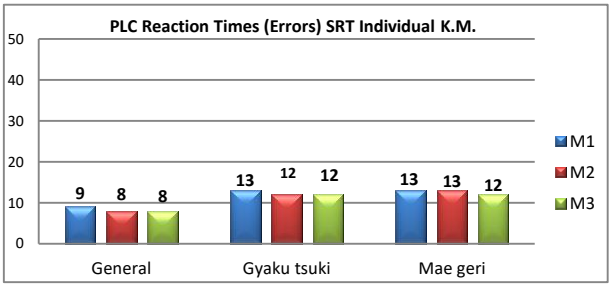
Fig8-9. Reaction time of the experimental group

The mean times and SD at the first measurement of the group were: Overall 0.670 ±77 sec. with 16% errors, Gyaku zuki 1.010 ± 87 sec. with 28% errors and Mae Geri 1,190 ± 86 sec. with 24% errors. The mean times during the control measurement were: Overall 0.590 ±62 sec. with 16% errors, Gyaku zuki 0.870±78 sec. with 24% errors and Mae Geri 0.960±76 sec. with 22% errors. The mean times at the final measurement were: Overall 0.510 ±47 sec. with 14% errors, Gyaku zuki 0.710±62 sec. with 20% errors and Mae Geri 0.830±65 sec. with 20% errors (table 5 and graph 8-9).

The mean times and SD of the randomly shown individual at the first measurement were: Overall 0.743 ±76 sec. with 18% errors, Gyaku zuki 1.150 ± 95 sec. with 26% errors and Mae Geri 1.210 ± 105 sec. with 26% errors. The mean times during the control measurement were: Overall 0.685±69 sec. with 16% errors, Gyaku zuki 1.030±89 sec. with 24% errors and Mae Geri 1.100±97 sec. with 26% errors. The mean times at the final measurement were: Overall 0.650 ±59 sec. with 16% errors, Gyaku zuki 0.890±81 sec. with 24% errors and Mae Geri 0.965±89 sec. with 24% errors (table 6 and figure 10-11).

Table 6. Results of the motor response of the randomly selected individual

Individual K.M. M1-M3	ERRORS Number / % PLC SRT			TIME PLC SRT Sec		
Technique	General	Gyaku zuki	Mae geri	General	Gyaku zuki	Mae geri
Initial Test -M1	9±3 18 %	13±7 26 %	13±4 26%	0.743 ± 76	1.150 ± 95	1.210 ± 105
Control Test -M2	8±3 16 %	12±7 24 %	13±4 26%	0.685 ± 69	1.030 ± 89	1.100 ± 97
Final Test -M3	8±3 16 %	12±6 24 %	12±4 24 %	0.650 ± 59	0.890 ± 81	0.965 ± 89



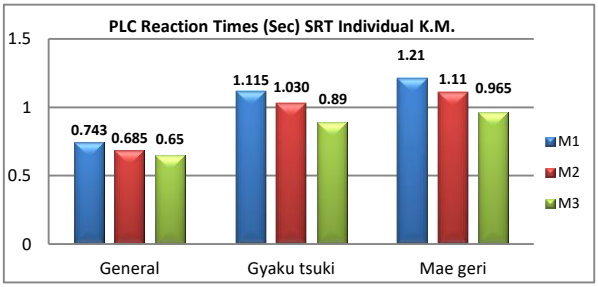


Fig10-11. Reaction time of the control group

All comparative results are shown in (table 7 and Figures 12-15). To support our presented results we decided to make a statistical analysis using Md Calc 2013 software. First, we checked the normal distribution that appeared to be normal in all cases, so we used the paired Student T-test to check the probability. In all comparisons, the p values were ≤ 0.05 which, in turn, proved the hypothesis that the continuous, individually modeled intervention, with Karate-do as working therapy had an impact on the capability for optimal performance and would substantially decrease the errors as well as the time of response.

Table 7. Comparative results of motor reaction Group-Individual person K.M.

Experimental group – Individual K.M. M1-M2-M3 PLC SRT	ERRORS Number/SD/ %						TIME Sec/SD					
Technique	General		Gyaku zuki		Mae geri		General		Gyaku zuki			
	Ex.group	Individual	Ex.group	Individual	Ex.group	Individual	Ex.group	Individual	Ex.group	Individual	Ex. group	Individual
Initial Test -M1	8±3 16 %	9±3 18 %	14±7 26 %	13±7 26%	12±4 24%	13±4 26%	0.670 ± 77	0.743 ±76	1.010 ± 87	1.150±95	1.190 ± 96	1.210 ±105
Control Test - M2	8±3 16 %	8±3 16 %	12±7 24 %	12±7 24%	11±4 22%	13±4 26%	0.590 ± 62	0.685 ±69	0.870 ± 78	1.030±89	0.960 ± 76	1.100 ±97
Final Test -M3	7±2 14%	8±3 16 %	10±6 20 %	12±6 24%	10±3 20 %	12±4 24 %	0.510 ± 47	0.650± 59	0.710 ± 62	0.890±81	0.830 ± 65	0.965 ±89

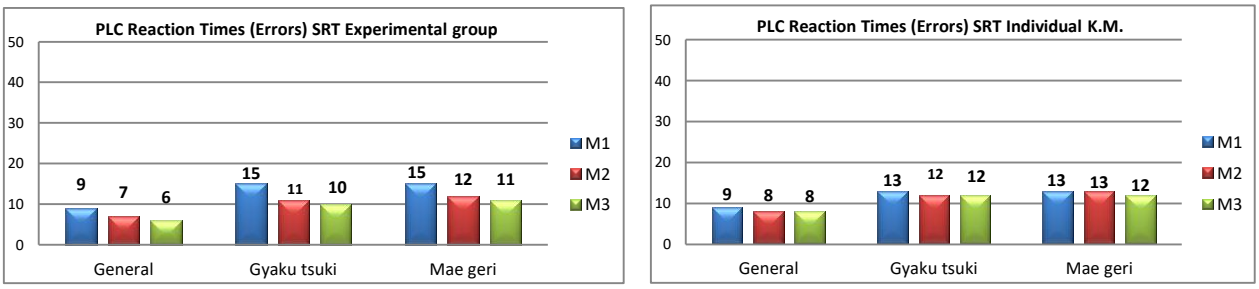


Fig12-13 Comparative results of errors inreaction time Group-Individual person K.M.

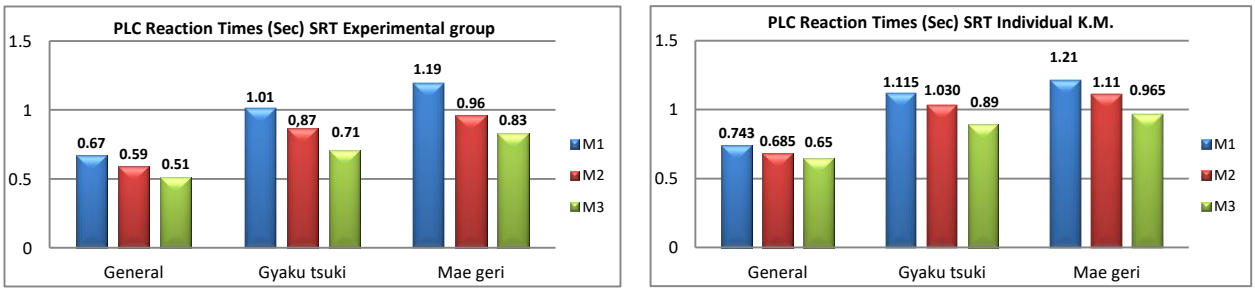


Figure 14-15 Comparative results of reaction time (sec) Group-Individual person K.M.

Conclusion

With the training intervention supported by the experimental analysis, we got a general impression that we have significantly influenced the reduction of gravitational uncertainty, visual tracking, emotional stability, and the ability to perform tasks and organize a logical sequence of procedures. The comparative analysis showed that mean times and error rates were generally improved. The presented training approach which included auxiliary activities with hippotherapy, floorball, swimming, hiking, teaching in nature, etc. largely contributed to socialization through mutual association and meeting new people, which contributed to the development of positive emotions among the respondents. Through constant observation, we concluded that the interest in communication and socialization, in general, has increased significantly, and we believe that this is due to their increased security and self-confidence. The adoption of technical karate elements (kihon) to a certain level had a great impact on the sensorimotor integration of movement, the compositions (kata) affected motor integrity and memory, while the contracted forms of fighting (gohon and sambon kumite) significantly affected the emotional factor, i.e. increasing self-confidence and reducing fear. It confirmed our hypothesis about the influence of karate-do occupational therapy on the comprehensive development not only of people with normal psychophysical development but also of those with special needs. Based on the obtained results, we believe that the program of this occupational therapy can be expanded or supplemented with additional content. We recommend that karate-do occupational therapy is used as a method of treatment and training for people with disabilities, because it is of particular importance as an experience that comprehensively especially treats each individual, helping to integrate them more successfully into public life.

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