DIFFERENCES IN THE SPEED OF LEARNING PARTICULAR JUDO THROWING TECHNIQUES

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Abstract:

The general objective of the research was to determine the speed of learning and the quality of performing several judo throwing techniques in the one-semester judo course of the Bachelor PE teacher education curriculum at the Faculty of Kinesiology, University of Zagreb. A sample of 122 male sophomores participated in the study. Their task was to learn and perform 14 typical judo-throwing techniques, which are also the obligatory component of the PE curriculum in Croatian grammar schools. The students learnt and practised two throws in one 90 minute class. They demonstrated each throwing technique at the end of a 10-minute instruction cycle and at the end of the class. The quality of the motor skill expertise (knowledge) was evaluated twice for each particular throw. The statistically significant differences between the two grades given for the throw demonstrations occurred in 6 techniques: two hand, two hip, one self-sacrificing and one leg throwing technique *(tai-otoshi, te-guruma, tsuri-goshi, harai-goshi, soto-makikomi* and *osoto-gari),* whereas no significant differences were obtained between the grades for the remaining eight throws. On the basis of the determined varying speeds of acquisition (motor learning and mastering) of the particular judo throwing techniques that pertain to various groups of throws, the authors suggest certain modifications in both judo instruction programmes.

Key words**:** *judo, throwing technique, motor learning, acquisition speed, performance*

UNTERSCHIEDE IN DER GESCHWINDIGKEIT DES ERWERBENS VON BESTIMMTEN WURFTECHNIKEN IM JUDO

Zusammensetzung:

Das allgemeine Ziel dieser Forschung war, die Geschwindigkeit des Erwerbens und die Qualität der Durchführung von einigen Wurftechniken im Judo während des einsemestrigen Judounterrichts an der Fakultät für Kinesiologie, Universität Zagreb, zu bestimmen. Die Stichprobe von 122 Studenten, die im 2. Studienjahr waren, nahm an der Forschung teil. Ihre Aufgabe war, 14 typische Wurftechniken, die auch obligatorische Techniken innerhalb des Sportkurrikulums in kroatischen Gymnasien sind, zu erwerben und durchzuführen. Die Studenten lernten und übten zwei Würfe während einer Unterrichtsstunde, die 90 Minuten dauerte. Sie demonstrierten jede Wurftechnik am Ende des Instruktionszyklus, der 10 Minuten dauerte, und am Ende der Unterrichtsstunde. Die Erwerbsqualität jeder motorischen Fertigkeit wurde zweimal für jeden Wurf bewertet. Statistisch bedeutende Unterschiede zwischen zwei Noten, die für die Demonstration von Würfen gegeben wurden, kamen in 6 Techniken vor: in zwei Hand- und in zwei Hüftwurftechniken, in einer Opferwurftechnik und in je einer Fuß- und Beinwurftechnik (*tai-otoshi, te-guruma, tsuri-goshi, harai-goshi, soto-makikomi* und *osoto-gari*), wobei keine bedeutenden Unterschiede zwischen den Noten für die anderen acht Würfe bestimmt wurden. Aufgrund der determinierten variierenden Erwerbsgeschwindigkeit (motorisches Lernen und Erwerben) von bestimmten Wurftechniken aus verschiedenen Gruppen von Würfen schlugen die Autoren die Modifikationen von beiden Judo-Instruktionsprogrammen vor.

Schlüsselwörter: *Judo, Wurftechnik, motorisches Lernen, Erwerbsgeschwindigkeit, Leistung*

Introduction

Judo is, from a structural analysis point of view, a combative sport that pertains to the martial arts family of polystructural acyclic sports because in them acyclic motion patterns prevail. The application of these movement structures by the two competitors engaged in a contest results eventually in the binary outcome variable, i.e. *victory – defeat* (Kuleš, 1980; Kuleš, 1990; Mraković, 1997).

From a functional point of view, kinesiology describes judo as a sport in which the technique is characterised by both the open and closed kinetic chains of motion structures. A variety of perfected technical elements, manifested as acyclic motions with extremely complex structures, may bring the desirable outcome (victory) only if a judoka applies them in time (proper timing) and in the most effective way from the aspects of energy consumption and psychological balance. Because of the relationship of opposition, which reigns in a judo bout, it is a dynamic, continuously changing environment. The chains of combat situations, ranging in nature from the unknown to the familiar ones to an individual contestant, and from the uncontrollable to the controllable, imposes high demands on athletes: the technical-tactical stereotypes they apply in a combat must be perfected to the maximum and judokas must be able not only to reorganize these motor programmes quickly, but also to create new defensive, offensive, or counter-attacking programmes of action instantly. From the theory of a fighting/rivalry point of view, one may open a discussion here over the separation of categories defensive and counter-attacking actions, but it would be beyond the scope of this paper. The authors wanted to emphasize here that counter-attack is a particular case of defence which need not be applied each and every time when a judoka defends himself/herself.

A vast variety of linked technical and tactical elements characterises judo – the positions, contacts, movements, breakfalls, throws, leverages, grappling techniques, pinnings, holds, breaking-free techniques and their innumerable variations are implemented quickly and fluently by the two adversary fighters in various directions of the sagittal, frontal and horizontal planes. This technical abundance grows with each change of a rival. Namely, a judoka must partially adjust his/her dynamic motor stereotypes in advance (tactics) to encounter effectively the opponent's specific physique and style of fight if he/she wishes to impose and maintain his/her own superiority and technical efficiency even under the transformed conditions. The factors that cause changes of a combat environment can be defined as the rival's features: body weight and body composition, then his/her specific guard and posture, style of combat, way of moving and technical repertoire. Therefore, a judoka must be extremely creative on both attack and defence and able to modify his/her dynamic motor stereotypes in a fraction of a second in order to react appropriately and effectively, that is, to score in the ever changing, unstable space-time biomechanical situations of a bout.

Because of the high and vast technical complexity and high demands on the coordination abilities of an athlete, he/she is not able to master and perfect equally all the technical elements of judo. Therefore, top-quality competitors usually perfect only certain technical elements that are in concordance with their morphological and conative characteristics and motor capabilities, that is, the ones they will predictably, with the highest probability, need and score with them in a combat (*tokui-waza* or, so-called, pet techniques or specialities).

Judo throws are generally divided into leg, hip and hand throws, and the self-sacrificing throwing technique. Legs have a predominant role in the *leg throws*; whereas the *hip throws* regard throws in which *tori* (a person performing a technique) attacks the *uke's* hip (his/her partner; a person receiving a technique). In both groups of throws the arms play a role of the chief initiators of an action; they exert force and apply it on the opponent to break his/her balance (*kuzushi*), to initialise his/her body to move, or to fix the upper part of the rival's body. In the *hand throwing techniques*, however, besides the already described actions of unbalancing and fixing the opponent in position, arms perform the main actions that prepare the closing phase of a throw - *kake*. The *self-sacrificing techniques* are those in which *tori*, by sacrificing his/her own balance, makes an attempt to throw the opponent, primarily by means of his/her own body weight.

The quality of a judo technique performance is evaluated subjectively, through the observation method executed by expert judges. For the sake of the kinesiometry principles it should be emphasized here that this method is not quite an unbiased one and that it has a considerable potential for an assessment error. Because of the perception error the correctness of a motor task performance may not always be satisfactorily and objectively estimated. The authors had this feature of the applied research method in mind while designing and conducting the study.

The aforementioned is particularly truthful for the performance assessment in the early stages of judo instruction and should be regarded in teaching evaluation. It is very important for a judo instructor,

or any other designer of a judo training, to know which throws and their elements are simple and easy to learn, and which are more complex, therefore more difficult and demanding from the aspect of learning. The information may enable a proper, adequate design of the process of judo learning and practising in which the basic didactic principles of teaching will be respected. The latter means that the instruction should unfold from the simple to the more complex, from the easy to the difficult, and from the familiar to the unfamiliar contents. When the information about the complexity weights of particular elements is available and an instructor has become acquainted with his/her trainees, that is with their anthropological characteristics, as well as their general and sport-specific motor expertise and capabilities, he/she may even introduce certain changes, if needed, in common programmes for beginners. Such changes should facilitate, and consequently improve, the process of acquiring judo techniques and enhance competition performance.

The objective of the present research study is to determine the probable differences in the speed of learning and in the quality of motor skill (knowledge) acquisition needed to perform 14 typical judo throwing techniques in a judo course, being a compulsory part of the Bachelor physical education (PE) teacher a study curriculum at the Faculty of Kinesiology University of Zagreb. At the same time, the instruction effectiveness is to be assessed, that is, the efficiency of the applied teaching methods and programmes, aimed at teaching polystructural motor tasks, should be tested. The ultimate purpose of the study is to improve the process of PE teacher's education in its part of judo instruction.

Material and methods

Sample of participants

The population of subjects is defined as a group of regular Bachelor PE students of the Faculty of Kinesiology University of Zagreb. The convenience sample of participants in the study consisted of 122 male students, aged 19-21 years, who had never before been engaged in judo or any other similar combative sport, therefore, they can be regarded as adult beginners in judo. The sample of participants is generally most comparable to the sample of athletes.

Sample of variables

The sample of variables consisted of 14 throwing techniques which pertain, according to the K. Kudo's classification (1967 and 1976), to groups of the hand, hip, leg, and self-sacrificing throws. These techniques seemed to be statistically the most effective (and most frequently applied) combat techniques during the judo tournament of the Barcelona Olympic Games (The XXV Olympic Games Organizing Committee, Barcelona, 1992; Orlović, 1993).

The quality of performance of the 14 throwing techniques (the detailed description of the throws can be found in Kudo, 1976; Okano, 1989; and Kano, 1994) has been evaluated on a five-point scale. The grades present the group of variables for the motor learning and teaching process effectiveness assessment. The following techniques were taught and performed:

1. ippon-seoi-nage (IPP - Fig. 1); 2. *morote-seoi-nage* (MOR - Fig. 2); 3. *tai-otoshi* (TAI - Fig. 3); 4. *te-guruma* (TEG - Fig. 4); 5. *tsuri-goshi* (TSG - Fig. 5); 6. *koshi-guruma* (KOG - Fig. 6); 7. *harai-goshi* (HAG - Fig. 7); 8. *uchi-mata* (UCM - Fig. 8); 9. *de-ashi-barai* (DAB - Fig. 9); 10. *osoto-gari* (OSG - Fig. 10); 11. *ouchi-gari* (OUG - Fig. 11); 12. *kouchi-gari* (KCG - Fig. 12); 13. *soto-makikomi* (STM -Fig. 13); 14. *tomoe-nage* (TMN - Fig. 14).

Figures 1 – 14. The 14 judo-throwing techniques taught and evaluated in the research.

Figure 1.
Ippon-seoi-nage.

Figure 2.
Morote-seoi-nage.

Figure 3.
Tai-otoshi.

Figure 4.
Te-guruma.

Figure 5.
Tsuri- goshi.

Figure 6.
Koshi-guruma.

Figure 7.
Harai-goshi.

Figure 8.
Uchi-mata

Figure 9.
De-ashi-barai.

Figure 10.
Osoto-gari.

Figure 11.
Ouchi-gari

Figure 12.
Kouchi-gari.

Figure 13.
Soto-makikomi.

Figure 14.
Tomoe-nage

Throwing technique performance evaluation procedures. Five highly competent judo experts, holders of the black belt and judo trainers with many years of experience in coaching, assessed the quality of the performance, or the level to which the throwing techniques were acquired (mastered). Prior to the experiment, the judges reached a consensus on the evaluation criteria and together performed a trial assessment on a sample of students. Simultaneously, they agreed on the most common errors and their weights that might appear and compromise performance of the throwing techniques.

The quality of a throw performance was evaluated on the classic scale from 0 to 5 according to the following criteria:

- Grade 5 was given for a perfect performance or for a proper execution of a throwing technique (no technical errors noticed); application of adequate power and speed, with a good amplitude of flight.
- Grade 4 was given for a throw that was not perfectly performed, from a technical point of view, nor was it performed using sufficient power or speed; *uke* (the person receiving a throwing technique) did not attain a satisfactory amplitude of flight, or the participant made a mistake in the technique execution, like insufficient *kuzushi* (breaking balance), or improper *tsukuri* (assuming the proper position for a throw and making contact).
- Grade 3 was awarded for a throw in which at least two mistakes were made, either in the technical or in the energy sense, or for a throw with insufficient flight amplitude, or for a throw in which all the three phases were distinctly recognizable - *kuzushi* (breaking balance), *tsukuri* (positioning and making contact), and *kake* (the final phase of a throw - includes pulling, sweeping, reaping, hooking, clearance, and propping the partner in the air and his/her flight), which meant that a throw was not performed fluently enough.
- Grade 2 was awarded for a throw with an obvious mistake in execution. It implies evident omission or faulty execution of one of the first two phases of a throw (either *kuzushi* or *tsukuri*), or omission or improper execution of any segment of a throw; or the thrower did not apply the speed or power needed because of which *uke* did not attain the desired flight amplitude, but the throw is still recognisable because at least two phases of the throw (out of three: *kuzushi, tsukuri* or *kake*) have been performed somehow.
- Grade 1 was given for an unsatisfactory throwing performance, especially from the basic technical point of view. The participant did not meet

the basic technical requirements – the particular throw was performed with insufficient speed and power, and *uke* did not attain the desired flight amplitude. The examinee failed to properly execute two out of the three throwing phases.

- 0 was given for a completely faulty execution of a particular throw – all the three phases were incorrectly performed at a too slow speed and with too little power applied, causing too little amplitude of the partner's flight. The performance could not be classified as a judo throw, so the experts did not evaluate it at all.

The quality of the performance of each of the 14 throws was evaluated twice. For the first time a throw was evaluated following a 7-minute period of learning and practising it, and for the second time, at the end of the class. The participants performed their stationary throwing demonstrations under the ideal conditions of *uke's* (a judoka subjected to a throw) posture and resistance.

The first evaluation:

The first grade represented ***the quality of a stationary throwing technique performance, or situation-related motor efficiency under standardized conditions.*** *It includes the* ***initial level of motor expertise*** *and* ***an assessment of the coordination of the basic movements during the first phase of motor learning.***

The speed of learning the throwing techniques (the motor skill acquisition speed) is considered here as an ability of an individual to perform the motor task (a throw) maximally well after a limited period of learning and practice. It is almost equally important to determine how permanent the so acquired motor skill is. Therefore, the duration and quality of retention of the learned motor skill should be tested after a relatively «longer» period of time as well. The variable *speed of learning / acquiring judo techniques* was defined as the difference in the quality of a particular judo throw performance executed at the end of a learning cycle of seven minutes (the first grade) and at the end of a 90-minute class (the second or final grade).

The assumption was that the students would need less time to acquire the simpler motion structures (throws) than the more complex ones and that the throwing performance evaluation marks (higher marks for the simpler and lower grades for the more complex throws) would discriminate between the groups of «difficult» and «easy» throws. The issue concerns the improvements of the judo instruction in the PE classes and sports training.

The second evaluation:

The second evaluation took place at the end of a class. The subjects performed both throws in place, which had been taught in the lesson and had been evaluated with the first grade, but now the throws were performed in succession.

The second grade denotes the level of ***the throwing technique expertise.*** It evaluates and defines the level of current ***motor skill memory or motor skill acquisition*** of a subject. The variable was used for evaluating the efficiency of the judo instruction / teaching process.

The so acquired motor expertise, or the motor skill memory, was integrally observed through the performance of a motor programme. The quality of the judo throw performance generally depends on several factors (and so did the second or the final grade in the research), such as:

- the repertoire of the already mastered motor skills which were applied in the performance of a throw (learning transfer of motor skills);
- the manifestations of motor abilities;
- the motivation of the participants;
- the focus of attention on practice.

Description of the experimental procedure. Judo throwing instructions took place twice a week in 90-minute sessions. Within the framework of one lesson the students were expected to acquire enough motor skill to perform two throws properly. It might seem a very large amount of motor information, but the programme designers and teachers had assessed that the initial motor expertise of the participants was sufficient to sustain such an information load.

The procedure of instruction and practice was the same for all the 14 throws:

1) 3 minutes of verbal explanation and demonstration of the technique;
2) Learning and practising a particular throw for 7 minutes; attention was paid to correct execution, errors were corrected;
3) The 1st evaluation of the skill mastered – a technique performance in place (stationary) under standardized conditions;
4) After the assessment of the stationary performance of the throw, the instructor demonstrated the throw in motion – three times in linear movements forward or backward (relative to the type of the throw). The subjects had 3.5 minutes to practise their performance of the throw in motion; attention was paid to correct execution, substantial performance errors were corrected;
5) The period of practising the throw in motion ended with evaluation of the throw performance

under the variable or situational conditions (this assessment grade was not included in the research);

6) At the end of the class, after the stationary performances of both throws had been evaluated with the first grade, the participants performed the learned throws in place and in succession and got the final grades for their throwing technique performance.

The final grade for the throw performance in place was utilized in the analysis of the effectiveness of the teaching process. Every subject executed in place two different throwing techniques, acquired during the current lesson. The judges evaluated the quality level of how each of the throws had been mastered, that, is the motor retention (memory) was tested through execution of the memorized motor programmes of throwing and the application of motor abilities.

The verbal explanations were based on the biomechanical terms which were adjusted to the level of the knowledge the students had already acquired during the course of their study. Every phase of a single motor task was presented at the level of novice training and the importance of particular phases of performance was highlighted.

Further, a technical element was simply presented by means of visual emission of information, i.e., by the method of demonstration. Special attention was paid to the level of motor performance which was adjusted to the perceptual and motor abilities of the students. The correctness of execution of the basic motion structures was maximally emphasized in each phase of the teaching process, and special emphasis was put on the details that were crucial for a successful performance.

A few details in the proper throwing performance, three to the maximum, were isolated and the focus of attention was directed to them during the class. The analytical method of instruction was used because the throwing techniques were too complex motor tasks, with too many phases and subphases for the sophomores who had no previous experience in judo or in any similar martial art. The authors were aware that the analytical approach to teaching might hinder the subsequent process of integration of the well-mastered parts in a rhythmically coordinated performance, but the inexperience of the students and the complexity of the tasks left no other option.

Not only the substantial and noticeable mistakes in the judo throws performance were corrected, but also the same was done with the less obvious errors during the instruction. The minor throw errors included minor execution details, like faulty hip positioning, legs insufficiently straightened at the knee or ankle, or inaccurate foot positioning. Minor errors in arm motions included incorrect jacket grasps, insufficient rotation of the forearm and elbow to the throw direction, and others.

The judo technique teaching process and practice followed the famous sequence of methodical procedures aimed at mastering throwing techniques executed in place (Inokuma & Sato, 1979; Matveev, 1985; Kuleš, 1990; Kano, 1994; Sertić, 1995a):

UCHI-KOMI – This method is the starting exercise in the process of instructing judo standing techniques. Its basic objective is to teach a student how to perform properly the *KUZUSHI* (breaking balance) and *TSUKURI* (positioning and making contact for a throw) in place. The exercise usually includes sets of 10 to 20 repetitions.

PUSHI-GARI – is a method that draws on the previous one, but it is expanded by one crucial element: *tori* (a person performing a throw) lifts *uke* (a person receiving a throw) in the air. The main aims of the method are to teach *tori* how to control the contact with *uke* in the moment of lifting him/her, then how to maintain his/her own balance while breaking the opponent's equilibrium, and how to accomplish continuous performance.

KAKE-AI - is a logical continuation of the first two methods. Its characteristic is that an actual throw, at all its phases, is performed for the first time (*kuzushi*, then *tsukuri*, and the closing phase of a throw *kake* – pulling, sweeping, reaping, hooking, clearance, or propping the partner in the air with his/her flight through it). This method also includes performances of a throw in place and in motion.

NAGE-KOMI – is a closing teaching exercise in which a throwing technique is performed as a continuum (at all the phases: *kuzushi* – breaking balance; *tsukuri* – correct throwing-related posture and position assuming; *kake* – the closing phase of a throw: pulling, sweeping, reaping, hooking, clearance, or propping the partner in the air). Usually, the exercise includes sets of 5 to 10 throw repetitions.

Each of the listed instruction exercises were carried out for a minute or two, relative to the throwing technique, except for the *leg* and *self-sacrificing techniques*, in which *pushi gari* was left out.

Structure of a lesson:

1.	Introduction, preparatory part of the lesson	10 minutes
2.	Explanation, demonstration (3') and learning/mastering (7') the first throwing technique in place	10 minutes
3.	The first evaluation of the first throw performance, in place	10 minutes
4.	Explanation, demonstration (1.5') and learning/mastering (3.5') the first throw in motion	5 minutes
5.	Evaluation of the first throw performed in motion – marks were not included in the research	10 minutes
6.	Explanation, demonstration (3') and learning/mastering (7') the second throwing technique	10 minutes
7.	The first evaluation of the second throw in place	10 minutes
8.	Explanation, demonstration (1.5') and learning/mastering (3.5') the second throw in motion	5 minutes
9.	Evaluation of the second throw performed in motion	10 minutes
10.	The second evaluation of both the first and the second throw in place	10 minutes
	T o t a l	**90 minutes**

Data processing methods

All the variables, that is, the throwing technique performance grades were subjected to the standard statistical procedures. The following descriptive parameters were computed: mean (Mean) and standard deviations (SD).

The magnitude and significance of the differences in learning particular judo throwing techniques were determined by means of the *t* – test for dependent samples (*t*), and then the levels of its statistical significance were determined (p).

Results and discussion

Central and dispersion parameters of variables assessing the speed of acquiring the judo throwing techniques

The basic values of grade point averages (GPA) awarded to each of the two throwing technique performances in place – the first immediately after the instruction cycle and the second, finally, at the end of a class, are presented in Table 1. The GPA for the first evaluation ranges from 2.46 for *harai-goshi* (pertains to the group of hip throws) to 3.24 for *de-ashi-barai* (pertains to the group of leg throws). The general GPA for the first throwing performance evaluation quotes 2.94.

The throw with the lowest final grade (2.61) was *uchi-mata*, from the group of the hip throwing techniques, whereas the highest final grade (3.45) was attained in *soto-makikomi*, from the self-sacrificing group of throws. The overview of the basic numerical values of GPAs reveal differences between the first and the final grades in favour of the latter in each of the 14 throws. However, it is also obvious that the first GPAs of most of the throws are relatively high, which is explained by the motor and physical attributes of the positively selected sample.

Relative to the first and the final grades of throwing demonstrations all the observed throws can be classified into three groups.

Table 1. Descriptive statistics (Mean and standard deviation - SD) of the marks given for the demonstrations of stationary throws performed in place after the first 10-minute instruction cycle (M) and at the end of the lesson (K)

1st ASSESSMENT	Mean	SD	FINAL ASSESSMENT	Mean	SD
MDAB	3.24	0.03	**KDAB**	3.30	0.18
MKOG	3.08	0.27	**KKOG**	3.17	0.10
MMOR	3.07	0.14	**KMOR**	3.09	0.10
MTMN	3.15	0.22	**KTMN**	3.18	0.26
MTSG	2.87	0.27	**KTSG**	3.08	0.23
MTEG	2.97.	0.14	**KTEG**	3.21	0.20
MTAI	2.93	0.16	**KTAI**	3.17	0.30
MHAG	2.46	0.13	**KHAG**	2.66	0.10
MSTM	3.19	0.09	**KSTM**	3.45	0.11
MOSG	3.22	0.06	**KOSG**	3.43	0.12
MIPP	2.59	0.17	**KIPP**	2.71	0.19
MOUG	2.89	0.10	**KOUG**	3.01	0.06
MKCG	3.01	0.12	**KKCG**	3.02	0.12
MUCM	2.49	0.12	**KUCM**	2.61	0.12

The first group consists of throws - *morote-seoi-nage* (MOR), *koshi-guruma* (KOG), *de-ashi-barai* (DAB), and *tomoe-nage* (TMN) - for which the subjects were awarded higher initial grades, but these grades did not change substantially after the process of instruction The numerical differences between grades given at the two assessment points in this group range from 0.02 to 0.09.

The second group of throws is characterized by the variable *first grades* and by the highest second, post-instruction grades the examinees attained. The differences between the first and the second grades range from 0.20 to 0.26. The group includes: *tai-otoshi* (TAI), *te-guruma* (TEG), *tsuri-goshi* (TSG), *harai goshi* (HAG), *osoto-gari* (OSG), and *soto-makikomi* (STM). Only in this group of throws statistically significant differences between the two grades occurred (Table 2).

The third group consists of throws for the execution of which the examinees got relatively low first grades. The final grades were not much higher either, denoting a low level of throwing expertise at the end of a class. The numerical difference between the two grades given at the two assessment points in this group is 0.12 given for the demonstrations of *ippon-seoi-nage* (IPP), *uchi-mata* (UCM) and *ouchi-gari* (OUG), with the exception of the *kouchi-gari* (KCG), for the demonstration of which the numerical difference quotes 0.01.

The general grade point average (GPA) for the final throwing performance evaluation quotes 3.08. It suggests that the instruction was effective and that the examinees developed a satisfactory judo throwing expertise. The results would have been better if only one throw had been taught in one class, but it was impossible due to the defined curriculum.

Effects of teaching the judo throwing techniques

The differences between the first and the final grades were analysed to determine the differences in the speed of acquiring particular judo throwing techniques. The standardized values of the first evaluation and the post-instruction final grades are presented in the Table 2. The arithmetic means (Mean) tended to zero values, whereas standard deviations (SD) tended to one. The statistical significance of the differences between the first and the final grades for each of the 14 throwing techniques was determined by means of the *t*–test for the dependent samples. The statistically significant positive differences between the two grades, consequently between the two performances of a throw, occurred in 6 throws, which are typical representatives of their specific groups - *tai-otoshi* and *te-guruma* (hand throws)*, tsuri-goshi* and *harai-goshi* (hip throws)*, soto-makikomi* (self-sacrificing throw), and *osoto-gari* (leg throw).

The significant differences between the grades for the listed throws occurred due to the positive structural changes in the quality of performance. At the end of the instruction process the students performed the throws quicker, more smoothly and dynamically, and with fewer technical faults or errors. The obtained enhancement of the throwing quality at the end of a class suggests that these throws can be learned in a very short period of time and per-formed with satisfactory expertise under standar-dised conditions. The instruction time was enough to develop the basic throwing expertise at a level of the basic movements' coordination.

Attractiveness of these throws was, probably, a significant factor of the successful instruction, because the students were positively motivated to perform them (Kuleš, 1980 and 1990). The earlier acquired motor skills and experience from wrestling (mechanism of transfer of learning) significantly facilitated judo motor learning and the successful performance of the throws in question. All the throws were characterized by the high numerical differences between the first and the final grades, ranging from 0.20 to 0.26.

The existent numerical differences between the first and the final grades for the rest of the eight throws were not statistically confirmed. These eight throws can be classified into two groups.

The first subgroup consists of throws for the performance of which the participants attained relatively high first grades at the beginning of the instruction and in which the level of expertise was not significantly improved in the post-instruction period (only the numerical progress was registered; Tables 1 & 2, the first four throws). These are, the so-called, easier throws: *tomoe-nage* (self-sacrificing throw), *de-ashi-barai* (leg throw), *koshi-guruma* (hip throw) and *morote-seoi-nage* (hand throw). The simple structure of these throws (Sacripianti, 1989; Škraba, 1980) undoubtedly had a considerable influence on the relatively high first performance grades. However, in contrast to the basic, simple performance, the top-quality expertise of these throws requires inclusion of sophisticated technical details. These details are crucial for their final effectiveness in a bout (Isao, 1976; Kuleš, 1985). It seems that these details in particular – related to amplitude, timing and tempo of performance - were not acquired properly due to the time limitations. It is an indisputable fact that the whole process of teaching-learning was some-

Table 2. Standardized values of means (Mean), standard deviations (SD), and tests of significance of differences (t), degrees of freedom (df) and p (t) in the speed of acquiring particular judo throwing techniques

	Mean	SD	t	df	p (t)
DAB1 (M)	-0.06	0.92	-1.59	121	0.11
DAB2 (K)	0.06	1.08			
KOG1 (M)	-0.02	1.03	-0.58	121	0.56
KOG2 (K)	0.02	0.98			
MOR1 (M)	-0.04	1.02	-1.15	121	0.25
MOR2 (K)	0.04	0.99			
TMN1 (M)	-0.01	0.92	-0.29	121	0.77
TMN2 (K)	0.01	1.08			
TSG1 (M)	-0.12	1.01	-3.79	121	0.00
TSG2 (K)	0.12	0.98			
TEG1 (M)	-0.12	0.96	-3.80	121	0.00
TEG2 (K)	0.12	1.04			
TAI1 (M)	-0.17	0.95	-4.50	121	0.00
TAI2 (K)	0.17	1.03			
HAG1 (M)	-0.12	1.01	-2.94	121	0.00
HAG2 (K)	0.12	0.98			
STM1 (M)	-0.13	1.00	-3.60	121	0.00
STM2 (K)	0.13	1.00			
OSG1 (M)	-0.08	0.98	-2.31	121	0.02
OSG2 (K)	0.08	1.02			
IPP1 (M)	-0.05	1.10	-1.12	121	0.27
IPP2 (K)	0.05	0.95			
OUG1 (M)	-0.05	1.02	-1.35	121	0.18
OUG2 (K)	0.05	0.99			
KCG1 (M)	0.02	0.98	0.45	121	0.65
KCG2 (K)	-0.02	1.02			
UCM1 (M)	-0.06	0.98	-1.43	121	0.16
UCM2 (K)	0.06	1.03			

what forced. Therefore, there was not enough time for the crucial factor of effective motor learning to be realized – an adequate number of repetitions of throws was missing. A greater number of throwing repetitions through a longer period of time would have guaranteed a more considerable improvement in the throwing skill acquisition.

The second subgroup of throws in which no statistically significant differences between the two grades were obtained (*ippon-seoi-nage,* the hand throw, *uchi-mata*, the hip throw, *ouchi-gari* and *kouchi-gari,* the leg throws) is characterised by the lowest level of throwing expertise demonstrated in both measurements. It can be explained by the very complex structure of the throws (Kano, 1994), which demands a relatively high level of motor abilities, coordination in particular (Kuleš, 1990; Sertić, 1997). Therefore, quite a number of execution faults were observed in the performance of these throws and, consequently, the grades were lower because of that. The most common faults were: poor balance breaking, inadequate contact establishment between *tori* (the thrower) and *uke* (the receiver of a throw), insufficient flight amplitude, poor space adjustments and poor timing. These throws are the most difficult to learn, therefore the process of acquiring and mastering them is the slowest one. The difficulties that occurred in the process of instruction were connected with the negative transfer of the motor skills learned earlier (the shoulder throw skill from wrestling was incorrectly implemented in the execution of the hand throw *ippon-seoi-nage*). When performing certain throws the students felt anxious about injuries because their leg swings were somewhat clumsy and a lot of contacts occurred in the groin region, for example in *kouchi-gari* (KCG) and *uchi-mata* (UCM). The lack of time and insufficient number of repetitions were the main reasons for the low effectiveness of instruction where these throws were concerned – there was not enough time to correct all the observed execution faults. This is in concordance with the explanations given for the first subgroup, but the judo expertise of the particular throws was influenced even more strongly by the lack of time and shortage of repetitions. Obviously, if enough quality expertise

of these throws is expected, much more time should be planned than it was allocated in the curriculum of the PE teacher education at the Faculty of Kinesiology at Zagreb.

Conclusion

The 122 sophomores, aged 19-21 years, from the PE teacher study, the sample of the research, may be regarded as adult judo beginners. The main objective of the study was to determine the differences in the speed of learning and the quality of acquisition of motor skills needed for the performance of the 14 typical judo throwing techniques. The teaching effects, that is the changes in motor expertise were analysed by means of the *t*-test for dependent samples at the significance level of .99.

The findings confirmed the varying speeds of learning various judo throwing techniques. The statistically significant differences were obtained between the two grades (the first and the final grade) awarded for execution of six throws *(tsuri-goshi - TSG, te-guruma - TEG, tai-otoshi - TAI, harai-goshi - HAG, soto-makikomi - STM* and *osoto-gari - OST)*. The varying initial levels of expertise and considerable improvement of performance after the instruction received are characteristic for these techniques. In several throws the subjects attained extremely high final grades which speaks in favour of the very high efficiency of instruction. For the remaining eight throws (*ippon-seoi-nage - IPP, ouchi-gari - OUC, kouchi-gari - KCG, uchi-mata - UCM,* all presented as the third group in Tables 1 and 2, and *de-ashi-barai - DAB, koshi-guruma - KOG, morote-seoi-nage - MOR, tomoe-nage - TMN,* presented as the first four throws in Tables 1 & 2) no statistically significant differences were obtained between the two grades. The causes for somewhat lower instruction effects regarding these throws are attributable to the demanding performance (complex structure of throws), the phenomenon of fear in the students, and, which is particularly important, to the negative transfer of learning (earlier acquired wrestling throwing skills). The listed causes were the hindering factors of the teaching-learning process efficiency.

According to the obtained results the following sequence of throws is suggested for the judo throwing instructions: the simplest and the most easy to learn are the throws: *de-ashi-barai, koshi-guruma, morote-seoi-nage* and *tomoe-nage,* therefore, they should be taught first. Only then *tsuri-goshi, te-guruma, tai-otoshi, harai-goshi, soto-makikomi* and *osoto-gari* should be introduced in the instruction. They are slightly more difficult, but trainees acquire them faster than *ippon-seoi-nage, ouchi-gari, kouchi-gari, or uchi-mata*, which are the most difficult to learn due to their complex structure.

On the basis of the above findings, the teaching concept implemented in the experiment, that is, the structure of individual lessons, can be positively evaluated from the aspect of teaching methods and didactics. It can be recommended for future judo throwing instructions within the judo course in the Bachelor PE teacher training curriculum.

The same is valid for secondary school teaching (Sertić, 1995 and 1995b) in which certain judo throwing techniques are obligatory components of the PE syllabus. Secondary school students may perform most throws without gripping the judogi costume (Sertić 1995b). It is enough to seize an opponent by an arm with one hand and with the other around his/her waist, neck, or trunk, depending on the type of throw performed. The following order of introducing and practising the throwing techniques in the secondary school PE classes is suggested: *de-ashi-barai, koshi-guruma, tsuri-goshi, tomoe-nage, morote-seoi-nage, tai-otosh. te-guruma, harai-goshi, soto-makikomi, osoto-gari, ippon-seoi-nage, ouchi-gari, kouchi-gari* and *uchi-mata*.

The recommended order may probably allow more judo throwing techniques to be introduced into the elementary and secondary school curricula and syllabi. These new motor skills, acquired and mastered, will surely, on the one hand, enrich the general motor expertise and efficiency of young students, especially with regard to the development of coordination, all types of strength and power, explosiveness and balance (Kuleš, 1990; Sertić, 1995b and1997). On the other hand, such motor knowledge may help young people to control their aggressive impulses better by transforming them into instrumental aggression. Furthermore, well-mastered judo throwing techniques will undoubtedly facilitate the introduction and execution of the self-defence programmes the PE classes, the ultimate purpose of which is to enhance the physical and mental security and self-reliance in children and the young.

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RAZLIKE U BRZINI UČENJA POJEDINIH TEHNIKA JUDO BACANJA

Sažetak

Uvod

Kvaliteta izvođenja judo bacanja i brzine učenja bacanja procijenjena je na 14 tehnika koje pripadaju, prema klasifikaciji K. Kudoa (1967,1976), skupinama ručnih, bočnih, nožnih i požrtvovnih bacanja, ovisno o tome je li u njima dominantan rad ruku, nogu, kukova (boka) ili se pak žrtvovanjem vlastite ravnoteže nastoji baciti protivnika. Te su se tehnike pokazale kao najefikasnije borbene tehnike na Olimpijskim igrama u Barceloni (Organizacijski odbor XXV. olimpijskih igara u Barceloni 1992; Orlović, 1993).

Materijal i metode

Kvalitetu izvođenja, odnosno naučenosti pojedinih tehnika judo bacanja procijenilo je pet eksperata, vrhunskih stručnjaka, nositelja crnog pojasa te dugogodišnjih trenera juda, davanjem ocjena od 1 do 5. Prije eksperimentalnog postupka ocjenjivanja, svi su suci, sumirajući spoznaje, utvrdili kriterije ocjenjivanja i zajednički probno ocijenili uzorak studenata radi provjere osnovnih dokimologijskih pravila kojih su se pridržavali u procjenjivanju znanja. Pri tome su utvrdili greške koje se u pravilu mogu pojavljivati u izvođenju tehnika i njihovu težinu, a koje su mogle utjecati na ocjenu kvalitete.

Kvaliteta izvođenja svake od 14 tehnika bacanja procijenjena je dva puta. Prvi put nakon 7 minuta učenja i vježbanja zadane tehnike te na kraju nastavnog sata. Vježbanje i učenje tehnika bacanja provodilo se dva puta tjedno po 90 minuta. Unutar jednog treninga valjalo je što kvalitetnije svladati po dva bacanja.

Završna ocjena za svako bacanje uzeta je za analizu učinka procesa poučavanja. To znači da je svaki ispitanik za ocjenu izveo dvije različite tehnike bacanja na mjestu, jednu za drugom. Ocijenjena je usvojenost tehnike bacanja, odnosno provjereno je motoričko pamćenje na temelju izvedbe memoriranog motoričkog programa tehnike bacanja uz angažiranje motoričkih sposobnosti.

Ispitanici su bili studenti Fakulteta za fizičku kulturu koji su na redovitom studiju slušali kolegij Judo. Mogu se smatrati starijim judo početnicima.

Dobivene ocjene obrađene su postupcima deskriptivne statistike, a veličina i značajnost razlika u brzini usvajanja pojedinih tehnika utvrđene su *t*-testom.

Rezultati i rasprava

Osnovne vrijednosti prosječnih ocjena kvalitete izvođenja tehnika bacanaja prikazane su u tablici 1. Prosječna početna ocjena za sva bacanja iznosi 2.94, a završna 3.08. Prosječne ocjene na kraju sata (sve su bile više od početnih) govore u prilog učinkovitosti nastavnog procesa. Rezultati bi najvjerojatnije bili i bolji da se na jednom nastavnom satu mogla poučavati i vježbati samo jedna tehnika bacanja.

U tablici 2 navedene su standardizirane vrijednosti aritmetičkih sredina, standardne devijacije i rezultati *t*-testa za procjenu značajnosti razlika u brzini učenja pojedinih tehnika. Vidljivo je kako je statistički značajna razlika u kvaliteti izvođenja tehnika judo bacanja na početku i na kraju nastavnog sata ustanovljena u njih 6, kao karakterističnih predstavnika svojih skupina bacanja: *tai-otoshi* i *te-guruma* (ručna bacanja), *tsuri-goshi* i *harai-goshi* (bočna bacanja), *soto-makikomi* (požrtvovno bacanje) i *osoto-gari* (nožno bacanje). Do statistički značajnih razlika u ocjenama ovih tehnika na početku i na kraju nastavnog sata došlo je zbog pozitivnih kvalitativnih strukturalnih promjena u njihovu izvođenju. Ispitanici su bacanja izvodili skladnije, brže, dinamičnije te s manje tehničkih nedostataka, odnosno pogrešaka. Povećanje kvalitete izvođenja bacanja tijekom nastavnog sata dozvoljava zaključak da se ova bacanja mogu naučiti i izvesti na zadovoljavajućoj razini u standardnim uvjetima i u vrlo ograničenom vremenu. Vrijeme utrošeno na poučavanja bilo je dovoljno za usvajanje tih tehnika bacanja u osnovnoj formi na razini osnovne koordinacije pokreta.

Značajni čimbenici uspješnosti poučavanja u ovim bacanjima sigurno su bili povezani s njihovom atraktivnošću koja je utjecala na pozitivnu motivaciju u njihovom uvježbavanju (Kuleš, 1980, 1990). Isto tako, na uspjeh u ovim bacanjima utjecala su i ranije naučena znanja i motorička iskustva iz hrvanja. To znači da je mehanizam transfera znanja imao znatan utjecaj. Karakteristika svih tih bacanja je da je dobivena i visoka numerička razlika između prvog i drugog ocjenjivanja i ona se kreće u intervalu od 0.20 do 0.26 boda.

Iako postoji numerička razlika u ocjenama kvalitete izvođenja preostalih osam bacanja na početku i na kraju sata, ta razlika nažalost nije statistički potvrđena.

Zaključak

Na temelju dobivenih rezultata metodička koncepcija sati, primijenjena u eksperimentu, može se pozitivno valorizirati s didaktičko – metodičkog stajališta i preporučiti za poučavanje tehnike judo bacanja u nastavnom procesu na studiju kineziologije. To isto vrijedi i za nastavu u srednjoj školi (Sertić, 1995a i 1995b), gdje su neki od navedenih elemenata bacanja propisani nastavnim planom i programom predmeta Tjelesna i zdravstvena kultura.

Učenici u nastavi mogu većinu bacanja izvoditi bez hvata za kimono (Sertić, 1995b). Dovoljno je partnera uhvatiti jednom rukom za ruku, a drugom oko struka, vrata ili trupa, što ovisi o tehnici bacanja koja se izvodi. Preporučujemo slijedeći redosljed poučavanja tehnike judo bacanja u školama: *de-ashi-barai, koshi-guruma, tsuri-goshi, tomoe-nage, morote-seoi-nage, tai-otoshi, te-guruma, harai-goshi, soto-makikomi, osoto-gari, ippon-seoi-nage, ouchi-gari, kouchi-gari* i *uchi-mata.*

Navedeni redoslijed omogućio bi da se još više tehnika judo bacanja uključi u izvedbeni plan i program srednjih i osnovnih škola. Prihvaćanje i ovladavanje novim motoričkim znanjima utjecalo bi na razvoj šireg spektra motoričkih sposobnosti, a prvenstveno koordinacije, svih vidova snage, brzine, eksplozivnosti i ravnoteže (Kuleš, 1990; Sertić, 1995b i 1997), kao i instrumentalne agresivnosti.

Na podlozi dobro naučenih i svladanih tehnika bacanja lakše bi se poučavao program samoobrane koji je zastupljen u nastavnom programu srednje škole, a on, u današnje vrijeme, sigurno nije nevažan za tjelesnu i psihološku sigurnost djece i mladeži.