THE INFLUENCE OF FIVE DIFFERENT TYPES OF OBSERVATION BASED TEACHING ON THE COGNITIVE LEVEL OF LEARNING[1]

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Abstract:

One of the most popular methods for coaches and teachers, as far as the understanding of an exercise on the cognitive level is concerned, is the method of learning via modeling. Research has shown that this method is fairly effective. Nevertheless, other factors interfere in the observation of a model, for example oral intervention by the teacher. The purpose of the present study was to examine the influence of five different teaching methods on the Level of Cognitive Acquisition of Execution (LCAE), on the basis of the observation of a model. Ninety-three individuals, aged 17-21, participated in the study. The sample was divided into the following five groups: A) Oral Intervention (verbal description) by the Teacher (OIT). B) Observation of Model Without any other Intervention (OMWI). C) Observation of Model and Oral Intervention by the Teacher (OMOIT) before each execution. D) Observation of Model and Oral Intervention by the Model (OMOIM) before each execution. E) Observation of Animated Model and Oral Intervention by the Teacher (OAOIT) before each execution. The results of the study showed a significant difference ($F = 30.9$ and $p < .0001$) from pre- to post-test for the whole sample. Additionally, the five experimental groups, separately, showed significant statistical differences ($p < .0001$). Meta-anova analysis revealed that the greater influence in the improvement of LCAE was observed in (OMOIM), followed by (OAOIT), (OMOIT), (OIT) and (OMWI).

Key words: *modeling, observation learning, animation*

Introduction

Observation learning through modeling is the most popular method in the teaching of motor skills (Bird & Ross, 1984). These theories are presented in previous and recent literature. From the beginning of the 20th century scientists have used learning through observation as a basis for their research (Adams, 1987; Bandura, 1962, 1971, 1977; Black & Wrigth, 2000; Sheffield, 1961), and this method is now widely accepted and effective in physical education and sports skills' acquisition (Garay & Hernadez, 2002; Magill, 1993; Pollock & Lee, 1992; Raudsepp & Raie, 2001). Weeks (1992) mentioned that cognitive learning through modeling is equally important to motor learning through modeling, as a source of information. It seems that the cognitive process plays a determinant role in the acquisition of motor skills (Downey, 1988), and the observation of a model helps the trainees to develop a cognitive representation, which regulates the production of movement and serves as a comparison measure for the correctness of a skill. Sheffield (1961) developed the theory of symbolic representation, which maintains that a person observing a demonstration of a motor skill forms a cognitive symbolic representation of this skill. The person can recall symbolically the demonstration of the model from the cognitive program that is created. Thus, in the case of simple and brief tasks, the projection of a filmed motor skill is enough for the observer to learn the required series of movement execution. In the meantime, Bandura (1962, 1971, 1977) established the mediational-contiguity theory, also known as the social learning theory. Like Sheffield, Bandura believed that cognitive involvement in the learning process via observation of a model is critical.

Most of the cognitive processes, which adjust the behavior, are at the beginning rather oral than visual. The verbal coding of the observed events probably accounts for the notable speed of observational learning via modeling and the long-term retention of the model's behavior. The verbal codes

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facilitate retention, because they include a great deal of information in an easily stored form (Bandura, 1971). In those verbally coded operations, the repetition of the observed stimulant stabilizes and strengthens the acquired responses, and facilitates their retention (Weiss, 1983; Weiss & Klint, 1987). McCoullagh and Little (1989) mention that visual demonstration on its own is weak without verbal instructions. The repetition of the execution of the exercise by the model much increases the level of learning through observation. It is possible that repetition facilitates retention, which depends on the ability of the observer to organize the observed execution of the model into meaningful units (Bandura, 1971; Blandin, Proteau, & Alain, 1994; Weeks, Hall, & Anderson, 1996). The executions are selected and organized on a cognitive level (Bandura, 1971).

The virtuosity of the model is also a very important factor, because the clarity of the actions of the model influences greatly what is observed (Adams, 1986; Bandura, 1971; Landers & Landers, 1973; Martens, Burwitz, & Zuckerman, 1976; Pollock & Lee, 1992). There is evidence that models performed correctly are more effective in the facilitation of the acquisition of the skill than models performed incorrectly (Martens, et al., 1976; Adams, 1986; Ross, Bird, Doody, & Zoeller, 1985).

A question, which arose when designing this work, was how far a real model or a symbolic one (as the symbolic representation via the execution of a skill by an animated model) could be more effective. Most studies, which used either real or symbolic models (presentation via video), assumed that they are equally effective, as long as the basic elements of the execution are selected, and that these elements transmit the same percentage of information and are equally effective in stimulating the attention (Bandura, Ross, D., & Ross, S.A., 1963; Feltz & Landers, 1977; Feltz, Landers, & Raeder, 1979; McCullagh, 1986).

The learning theory via observation emphasizes the importance of the cognitive activity for the acquisition of the skill. The processes that are mixed in this activity are rather learnt more than innate. The coherence of the mental activities, which depend on the cognitive activities, is known as control processes (Bandura, 1971).

Carroll and Bandura (1990) claim that verbal coding increases the cognitive and the representative accuracy, only when it is combined with many opportunities for observation of the execution of the model. Only the observation of a correct model during the phase of acquisition results in the development of a strong pattern or in a cognitive representation of the observed movement (Carroll & Bandura, 1982; Keele, 1976; Schmidt, 1975). Although, a review of the relevant bibliography shows that the achievement of learning on a cognitive level with the use of visual observation is given, yet, the need for investigation of different methods of teaching on the basis of learning through observation of a model, executing a simple exercise, with parallel intervention by other sources of information, like the verbal one, is clear. This happens because some methods are not clarified from the bibliography, as for example the method of observation of a model with verbal intervention by the model and direct instructions to the observers before each execution or the method of observation of an animated model and instructions by the teacher before each execution (no relevant bibliography existed with reference to this particular method), with the exception of the work by Feltz and associates (1979) who investigated intervention by the model in a difficult and complicated motor skill, as well as the work by Landin (1994) in which the model informs the subjects using a style of *personal speech* (verbal rehearsal), without direct instructions to them before each execution.The question which arises, as far the bibliography and experience are concerned, is to find out which one of the investigated methods in the present study is more effective in the acquisition of a simple motor skill on a cognitive level of learning. This problem has been formulated by Bandura (1986), who proposed different simultaneous measurements for the calculation of the percentage of learning through observation.

The purpose of the present study was to examine the influence of five different types of teaching in the cognitive acquisition of the execution, on the basis of the method of learning via observation of a model.

Method

The sample consisted of 93 female subjects (N = 93), aged 17-21 (M = 18.35 SD = 0.76), students of the Department of Physical Education and Sport Science in the University of Athens who voluntarily took part in the experimental procedure. The gender of the sample was decided on the basis of the morphological similarity to the model, namely age, gender, etc. (Del Ray, 1978; Weiss, McCullagh, Smith, & Berlant, 1998). The subjects had no former experience of any kind of experimental procedures. Furthermore, they did not have any specialized knowledge of the motor skills related to artistic gymnastics events. Instructions about the nature and the purpose of the experiment were given to all subjects. Specifically, the subjects were informed that they would participate in an experiment of a pedagogical nature aiming to inquire into teaching methods. The instructions were strictly given to the subjects, so that the results would not be affected.

Following this, the sample was randomly divided into five experimental groups:

A) Oral Intervention by the Teacher (OIT, n = 18)

B) Observation of Model Without any other Intervention from anywhere (OMWI, n = 17)

C) Observation of Model and Oral Intervention by the Teacher before each execution (OMOIT, n = 22)

D) Observation of Model and Oral Intervention by the Model before each execution (OMOIM, n = 20)

E) Observation of Animated Model and Oral Intervention by the Teacher before each execution (OAOIT, n = 16)

The models and the exercise. Two models were selected for the presentation of the exercise. The first model was a real one and the second was an animated model. The real model was a female athlete from the national team of artistic gymnastics, so that the correct informative elements of the exercise could be transferred, considering that the skillfulness of the model is a basic factor influencing the acquisition and the maintenance of a motor skill (McCullagh & Meyer, 1997; Pollock & Lee, 1992; Rose, 1997), while the animated model was constructed by the computer. The advantage of observation of an animated model is that it does not transfer sentimental informative elements which can influence the cognitive acquisition of learning. As McCullagh (1986) mentions, if there are some sentimental elements beyond the transmission of information, these should be taken under consideration, which does not exist in the case of an animated model. The exercise executed by the models was the handstand.

The experimental period for all experimental groups was 3 weeks, with 3 sessions per week, altogether 9 sessions. In each session the exercise was presented 10 times.

The real model presented the exercise in specific place and time, while the animated model presented the exercise via video projector in nine selected phases, in flow with time regulation, so that each phase lasted one second (Figure 1).

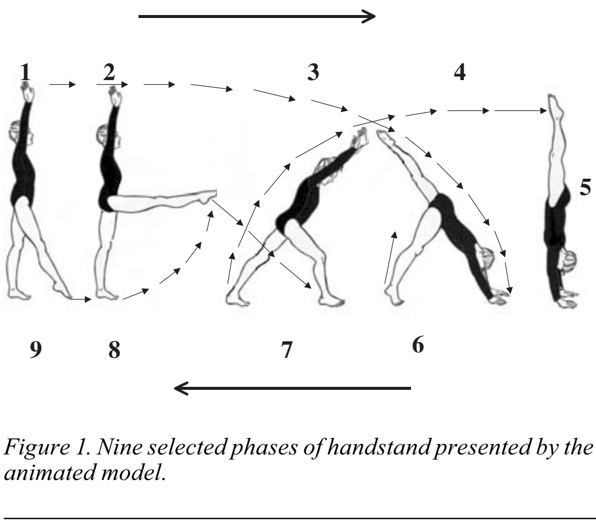

Figure 1. Nine selected phases of handstand presented by the animated model.

Instruments and measurements. The instrument for the collection of the data was a constructed close-ended questionnaire of 13 items, based on the regulations of the FIG's (Fédération Internationale de Gymnastique) gradation code for the technical execution of the exercises (Table 1).

This questionnaire is not a psychometric instrument that traces the psychological factors, but a test to check the level of cognitive acquisition of execution (LCAE). Thus, the instrument has logic validity, as long as the kind of questions and the way of evaluating are relevant to the examined variable (Paraskevopulos, 1993). Besides, the questions are based on the technical demands of FIG for the execution of the exercise, and these demands refer to the kinetic characteristics (stretching and bending in joints), as well as to the kinematic characteristics (spatial distances of limbs in space).

To check the reliability of the constructed instrument, the method of repeated measurements was used. The questionnaire, used in the present study, was constructed and checked for reliability to serve the purpose of this specific study and of the specific exercise examined in this work. Therefore, M and *t*-test were chosen. The questionnaire was answered by 40 female students, aged 18-21 (M = 19.3 SD = 1.02). After three weeks and under the same circumstances, the questionnaire was answered again by the same subjects. A *t*-test for dependent samples (Table 2) was conducted for the statistical analysis of the level of reliability. The results of the repeated measurements for the degree of reliability of the questionnaire showed that there was not any significant difference between the two measurements ($t = 1.89$ and $p > .05$), thereby the questionnaire could be used in the present study as a reliable and valid instrument.

The total of correct answers for each questionnaire rated 13 points. For each wrong answer a point was deducted. So, the gradation for each subject was determined by the total of correct answers.

After the control of the questionnaire, the experimental procedure followed.

The experimental measurements for LCAE occurred on two occasions, one before and the other after the experimental treatment (Table 3).

Results

The experimental model for the statistical analysis of the data of the LCAE was 5 x 2 (experimental groups x measurements). LCAE is determined as the subjects' level of knowledge with regard to the technique of the selected exercise according to the gradation code of FIG.

In order to ascertain whether there were any significant statistical differences among the groups (Table 4) in the first measurement, a simple analysis of variance was conducted. The results showed

Table 1. The questionnaire for the evaluation of the Level of Cognitive Acquisition of Execution

University of Athens
Department of Physical Education
and Sport Science

Name …………………………...
Age ………………………………
Class …………………………….

Group …………………………..

QUESTIONNAIRE*

	a	b	c
1). Preparation: Standing - one leg in front of the other. The weight of the body is:	between the legs	on the front leg	on the back leg
2) At the beginning of the exercise, the correct position of the front leg is:	the toes touch the floor	the foot is elevated, parallel to the floor	the foot is elevated with toes in front of the face
3) At the beginning of the exercise, the front leg is:	straight	bent	slightly bent
4) After the beginning of the exercise, the trainee places the front leg as regards to the back foot:	at a relatively close distance	at a relatively middle distance	at a relatively long distance
5) After the placement of the front leg (push-off leg) on the floor, the hands are placed on the floor as regards to the push-off leg:	at a close distance	at a middle distance	at a long distance
6) The distance of the hands placed on the floor must be:	equal to the shoulders width	bigger than the shoulder width	smaller than the shoulder width
7) When placing the hands on the floor the fingers are:	closed	open	bent into a fist
8) The elbows on handstand are:	slightly bend	straight	bent
9) The shoulders on handstand are:	in	out	at an intermediate level
10) The head on handstand is:	tucked	stretched out	between the arms
11) The trunk (at the height of the waist) on handstand is:	bending slightly out	bending slightly in	straight
12) The knees on handstand are:	bent	slightly bent	straight
13) The ankle joints on handstand are:	bent	straight	neither bent nor straight

* Read carefully and choose one of the three answers (a, b or c), marking with x the correct technique in each item.

Table 2. Statistical elements of the level of reliability of the questionnaire. Marked differences are significant at p < .05

Variable	Mean	Std. Dv.	N	Diff.	Std. Dv. Diff.	t	df	p
test	5.75	1.42						
retest	5.20	1.15	40	.55	1.84	1.89	39	.066

Legend: Std. Dv. – standard deviation; Diff. – difference; Std. Dv. Diff. – standard deviation difference; N – number of subjects; df – degress of freedom; p - reliability

that there was no significant difference among the groups regarding LCAE with reference to the technique of the selected exercise ($F_{(4.88)} = 2.194$ $p > .05$).

In order to determine if there was a significant difference between the measurements independently of the experimental groups, an ANOVA analysis was conducted on the main results for the whole sample (Table 4).

The results showed a significant increase (fig. 2) of LCAE for the selected exercise from pre-test ($F_{(4.88)} = 2.19$, $p > .05$) to post-test ($F_{(4.88)} = 30.9$, $p < .0001$).

In order to check which group outperforms across the five experimental groups in the improvement of the LCAE, we extracted the arithmetic differences from the data that arose from pre- to post--test measurements, for all the subjects in the five groups (Table 5), then an ANOVA was conducted. The results showed significant differences between the groups ($F_{(4.88)} = 19.04$, $p < .0001$). A *post-hoc* analysis with Tukey method for unequal N was conducted in order to detect these differences (Table 6, Figure 3).

Table 3. Experimental design

	Pre-test	Experimental period - 6 sessions	Post-test
EXPERIMENTAL GROUPS	Checking the LCAE		Checking the LCAE
• OIT	X	X	X
• OMWI	X	X	X
• OMOIT	X	X	X
• OMOIM	X	X	X
• OAOIT	X	X	X

Legend: OIT - Oral Intervention by the Teacher, OMWI - Observation of Model Without any other Intervention from anywhere, OMOIT - Observation of Model and Oral Intervention by the Teacher before each execution, OMOIM Observation of Model and Oral Intervention by the Model before each execution, OAOIT - Observation of Animated Model and Oral Intervention by the Teacher before each execution

Table 4. Means (M) and Standard Deviations (SD) of the LCAE (level of cognitive acquisition of execution) for the experimental groups and the experimental measurements

Groups	N	Pre-test M	Pre-test SD	Post-test M	Post-test SD
OIT	18	5.83	1.38	10.39	1.46
OMWI	17	5.71	1.53	7.23	2.05
OMOIT	22	5.18	1.30	10.64	1.33
OMOIM	20	5.15	1.09	11.65	1.23
OAOIT	16	6.12	0.62	12.06	.85
All groups	93	5.56	1.26	10.43	2.15

Legend: OIT - Oral Intervention by the Teacher, OMWI - Observation of Model Without any other Intervention from anywhere, OMOIT - Observation of Model and Oral Intervention by the Teacher before each execution, OMOIM Observation of Model and Oral Intervention by the Model before each execution, OAOIT - Observation of Animated Model and Oral Intervention by the Teacher before each execution

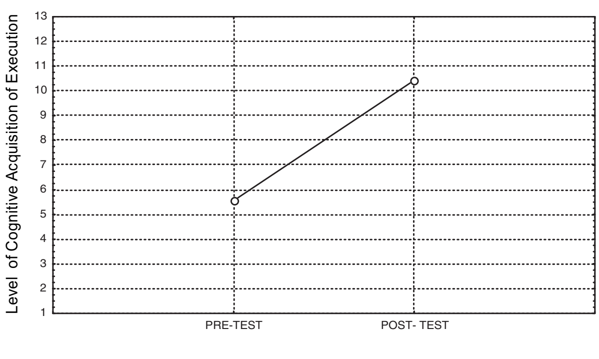

Figure 2. Mean values of the main results on LCAE independently the experimental group

Table 5. Means of the arithmetic differences of the groups from the initial data from pre- to post-test.

1st group	2nd group	3rd group	4th group	5th group
4.44	1.53	5.44	6.50	5.94

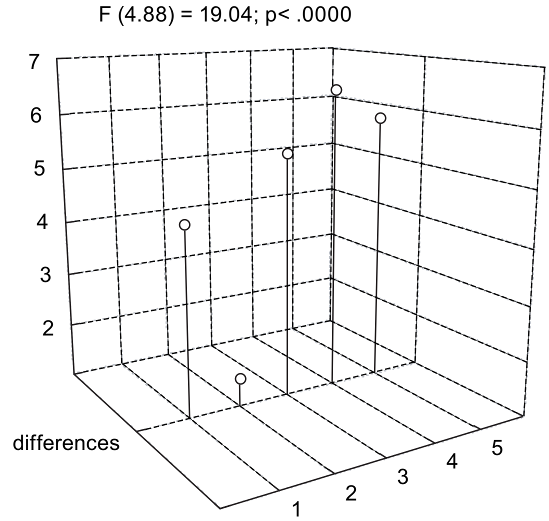

Figure 3. Mean values of differences which resulted from the data of the subjects for each group from pre-to post-test

Table 6. Comparisons between the experimental groups revealing the significant differences between the groups (indicates significant difference)*

	OIT. M=4.44	OMWI M=1.53	OMOIT M=5.45	OMOIM M=6.50	OAOIT M=5.94
OIT		.0003*	.4989	.0.133*	.1766
OMWI	.0003*		.0001*	.0001*	.0001*
OMOIT	.4989	.0001*		.4094	.9507
OMOIM	.0133*	.0001*	.4094		.9167
OAOIT	.1766	.0001*	.9507	.9167	

Legend: OIT - Oral Intervention by the Teacher, OMWI - Observation of Model Without any other Intervention from anywhere, OMOIT - Observation of Model and Oral Intervention by the Teacher before each execution, OMOIM Observation of Model and Oral Intervention by the Model before each execution, OAOIT - Observation of Animated Model and Oral Intervention by the Teacher before each execution

Independently of the former analyses, the *t*-test for dependent samples (Figure 4) was conducted in order to show the significant differences in the increase of learning for the LCAE of the selected exercise within the groups, from pre- to post-test.

The results showed:

Group A (OIT): $t = -8.29$, $p < .0001$
Group B (OMWI): $t = -6.69$, $p < .0001$
Group C (OMOIT): $t = -12.54$, $p < .0001$
Group D (OMOIM): $t = -18.10$, $p < .0001$
Group E (OAOIT): $t = -25.57$, $p < .0001$

The *t*-test analyses indicated that the five experimental groups showed significant improvement from pre- to post-test.

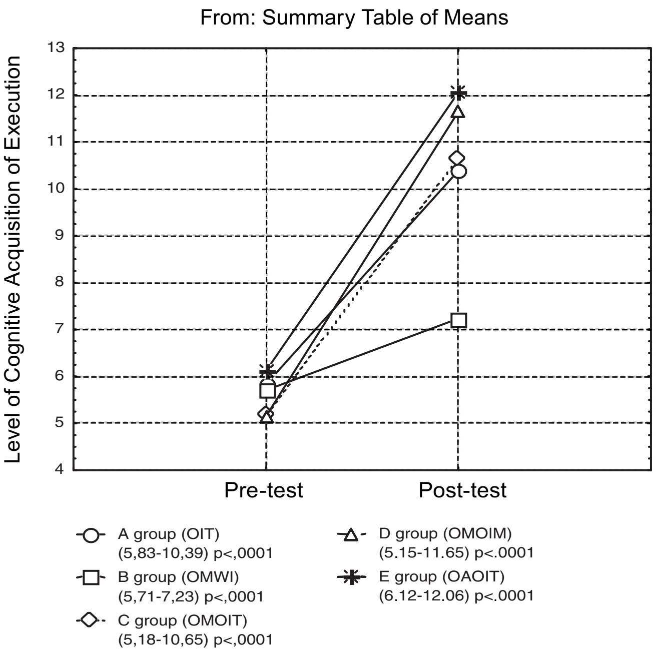

Figure 4. Comparison of mean values between the experimental measurements and the experimental groups.

Discussion and conclusion

Firstly, the purpose of this research was to examine the influence of five different types of teaching on the Level of Cognitive Acquisition of Execution (LCAE) that follow: a) Oral Intervention (verbal description) by the Teacher (OIT), b) Observation of Model Without any other Intervetion (OMWI) from anywhere, c) Observation of Model and Oral Intervention by the Teacher (OMOIT) before each execution, d) Observation of Model and Oral Intervention by the Model (OMOIM) before each execution, e) Observation of Animated Model and Oral Intervention by the Teacher (OAOIT) before each execution. The above methods were formed on the basis of the method of learning via modelling, depending on the experimental measurement and independently of the experimental group. Secondly, to investigate if there is any difference in the improvement of the LCAE, from pre- to post-test, for each group separately. Thirdly, to find out which group is outperforming.

The simple variance analyses in the first measurement showed that there was no significant difference between the experimental groups, thus ensuring the homogeneity of the groups at the beginning of the experiment.

As expected, the results indicated a significant increase of LCAE from pre- to post-test, between the measurements and independently of the experimental groups, and this depended on the different kinds of additional information, which each group received during the experimental treatment, such as the oral condition in OIT, the visual condition in OMWI or a combination of both oral and visual, in OMOIT, in OMOIM and in OAOIT. Newell and associates (1985) defined augmented information as any information that exists out of the limitations of the presented action. Visual presentations or oral intervention are examples of augmented information. Carroll and Bandura (1990) stated that oral coding increases the cognitive and representative accuracy only when it is combined with many opportunities for observation of the execution of the model by the observers.

According to many researchers, the retention of the execution, in general, is based on the feedback from completed memory codes which simultaneously include visual and kinesthetic information (Diewert & Stelmark, 1978; Laabs, 1973; Marteniuk, 1976; Russel, 1976; Schmidt, 1976). Smith (1969) stated that the basic teaching technique for the improvement of the trainees is the use of the oral and visual feedback, which increases the information of the trainees mostly.

The post measurement clearly showed statistically significant differences in reference to the LCAE between the groups. *Post hoc* analysis for unequal N with the Tukey method for the main results of the experimental groups revealed that the greater influence, as far as the improvement of LCAE (Figure 3) is concerned regarding the technique of the selected exercise, was displayed in the method of OMOIM, which showed significant differences compared to a) the method of OMWI, b) the method of OIT. Equally important for the improvement of LCAE was the method of OAOIT which did not show any significant differences from the other methods, with the exception of the method of OMWI.

The methods a) OAOIT, b) OMOIM and c) OMOIT seemed to be more influential than the other two despite the methodological differences between them, making clear that they are equally important for the development of LCAE. In these three methods the subjects were capable of distinguishing the phases of the exercise clearly and correctly. The observation of a correct model during the phase of acquisition results in the development of a powerfull pattern or a cognitive representation of the observed movement (Schmidt, 1975; Keele, 1976; Carroll & Bandura, 1982). One of the questions which came up during the research was the effectiveness of the model, in other words, how far the model, real or symbolic (as the symbolic representation of a model on television, in the movies or on video), is more effective. Most studies, which used real or symbolic models, assume that these models are equally effective, as far as the basic elements of execution are selected, they transmit the same amount of information and they are equally efficient in stimulating the attention (Bandura, Ross,

& Ross, 1963; Feltz & Landers, 1977; Feltz, et al., 1979; McCullagh, 1986). The results of the present study agree with the results of former works.

Feltz and associates (1979) claim that in difficult exercises, such as reverse diving, the real model, which participated directly with instructions to the learner, was more effective than a video recorded demonstration or a real model which merely demonstrated the exercise. These results partly agree with the results of this study which shows clearly that the experimental group that simply observed the demonstration of the exercise was significantly inferior compared to the other groups.

Although the method of OMOIT did not show any statistically significant differences compared to the other methods with the exception of the method of OMWI, it yet had a tendency to be inferior compared to the methods of OAOIT and OMOIM.

Feltz and associates explain this outcome (1979) and state that in case the model participates whith direct instructions to the trainee, the method is more effective than the other observational methods. Nevertheless, these three methods seem to be sufficiently strong as strategies for the development of the LCAE. Oral intervention either by the model or by the teachers during the demonstration of the execution of the exercise seems to play a determinant role in the cognitive acquisition (Adams, 2001).

The method of OIT showed a statistically significant difference and was superior to the method of OMWI, while it was inferior to the method of OMOIM.

The method of OMWI showed statistically significant differences and was inferior to the other methods. This finding indicates that the visual feedback alone cannot facilitate sufficiently the acquisition of the execution, unless adequate cognitive representation of the required execution has been developed. The visual feedback of an execution and the additional information, such as oral information to the subjects appears to be effective if there is an adequate cognitive representation included (Carroll & Bandura, 1982; Erbaugh, 1985).

Regarding the results of the measurements within the groups, the five teaching methods as they were applied in the present study, improved the LCAE from pre- to post-test in agreement with the available scientific works presented in this paper.

We recommend similar studies to be conducted in future, including more measurements, more repetitions and more experimental conditions regarding the animated model.

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UTJECAJ PET RAZLIČITIH METODA UČENJA UTEMELJENIH NA OPAŽANJU MODELA NA KOGNITIVNU RAZINU UČENJA

Sažetak

Uvod

Učenje opažanjem na temelju promatranja modela najpopularnija je metoda poučavanja motoričkih vještina (Bird & Ross, 1984). Čini se da kognitivni process igra odlučujuću ulogu u stjecanju motoričkih vještina (Downey, 1988) te da promatranje modela pomaže učenicima da razviju kognitivnu reprezentaciju izvedbe, koja upravlja izvedbom pokreta i služi kao komparativna mjera točnosti izvođenja vještine (Adams, 1987; Bandura, 1962, 1971, 1977; Black & Wrigth, 2000; Garay & Hernadez, 2002; Raudsepp & Raie, 2001; Sheffield, 1961). Sheffield (1961) je razvio teoriju simboličke reprezentacije, prema kojoj osoba koja promatra demonstraciju motoričke vještine oblikuje simboličku, kognitivnu reprezentaciju te vještine. U međuvremenu, Bandura (1962, 1971, 1977) postavlja teoriju socijalnog učenja (*mediational-contiguity theory*). Kao i Sheffield, Bandura je vjerovao da je upravo kognitivna uključenost u proces učenja posredstvom opažanja modela presudno važna. Teorije učenja opažanjem naglašavaju važnost kognitivne aktivnosti za stjecanje vještine. Procesi koji se miješaju prilikom te aktivnosti u većoj su mjeri naučeni nego urođeni. Svrha ovog rada bila je ispitati mogu li različite metode učenja na temelju opažanja modela utjecati na razinu kognitivnog usvajanja izvođenja (Level of Cognitive Acquisition of Execution, LCAE).

Metode

Sudionici. U istraživanju je sudjelovalo pet eksperimentalnih grupa, a sudionice su bile 93 studentice Fakulteta za tjelesni odgoj i sportske znanosti Sveučilišta u Ateni, u dobi od 17 do 21 godine.

Varijable. Korišteno je i ispitivano pet različitih metoda poučavanja

A) Usmena intervencija učitelja (verbalni opis aktivnosti) (OIT).
B) Opažanje modela bez bilo kakve intervencije (OMWI).
C) Opažanje modela uz usmenu intervenciju učitelja (OMOIT) prije svake izvedbe.
D) Opažanje modela i modelova usmena intervencija (OMOIM) prije svake izvedbe.
E) Opažanje animiranog modela i usmena intervencija učitelja (OAOIT) prije svake izvedbe.

Postupak. Dva su modela prezentirala vježbu, jedan živi i jedan animirani model. Eksperimantalni zadatak, tj. prezentirana vježba bila je stoj na rukama. Eksperiment je trajao tri tjedna; u svakom je tjednu provedena jedna eksperimentalna intervencija koja je uključivala 10 prezentacija vježbe. Živi je model prezentirao vježbu preko video projekcije u realnom vremenu i prostoru, dok je animirani model prezentirao vježbu preko video projekcije u 9 odabranih faza, usporeno tako da je svaka faza trajala 1 sekundu. Razina kognitivnog 'stjecanja vještine' (LCAE) ispitana je upitnikom zatvorenoga tipa od 13 pitanja koja su se temeljila na tehničkim zahtjevima Međunarodnog gimnastičkog saveza (FIG). Upitnik je bio primijenjen na početku i na kraju eksperimenta (pre-test i post-test).

Rezultati

Kako bi se provjerile razlike u učinkovitosti, tj. razini kognitivnog stjecanja vještine, korišten je eksperimentalni model 5X2 (broj grupa X mjerenje). Kako bi se ispitala značajnost razlika između mjerenja neovisno o pripadnosti eksperimentalnoj grupi, provedena je ANOVA na ukupnim rezultatima cijelog uzorka. Rezultati su pokazali statistički značajno povećanje razine kognitivnog stjecanja vještine (LCAE) za odabranu vježbu iz post-testa ($F_{(4,88)}$=30.9, p<.0001) u odnosu pre-test ($F_{(4,88)}$=2.19, p>.05). Rezultati su pokazali i statistički značajnu razliku između grupa ($F_{(4,88)}$=19.04, p<.0001). Proveden je post-hoc test (Tukeyjeva metoda za nejednak N) kako bi se locirale razlike između eksperimentalnih grupa. Neovisno je proveden i t-test za zavisne uzorke kako bi se pokazale značajne razlike u povećanju kognitivne razine učenja zadatka, tj. stjecanja vještine (LCAE) unutar grupa. T-test je pokazao da je kod sudionica svih pet eksperimentalnih grupa došlo do značajnog povećanja LCAE između mjerenja i ukupno, neovisno o grupi, što je ovisilo o količini dodatnih informacija koje su sudionice dobivale za vrijeme eksperimentalnog tretmana. Rezultati su jasno pokazali značajan napredak kognitivnog stjecanja vještine, a post-

-hoc test je pokazao da je najveći utjecaj metode učenja i najveći napredak utvrđen u grupi OMOIM. Te su studentice pokazale statistički značajno veću razinu kognitivne usvojenosti vještine od studentica iz grupa OMWI i OIT. Podjednako važna za napredovanje u kognitivnom stjecanju vještine bila je i metoda OAOIT koja se nije pokazala statistički značajno različito učinkovitom u odnosu na druge metode,osim prema OMWI.

Zaključak

Rezultati ovog istraživanja pokazali su da se metode a) OAOIT, b) OMOIM i c) OMOIT imaju najveći pozitivni utjecaj na kognitvno usvajanje motoričke vještine za razliku od ostalih dviju metoda. U okviru ove tri metode sudionice su mogle jasno i ispravno razlučiti pojedine faze vježbe. Takav nalaz sukladan je prethodnim istraživanjima (Schmidt, 1975; Keele, 1976; Carroll & Bandura, 1982). Rezultati mjerenja unutar grupa pokazuju da je u svim skupinama došlo do napretka LCAE, što je u skladu sa znanstvenim spoznajama prezentiranima u ovom radu.