Journal of Physical Education and Sport ® (JPES), 14(2), Art 31, pp. 198 - 204, 2014
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Improvement of rally crews pace notes training

LIUDMYLA RYBAK[1]; EVHEN PRYSTUPA[2]; OLEH RYBAK[3]; BOGDAN VYNOGRADSKYI[4]
[1,2,3,4] Lviv State University of Physical Culture, Lviv, UKRAINE

Published online: June 25, 2014
(Accepted for publication May 15, 2014)

DOI:10.7752/jpes.2014.02031;

Abstract:
Objective of the research was to substantiate the ways of pace notes training of rally crews. Methods of research included modelling, educational observation of rally crews competitive activity and educational experiment. As a result training simulators for pace notes training have been improved and made adequate to actual conditions of their competitive activity; effectiveness of training stimulators application as well as positioning satellite technologies for pace notes training of rally crews have been substantiated and confirmed; means of pace notes training of rally crews at the stage of specialized basic training have been validated, which has enabled to elaborate appropriate methodological recommendations and confirm their efficacy in special educational experiment.
It is necessary to emphasize in conclusion that high stability and efficient variability of compiling and recording of pace notes at the stage of specialized basic training might be efficiently implemented during classes with a training stimulator that imitates visual, sound and surrounding inertial and gravity effects upon athletes.
Key Words: rally, crew, pace notes, training, stage

Introduction

Traditional approaches to rally drivers' pace notes training are described in the works of E Singurindi (1982), N. Potapova & E. Tsygankov (1999). Their investigations are based on repeated driving the car along the route before competitions at a convenient time, holding training races at the particular route, refusal from last year's and somebody else's reports, thorough individualization of reports etc. However these modes are no longer relevant for the moment, which is stipulated by the fact that International Automobile Federation (FIA) has introduced rigid restrictions on speed, time and number of familiarization rides along the rally route.

Recommendations of R. Tago-Zade (2006), K. Kozal (2014) at alias concerning compiling and registration of special stage (SS) pace notes often do not coincide and contain quite a lot of contradictions, since they have been made on the basis of their personal empirical experience. Moreover, requirements to the content and form of the pace notes include no definite scales for their quantitative evaluation. Besides, the effect of crews' pace notes quality upon the results of their competitive activities has got no scientific coverage so far.

Despite strong recommendations of several authors like M. Gorbachov (2008) to apply car trainer-simulators in special car pilots training the development or production of modern special devices and constructions is still insufficient. Application of the improved pace notes system for rally crews on the basis of current information technologies of positioning has not been investigated either. Therefore definition and substantiation of the ways of rally crews' pace notes at the stage of specialized basic training has become the objective of the research.

Tasks of the research:

1. To substantiate the opportunity of trainer-simulators and modern information technologies of positioning usage in the pace notes of rally crews.
2. To elaborate and examine experimentally methodological recommendations concerning the ways of improvement of rally crews' pace notes training at the stage of specialized basic training.

Method

Following methods of research have been used for solvation of the above set tasks: analysis, generalization and systematization of the best practices of different countries concerning pace notes application as well as rally crews' pace notes management; SS routes and artificial driving medium modelled for the purpose of testing and training of rally crews; educational observations of rally drivers competitive activity; pedagogical experiment with the involvement of rally crews; instrumental biomechanical methods; theory of relativity and mathematical statistic methods.

Corresponding Author: BOGDAN VYNOGRADSKYI, E-mail: bvynohrad@ukr.net

Trainer-simulator of the joint authorship invention for rally crews' pace notes training (Fig. 1) provides certain sliding chassis' tilting at the moment of steering wheel turn, brake pedal and acceleration, thus imitating inertia stresses upon athletes at the expense of the change of attractive force vector's direction.

Depending upon the driver's actions a video output of the car's behavior in the route is produced upon the screen of the monitor, while the loudspeakers transmit the audiostream, which imitates engine and transmission noise as well as the car's vibration.

Operating efficiency of the invented training simulator for rally crews' pace notes training at the stage of specialized basic training has been tested in the settings of special educational experiment with the involvement of 17 students and graduates, male sex, aging from 19 to 24, who specialized in "Automobile Sport" at the Lviv State University of Physical Culture and who were at the stage of specialized basic long-term training for rally pilots' sports skills development. The above mentioned experiment participants were distributed as members of 17 rally crews. The crews were made up in such a way that each of the experiment participants entered the lineup of two crews, performing the role of a pilot in one crew and acting as a navigator in the other one, and besides each time they have been cooperating in pairs with another experiment participant. Educational experiment was held in the settings of the university laboratory on the described trainer-simulator during three special training sessions held from 3 p.m. to 5 p.m. over a period of one week of the annual training cycle. The experiment consisted in covering one and the same SS route with mixed surfacing 3.75 km long for five times in a row by each of the 17 crews. Each crew had got a task to compile fresh pace notes every running and make new recordings with the utmost accuracy, marking the direction, complexity rating and configuration of all the route turns, distance between them as well as additional information on possible route breaks, possibility "to cut" the turns by driving on the roadside, car "ejection" on the ramps, etc.

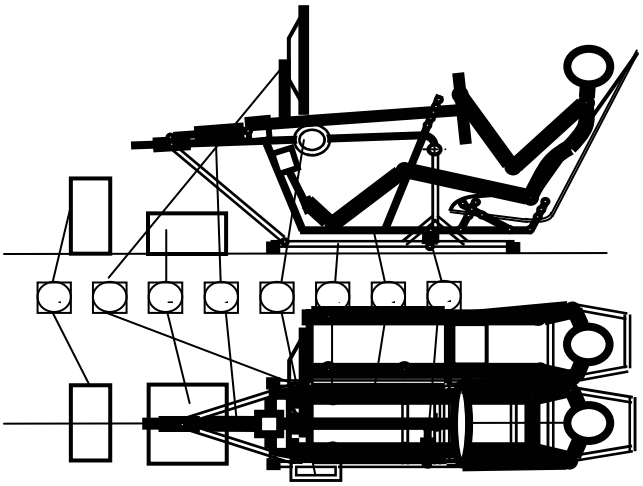

Fig. 1. Diagram of the trainer-simulator for pace notes training of rally crews: 1 – fixed section; 2 – sliding chassis; 3 – power pneumocylinder; 4 – steering console with vibrators; 5 – electronic module of the simulator's control; 6 – monitor display; 7 – compressor.

To substantiate experimentally the efficacy of the elaborated methodological recommendations concerning the ways of improvement rally crews' pace notes training at the stage of specialized basic training a formative educational experiment had been conducted that involved the participants of five-stages "Kubok Lymaniv – 10" ("Salt Lakes Cup - 10") national racing series, in which rather inexperienced and yet unqualified crews participated alongside with professionals (the stage of specialized basic training and transition to the stage of top class sport).

All the rally crews who participated in the educational experiment were divided into two groups. Forty six male and eight female drivers (all of the ladies acted as navigators) aging from 21 to 45 entered the lineups of the crews at the stage of their specialized basic training as an integral part of long-term sports development. The athletes who constituted the experimental group made use of the methods of training elaborated in accord with our recommendations concerning the ways of improvement of rally crews' pace notes training. It included three-hours theoretical training (June 2010), individual pace notes training on simulator for 27 – 30 hours i.e. 18 – 20 classes lasting for an hour and a half twice a week and training ground classes aimed at stabilization of pace notes compiling and recording including the control of satellite positioning technologies during 18-21 hours (6 – 7 three-hours classes on the "Marynivske Kiltse" training route Ivanivski region Odessa (Ukraine) district on free days). The experiment lasted for three months of the competitive period of the annual training cycle (from June, 21 till September, 17 2010).

Athletes of the control group were training according to traditional methodology of "drilling" by means of pace notes samples compiled by their coaches and attending master classes of the leading Ukrainian crews.

Results

Adhering to the priority of technical and tactical stability concept of rally crews training we made the analysis of the pace notes recorded on the training simulator by each of the 17 rally crews who took part in the experiment during 4 initial SS course driving and compared them to the final fifth drive pace notes, nominated for convenience as an exemplary. Quantitative differences between each set of pace notes with an exemplary one as for the turns' characteristics, distance between the turns as well as certain supplementary information (average pace notes of all the crews) are presented in table 1:

Table 1. Quantitative differences of pace notes compiled by each of the 17 rally crews during four drives as compared to the exemplary one compiled during the 5th drive (number of differences)

Drive's No	Number of differences between the exemplary pace notes and those of the previous ones (average data for all the crews)			
	Turns' characteristics	Distance between turns	Additional information	General quantity
First	10.3 ± 2.4	6.0 ± 2.1	5.1 ± 2.2	21.4 ± 6.7
Second	7.8 ± 2.1	4.4 ± 2.3	3.8 ± 1.6	16.0 ± 6.0
Third	4.2 ± 1.6	2.9 ± 1.3	2.2 ± 1.0	9.3 ± 3.9
Fourth	3.6 ± 1.2	2.1 ± 1.1	1.1 ± 0.7	6.8 ± 3.0
Average meaning	6.48 ± 1.83	3.85 ± 1.70	3.05 ± 1.38	13.38 ± 4.91

Traditional methodology of rally crews' pace notes inspection (E. Singurindi [1]) assumes coach's drive along the rally route guided by the composed pace notes. But new competitions rules exclude such training drive. According to the route videotaping made from inside of a car the turns do not look as complicated as they actually are, their connection as well as distance between them is interpreted in a wrong way, certain route peculiarities might be hidden, etc. Ozi Explorer and Google Earth methodology elaborated on the basis of modern computer positioning technologies seems much more objective in terms of further analysis and assessment of the pace notes compiled by rally crews. Google Earth helps to identify and record satellite pictures of the particular SS as well as its separate successive segments. After loading the pictures into the Ozi Explorer the previously received route trek of the special segment is drawn on them.

According the presented materials it is possible not only to assess objectively whether the pace notes made during familiarization route correspond to the actual SS route configuration but also introduce all necessary changes. For the purpose of obtaining experimental evidence of the abovementioned checking technique efficacy as well as seeking for the ways of pace notes improvement, the satellite pattern of «Wola Wieruszycka» SS route received during «45 Rajd Żubròw» rally race was compared to its initial pace notes recorded by O.R. – Y.R. rally crew during their familiarization rally route drive. Repetitive driving of this particular SS was first accomplished according to the initial pace notes and afterwards – in accord with those adjusted in compliance with the pace notes' graphic satellite pattern. The latter enabled the crew to improve the result of the second drive dramatically as compared to relatively stable results of the other rally SS repetitive drivings (table 2):

Table 2. Results of the O.R. – Y.R. crew passage of the SS routes during "45 Rajd Żubròw" International Rally (minutes, seconds)

SS No	SS place names	Length, km	1st pas.	2nd pas.	Difference
1, 5	Tarnawa (Poland)	01.60	01:28	01:29	+ 00:01
2, 6	Rozstajnie (Poland)	01.05	00:55	00:54	– 00:01
3, 7	Wola Wieruszycka (Poland)	01.70	01;49	01:45	– 00:04
4, 8	Kobylec (Poland)	01.55	01:17	01:18	+ 00:01

In order to experimentally verify the efficacy of the offered recommendations concerning the ways of rally crews pace notes training perfection we conducted the abovementioned forming educational experiment in the settings of the national racing series in "Kubok Lymaniv – 2010" mini-rally. After the educational experiment completion it was found out that the average ratings of the experimental crew pace notes (both composite estimate and the assessment of the pace notes' content and ways of recording) turned to be considerably higher as compared to the similar assessments of the pace notes made by control group crews, all the revealed differences was statistically reliable (Fig. 2):

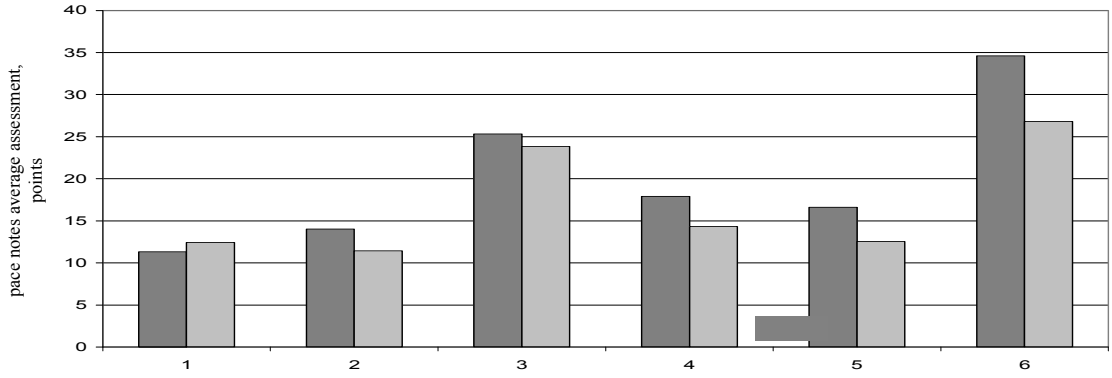

Fig. 2. Assessment of the experimental crew ( ) and control group ( ) pace notes before (1, 2 and 3) and after (4, 5 and 6) educational experiment: 1, 4 – the pace notes content evaluation; 2, 5 – assessment of the pace notes way of notation; 3, 6 – composite estimate

Both groups of crews pace notes assessment structure are presented in Fig. 3:

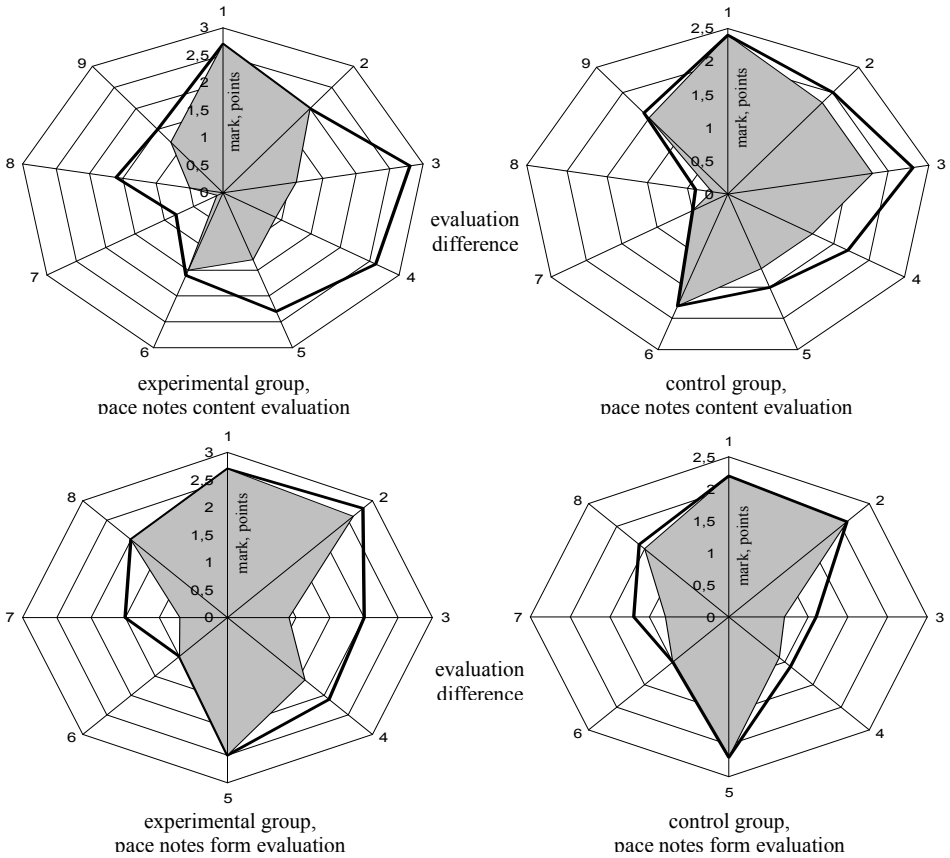

Fig. 3. Content and notation average assessment structure of the pace notes taken by experiment participants (– evaluations before the experiment; – evaluations after the experiment). Pace notes content: 1 – coding procedure of the turns complexity category; 2 – characteristics of long and difficult turns and their bundles; 3 – indication of the road longitudinal breaks, which make the route invisible; 4 - description of the road longitudinal profile (up and down); 5 – indication of the places of imminent car jumps and "ejections"; 6 – means of turns unification into groups and series; 7 – apply the brakes command (when, where and how); 8 – commands to cut (to cut a little underneath, to cut deeply) or not to cut the turns through roadside; 9 – use of specific word combination and terms. Pace notes formalities: 1 – notebook choice (format, stitching); 2 – number of line on a page; 3 – availability of side margins on a page; 4 – completion of each page to be turned with a considerable straight segment; 5 – left and right turns coding procedure; 6 – correlation between numbers height, which denote distances and complexity category of the turn; 7 – ways of significant issues singling out in the pace notes; 8 – separation of the information pieces.

Athletic results achieved by the experimental and control groups at certain stages and according to the "Kubok" totals are displayed on Fig. 4:

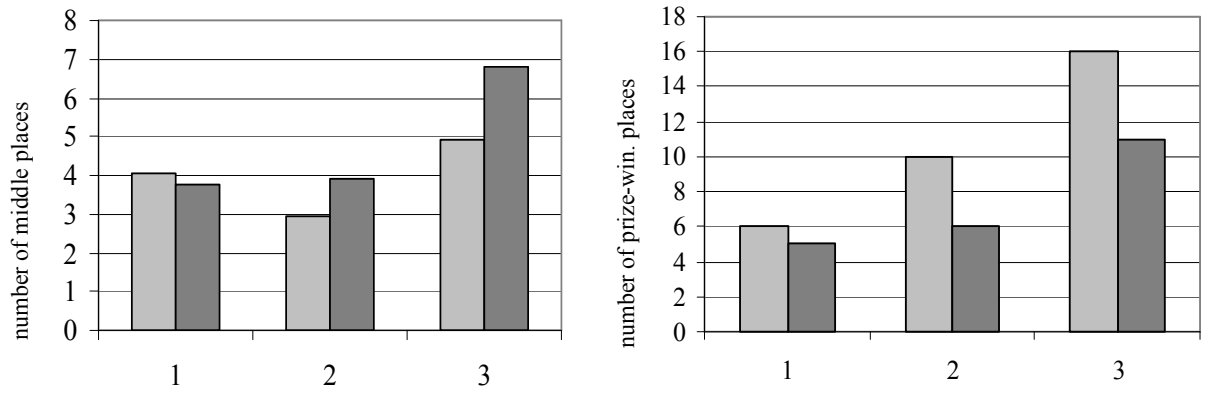

Fig. 4. Effectiveness of the crews of experiment ( ) and control ( ) groups at their racing-sports car class: 1 – before educational experiment; 2 – after educational experiment; 3 – in the "Kubok" totals.

Time results coefficients of variation demonstrated by the crews of experimental and control groups during successive drivings of the rally route during the same "Kubok" stages, which speaks of their stability, are displayed in Fig. 5:

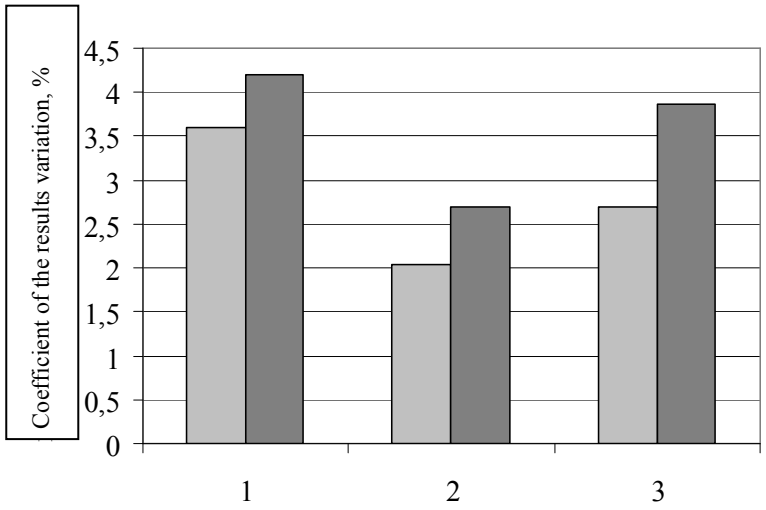

Fig. 5. Time results stability of the crews experimental ( ) and control ( ) groups relative to the leader's time results: 1 – before educational experiment; 2 – after educational experiment; 3 – in the "Kubok" totals

Discussion

According to the results of the educational experiment, which lied in the repeated speed pace notes registration of a definite SS route by 17 rally crews with the help of trainer-simulator of the joint authorship invention: general number of the discrepancies in pace notes registered during each following driving decreases as compared to the final fifth driving, which testifies to their stability increase. This fact corroborates V. Platonov's concept (2004) of stability increase and rational variability of specialized techniques in the process of their numerous objectively controlled repetitions, which significantly contributes to the major issue solution of technical skills perfection of athletes at the stage of their specialized basic training. Thereby application of the offered by M. Gorbachov (2008) safe trainer-simulators for rally crews pace notes training enables to bring the recommended by the authors (E. Singurindi, 1982) academic hours scope to 20 percent from the total number of hours, thus recompensing expensive and safe demanding route and testing ground pace notes training at various stages of long-term athletes' sport perfection.

Practical implementation of the offered analysis and assessment methodology of pace notes recording based upon Ozi Explorer and Google Earth modern computer technologies of positioning enables to evaluate objectively the quality of SS pace notes taking and recording. Moreover the offered methodology makes it possible to amend necessary corrections to pace notes. As opposed to traditional methodology of rally crews' pace notes efficiency inspection described by E. Singuridi (1982), which implies coach's rally route drive according to the pace notes under assessment, our methodology exclude preliminary familiarization with the

rally route. Specialized educational experiment confirmed the efficiency of the suggested methodology: corrections amended to the "Wola Wieruszycka" SS route pace notes during "45 Rajd Żubrów" rally according to their satellite pattern enabled the O.R. – Y.R. crew to improve considerably the results of their second driving, which was accomplished in compliance with the 'updated' pace notes.

Formative educational experiment, conducted for the purpose of experimental verification of the methodological recommendations efficacy as for rally crews' pace notes training improvement in the frames of "Rubok Lymaniv" 2010 national racing series in mini-rally, validated that the pace notes quality of the experimental group, which applied experimental technologies for pace notes recordings turned to be statistically significantly higher in comparison with the pace notes of the control group rally crews that were training according traditional modes described by E. Singurindi (1982), N. Potapova & E. Tsygankov (1999) and R. Tago-Zade (2006).

Increment of the pace notes total grades' for both crew groups in the course of the educational experiment should be attributed mainly to higher grades for the notes' content, which testifies to the athletes' conscious comprehension of new knowledge and independent critical approach to pace notes recording system used by them before the educational estimation structure experiment.

Estimation structure of the content and ways of pace notes recording for both crew groups is similar (especially the ways of pace notes recording evaluation). Nevertheless the ways of pace notes recording before and after the educational experiment might be improved considerably.

As concerns athletic results shown by the crews of the experiment and control groups at separate stages and "Kubok" totals (fig. 4) it should be pointed out that crews' medium places for both groups in their rally car classes during first two stages (before the educational experiment) practically did not vary from each other. But at the same time their medium places during the last three stages differed significantly to the detriment of the control group crews. The widest discrepancy could be observed during the fifth stage mainly, that is after the experiment finished (2.8 to 5.8 correspondingly).

Number of prize-winning places and points scored by the crews of both groups during first two stages (before the educational experiment began) also did not differ significantly. By the end of the experiment though the crews of the experimental group got 10 prize-winning places and scored 21 point against 6 prize-winning places and 11 points scored by the crews of the experimental group.

Comparison of time results stability (fig. 5) displayed by the crews of the experimental and control groups during their successive rally route drivings within the same "Kubok" stages showed that the variation coefficient average meanings for the crews of both groups during the first stage virtually remained similar. By the end of the final stage the results variability decreased significantly for all the crews, but at the same time the variation coefficient average meanings for the crews of the experimental group during the last three stages went down to 2.04 percent, whereas for the crews of the control group – only to 2.70 percent. But by the end of the pedagogical experiment, during the "Kubok" finals, variability coefficient for the experimental group amounted to 0.98 percent compared to 3.34 percent for the control group.

Conclusions

High level of stability and rational variability of pace notes recording at the stage of specialized basic training could be effectively achieved during training sessions with the help of trainer simulator that imitates visual, sound and inertial gravitation impact of the external environment upon athletes. The experiment results indicate that during repetitive drivings of one and the same SS the total number of discrepancies between the pace notes made during each subsequent driving goes down, thus indicating the growth of their stability rates. The trainer simulater could be also used for modelling all possible rally cars, routes and other environmental phenomena, thus safely training skills for recording various pace notes versions in extreme and emergency settings.

To give an objective analysis and evaluation of pace notes made by rally crews it is advisable to apply SS rally route graphic patterns received by means of satellite navigation technologies. The "treks" (recapitulations of successive coordinates of the route) superimposed upon satellite photos corresponding country fragments enable not only to correlate the compiled pace notes with actual configuration of the route but also permit to amend all necessary corrections.

The newly offered pace notes training methodology applied by the experimental rally crews group permitted to significantly improve average marks of their pace notes as compared to the marks for pace notes compiled by the control group, which had been trained in compliance with traditional methodological modes. Middle positions occupied by experimental group representatives at the last three legs of the race significantly differ to the benefit of the crews from the experimental group, the greatest difference having been noticed at the fifth stage after the end of the experiment (2.8 against 5.8 accordingly). By the end of the experiment the experimental group crews got 10 prize-winning places with 21 point whereas the control group crews won 6 prize places scoring 11 points. Comparative stability of time results displayed by the crews experimental and control groups during successive rally route drivings of same "Kubok" stages testifies that the results variability has decreased significantly for all the crews. At the same time the average variation coefficients rates for the

experimental group crews during the last three stages reduced to 2.04 percent, whereas for the control group it diminished to 2.7 percent. Moreover, by the end of the educational experiment at the "Kubok" finals the variation coefficient of the experimental group made 0.98 percent against 3.34 of the control group.

References

Singurindi, E. (1982). *Automobile sport* [in Russian]. DOSAAF, Moscow.

Potapova, N. A., Tsygankov E. S. (1999). Application of various symbolic information in rally drivers pace notes taking. *Materials of RGAFK Young Scientists and Students Conference*. [in Russian] Moscow, 74-77.

Tsagi-Zade R. (2006). Pace Notes as Means of Communication between a Pilot and a Navigator: third version of the article on methods of rally pace notes taking. [in Russian]. URL:. http://www.freedrive.ru /index.php?sec

Kozal, K. (2014). Secret letter of rally pilots [in Polish] URL: [Electronic resource]. – Access mode: http:// moto.onet.pl/ aktualnosci/tajne-pismo-pilotow-rajdowych/d70vj.

Gorbachov, M. G. (2008). Writing an article "Chinese Letter" [in Russian] URL: http://www.drive-class.ru/arhiv/ drive.php?id=282006-03-24.

Platonov, V. (2004). *System of athletes training in the Olympic sports: manual of a top quality coach*. [in Russian]. Olympic books, Kyiv.