PREDICTING STUDENTS PERFORMANCE IN GIANT SLALOM

Edin Mujanović,[1, A, B, C, D] Almir Atiković,[1, B, C]
Amra Nožinović Mujanović,[1, A, D] Nermin Nurković[2, A]

[1] University of Tuzla, Faculty of Physical education and Sport, Bosnia and Herzegovina
[2] University of Sarajevo, Faculty of Sport and Physical education, Bosnia and Herzegovina
[A] Study Design; [B] Data Collection; [C] Statistical Analysis; [D] Manuscript Preparation; [E] Funds Collection

Address for correspondence:
Edin Mujanović
University of Tuzla, Faculty of physical education and sport
2. Oktobra br. 1, 75000 Tuzla, Bosnia and Herzegovina
Phone/fax.: ++ 387 35 278 536
E-mail: edin.mujanovic@untz.ba

Abstract. The aim of this research is to determine the impact of specific motor knowledge of alpine skiing on success in giant slalom race of students. On a sample of 18 students of the Faculty of Physical Education and Sport there has been used set of four variables of specific motor knowledge of alpine skiing, as predictor variables, to determine the impact on the criterion variable modified giant slalom race. It was found that the variables dynamic long radius turns and skiing with the changes of rhythm and tempo together have a greatest predictor validity, at statistically significant level of $p = 0.01$, and that they are critical for success in modified giant slalom race of students. It can be concluded that the impact on the result in the modified giant slalom race for students have the level of mastering of advanced elements of ski technique, which at this level of knowledge is crucial in giant slalom competition. The results of this study may be of importance in creating programs for different levels of mastering of skiing techniques in both advanced ski school and some stages of competitive skiing, which is of great importance for the result in giant slalom and skiing in general.

Key words: specific motor knowledge of alpine skiing, race, regression analysis, impact

Introduction

Alpine skiing belongs to the motor activities which take place in specific and complex conditions of the external environment. Conditions at every race-course are specific and unique not only because of the race-course configuration but also because of the possibility of different ways of setting up the ski gates (Krističević et al. 2010). Also during motion on skis there is constant danger of losing balance which is determined by the minimum friction between the ski base and the snow surface. If the skier has mastered the technique of alpine skiing to high-level, it will be easier to go down the slope due to requirements to continuously adapt to conditions in regard to the speed and direction of movement down the default race course.

Success in the Alpine disciplines depends primarily on the level of the adopted ski specific motor knowledge (Franjko et al. 2006), which requires exceptional skiers agility, coordination, strength and endurance because in competitive skiing today the winner is determined only by hundredths of a second (Cigrovski and Matković 2003). Differences in performance that ski racers achieved are usually small due to approximately equal levels of mastering of skiing techniques and anthropological characteristics of skiers. Ski element – dynamic long radius turns – are characterized by dynamics, coordination, rhythm and faster movements of the body side to side with a maximum speed control and full safety in skiing. At higher level of skiing knowledge, examinees performed dynamic long radius turns with various radii, turn shapes and turn velocities. This implies that there is no exact order of overcoming the slope which results in the creation of variable accelerations and different moments of inertia which requires of a skier exceptionally high quality of perception and creating movement pattern. Ski element – skiing with the changes of rhythm and tempo – is characterized by the execution of turns of a long and short radius with various radii depending on the sense of a skier. Accordingly, skiing with the changes of rhythm and tempo is characterized by dynamics, coordination, rhythm and faster movements of the body along the longitudinal axis and side to side with a maximum speed control and full safety in skiing. At higher level of skiing knowledge, examinees performed skiing with the changes of rhythm and tempo with greater rhythm, control of the speed and direction of movement, a necessary position control of skier on skis and the corresponding control of pressure on the skis. All these factors point to the fact that the skiing with the changes of rhythm and tempo is a complex and specific motor task as the giant slalom performance.

A technique of skiing is undoubtedly an important factor for rational performance of movement that can be easily determined by careful observation of skiers by the examiner. Exact knowledge of movement execution and highly differentiated tactile and kinesthetic sensations and anticipation of external circumstances are the factors that enable a skier to apply the optimal technique in unpredictable conditions. Absence of knowledge of certain movements which are necessary in order to perform the motor-program resulted in irrational and non-effective performance (Schmidt and Wrisberg 2000). Motor-program is formed in the central nervous system and contains stored muscle efferent commands with all details necessary that are needed to make a movement (Horga 1993). There are different theories (Adams 1971; Schmidt 1976) of what is necessary in the formation of motor programs.

The process of testing and evaluating the motor knowledge is necessary to start earlier, at the stage of adoption of motor knowledge. The purpose of evaluation and measurement is collecting feedback on learning with the aim of progress in the performance of certain motor tasks. According to Eliot and Connolly (1974), motor learning or the formation of motor skills is the ability to achieve defined objectives with efficiency above those possessed by people with no experience, where the motor skill or knowledge is ability of smooth and harmonious execution of some motor task.

According to Kuna et al. (2009), was obtained different impact of motor abilities and motor knowledge on the result in giant slalom race in two groups of ski-demonstrators, divided on the basis of having different levels of motor knowledge of skiing.

In accordance with the stated, aim of this research is to determine the impact of specific motor knowledge of alpine skiing on success in giant slalom race at students who are studying to become physical education (PE) teachers as well as ski-instructors or coaches.

Material and methods

Participants

The participants in this research were 18 male students from the Faculty of Physical Education and Sport, aged 22 ±6 months, who attended the classes in the alpine skiing. The teaching process of the subject alpine skiing that takes place in the winter semester of the third and fourth year of university studies contains exercises in the form of a field course for 30 hours during the semester and lectures for 45 hours during the semester. All examinees underwent 2 courses of skiing on adequate ski resort. The first course of elements of basic ski technique lasted 7 days. The second course of elements of advanced ski technique took place a year after the first course, and also lasted 7 days, after which the examinees take the test. Ski lessons, for 7 days, were executed by 3 teachers following the identical program. None of the examinees had prior experience with skiing and giant slalom competition. All students from the sample were without expressed morphological, motor and psychological aberration and they were able to regularly attend lectures and courses in the third and fourth year of the university study. The Ethical Committee of Tuzla University approved the study and the procedures conformed to the principles of human experimentation outlined in the Declaration of Helsinki. All participants were informed of the procedures and potential risks, and gave their written consent to participate in testing.

Variables

In determining the level of specific motor knowledge of alpine skiing, as predictor variables, the examinees were evaluated in four ski elements as follows: BAPT – basic parallel turns, DSRT – dynamic short radius turns, DLRT – dynamic long radius turns and SCRT – skiing with the changes of rhythm and tempo as the elements of advanced ski school according to the curricula of skiing and based on an expert model of advanced ski school (Kuna 2012).

The results achieved by the students in giant slalom competition represent the criterion variable MGSR – modified giant slalom race.

Instrument

Description of movements during performance of specific motor knowledge of alpine skiing and common mistakes are explained by a large number of researchers (Jurković and Jurković 2005; Lešnik and Žvan 2007; Kuna 2012; Mujanović et al. 2012). The analytical method of assessment is used as most appropriate for testing and evaluating at the end of the entire athletics program when students have already mastered the test exercise and their knowledge has already been tested (Majerič et al. 2005), which is also the case in this study.

All testing was conducted on the same slope marked by safety fence, with start at an altitude of 490 m and the finish line at an altitude of 325 m, on an incline between 20° and 21°. The giant slalom course was with a gate set-up of 13 gates, with distance between the gates of 15 m as a constant value and a horizontal offset of 7 m between first and second, fifth and sixth, and eighth and ninth gate, and 8 m between the remaining gates.

Assessment criteria with measurement scale and description of standards that are based on the quality of execution of specific motor knowledge of alpine skiing are presented in Table 1.

Table 1. Assessment criteria

Measurement scale (marks)	Description of standards
5	Student performs skiing element, with self confidence, without technical and aesthetic mistakes
4	Student performs skiing element with lack of self confidence and with discontinuous pushing of lower extremity joints onward and in the direction of new turn
3	Student performs skiing element, with lack of self confidence, and with inappropriate load of skies at the beginning of the turn, and discontinued pushing of lower extremity joints onward, and in the direction of new turn
2	Student performs skiing element without self confidence, with no moves along the longitudinal axis, with inappropriate load on skies at the beginning of the turn and without pushing of lower extremity joints onward and in the direction of new turn
1	Student performs skiing element and makes all listed technical mistakes
0	Student is unable to perform skiing element. He moves down the slope but does not keep the skies in parallel; has uneven connection of turns; tempo of performance is too slow without appropriate closure of the turn

Procedure

Testing of specific motor knowledge of alpine skiing was conducted in the morning hours from 10 am to 12 noon. After warming up, the test task was explained and demonstrated to the examinees; following that students performed the task two times under the same conditions and the better one was used in the analysis. Task performance was evaluated with the unique protocol by three examiners who are familiar with the way of the assessment. Examiners in this study are university professors with years of experience in working in various sports clubs and Faculty of Physical Education and Sport. Before the assessment, they had carefully read the description of the task and the criteria. Afterwards, they independently assessed both performances, from different positions, and considering possible mistakes, examiners evaluated the performances. After the evaluation of the best performance, we calculated the final mark for each examinee in each task as the arithmetic average of the marks assigned by the three examiners. For evaluation, they used marks from 1 to 5 according to the description of task and criterion, where the mark 1 is the lowest. Objectivity of evaluation is higher as higher is the level of agreement between the appraisals that are assigned to examinees (Mejovšek 2003; Dizdar 2006; Krističević et al. 2010). Other authors (Kovač 2012) conclude that with appropriate criteria, sufficiently precise for the evaluator, every PE teacher could objectively and reliably evaluate different motor skills, and assumption is that the examiners in this study with respect to theoretical and practical knowledge having high level of objectivity and reliability.

The data for giant slalom competition was collected the day after evaluation of specific motor knowledge of alpine skiing in the morning hours from 10 am to 12 noon. Modified giant slalom race was performed once and for evaluation we used results in 1/100 s, which the examinees achieved in modified giant slalom race. Time is measured by TAG Heuer wireless race timing system equipped with start gate, photocell and chronoprinter timer with timing calculation (speed) to the 1/100,000 of a second.

Data analysis

The data of specific motor knowledge of alpine skiing was collected during the evaluation. Analysis of the data was processed using a software system for data. Descriptive statistics (M – arithmetic mean, SD – standard deviation, Min – minimum value and Max – maximum value) were calculated for each variable. Data sets were checked for normality using KS – Kolmogorov-Smirnov test. Significance (p) for all statistical tests was set at $p \leq 0.01$. Spearman's rank correlation coefficient as a nonparametric measure of statistical dependence between two variables was used to determine values of correlation coefficients between specific motor knowledge of alpine skiing and results in giant slalom race.

Using factor analysis principal components (Hotelling's method) it was determined whether all examiners evaluated the same object of measurement. The Guttman-Kaiser criterion was used to determine the significance of the principal components (the characteristic root λ-Lambda of ≥1.00 was considered). Obtained principal components with $\lambda \geq 1.00$ was considered as the latent space of specific motor knowledge of alpine skiing for regression analysis.

Regression analysis stepwise method was applied to analyze the impact of specific motor knowledge of alpine skiing on result in giant slalom race. Stepwise regression is designed to find the most significant set of predictors that are most effective in predicting the dependent variable, based upon statistical criteria. Variables are added to the regression equation one at a time, using the statistical criterion of maximizing the coefficient of multiple determination (R^2) of the included variables. After each variable is entered, each of the included variables are tested to see if the model would be better off it were excluded. The process of adding more variables stops when all of the available variables have been included or when it is not possible to make a statistically significant improvement in R^2 using any of the variables not yet included. In this way, the predictive value of predictor variables' is established, considering their optimal number.

Results

Reviewing the results of the descriptive statistics (Table 2) it is noted that the M of majority of evaluated ski elements, shows marks in the zone of medium values 2.26–3.19, with a SD from 0.64 to 0.85. For MGSR – modified giant slalom race M is 32.31, with a SD 4.31. According to the KS test results (below 1.00), we can see that there are no statistically significant differences (p) between the obtained distribution of results from a normal distribution of results.

Table 2. Descriptive statistics of all variables

Valid N 18	M	SD	Min	Max	KS	p
BAPT	2.59	0.64	1.33	3.67	0.98	0.29
DSRT	2.26	0.80	1.00	3.67	0.91	0.38
DLRT	3.19	0.85	1.67	4.67	0.58	0.89
SCRT	2.69	0.77	1.67	3.67	0.80	0.54
MGSR	32.31	4.31	27.26	39.90	0.96	0.32

Test distribution is significant at the p = 0 .01 level.

Considering that in this study object of measurement was the level of acquired specific motor knowledge of alpine skiing of examinees, factor analysis principal components was conducted to determine whether all examiners evaluated the same object of measurement. Factor analysis was applied for the ratings assigned by the three examiners, separately for each of the four manifest variables of specific motor knowledge of alpine skiing.

Results of factor analysis principal components presented in Table 3 show the values of the first principal components that meet the criteria $\lambda \geq 1.00$, where obtained results are $\lambda = 2.57$ for ski element basic parallel turns, λ = 2.40 for ski element dynamic short radius turns, λ = 2.64 for ski element dynamic long radius turns and λ = 2.66 for ski element skiing with the changes of rhythm and tempo. Also, in all four variables of specific motor knowledge of alpine skiing there were identified high percentages of variance and it is possible to argue that the first principal component is largely involved in the variance of all results. The values of total explained variance of the first principal component for ski element basic parallel turns is 85.67%, for ski element dynamic short radius turns is 79.89%, for ski element dynamic long radius turns is 87.90% and for ski element skiing with the changes of rhythm and tempo is 88.57%. As all tests for evaluation of specific motor knowledge of alpine skiing have good characteristics of sensitivity and objectivity, they allow use of the results for further analysis.

Table 3. The projections of the vector of manifest variables of all tests with extracted principal components*, eigenvalues (λ) and percentage of explained variance for extracted components (cumulative %)

Examiners	BAPT[a]	DSRT[a]	DLRT[a]	SCRT[a]
1	0.97	0.88	0.92	0.93
2	0.92	0.91	0.96	0.92
3	0.89	0.89	0.94	0.97
λ	2.57	2.40	2.64	2.66
Cumulative %	85.67	79.89	87.90	88.57

Extraction Method: Principal Component Analysis.
[a] Significant principal component extracted for each test.

The isolated factors for each of the four manifest variables of specific motor knowledge of alpine skiing will be used in further analysis of data as the latent space of specific motor knowledge of alpine skiing.

In a further analysis of data, Spearman's rank correlation coefficients were calculated between latent space of specific motor knowledge of alpine skiing (obtained by factor analysis principal components where λ ≥ 1.00) and the results of the criterion variable, modified giant slalom race (Table 4). All obtained correlation coefficients are of high values, from r = –0.67 to r = –0.93 at the statistically significant level of p = 0.01, and they are logically negatively correlated because numerically lower score is a better result in criterion variable.

Table 4. Spearman's rank correlation coefficients between latent space of specific motor knowledge of alpine skiing variables and criterion variable

Valid N 18	MGSR
BAPT[a]	–0.87**
DSRT[a]	–0.70**
DLRT[a]	–0.67**
SCRT[a]	–0.93**

** Correlation is significant at the p=.01 level.

Generally, cross correlation matrix represent a basis for regression analysis. Regression analysis stepwise method was performed for the criterion variable modified giant slalom race-MGSR against the four predictor variables, latent space of specific motor knowledge of alpine skiing, obtained by factor analysis principal components where λ ≥ 1.00. The result of the regression analysis stepwise method for the criterion variable, MGSR is shown in

Table 5. Two models composed of one (Model 1) and two (Model 2) predictor variables were found to be significant. The variable skiing with the changes of rhythm and tempo-SCRT[a] is negatively correlated and best fit the prediction of modified giant slalom race-MGSR, as shown in Model 1. The variable dynamic long radius turns-DLRT[a] also negatively correlated, contributed significant variance in Model 2. Multiple correlation of latent space of specific motor knowledge of alpine skiing for these two predictors together with the criterion variable was high (R = 0.91), at statistically significant level of p = 0.00. Additionally, the value of multiple determination (R^2 = 0.82) indicates that 82% of the total variance can participate in prediction of success in modified giant slalom race-MGSR.

Table 5. Regression analysis stepwise method for criterion variable MGSR

Model	Predictor variable	B	Standard error	β	t	p	R	R^2	$p^{a, b}$
1	(constant)	32.31	0.56		57.34	0.00	0.84[a]	0.71	0.00[a]
	SCRT[a]	−3.63	0.58	−0.84	−6.27	0.00			
2	(constant)	32.31	0.46		71.00	0.00	0.91[b]	0.82	0.00[b]
	SCRT[a]	−2.25	0.65	−0.52	−3.46	0.00			
	DLRT[a]	−2.00	0.65	−0.47	−3.09	0.01			

[a] Predictors in the Model: (constant), SCRT[a].
[b] Predictors in the Model: (constant), SCRT[a], DLRT[a].
[c] Dependent Variable: MGSR.

When we look at the coefficients of the partial effects of latent space of specific motor knowledge of alpine skiing (Table 5), it can be said that these two variables, dynamic long radius turns and skiing with the changes of rhythm and tempo have a statistically significant impact on the criterion variable at the level of p ≤ 0.01. As can be seen from the Table 6 the other variables are excluded.

Table 6. Regression analysis stepwise method Excluded Variables[c]

Model		β In	t	p	Partial correlation	Collinearity statistics (tolerance)
1	BAPT[a]	−0.35[a]	−1.89	0.08	−0.44	0.46
	DSRT[a]	−0.20[a]	−0.99	0.34	−0.25	0.45
	DLRT[a]	−0.47[a]	−3.09	0.01	−0.62	0.52
2	BAPT[a]	−0.13[b]	−0.66	0.52	−0.18	0.34
	DSRT[a]	−0.05[b]	−0.29	0.78	−0.08	0.41

[a] Predictors in the Model: (constant), SCRT[a].
[b] Predictors in the Model: (constant), SCRT[a], DLRT[a].
[c] Dependent Variable: MGSR.

Discussion

According to the results of factor analysis principal components we can say that all four first principal components in total test sample behave as a component of specific motor knowledge of alpine skiing. Given that the first principal components are statistically significant leads to the conclusion that the examiners in all four elements of specific motor knowledge of alpine skiing appraised the same object of measurements and it is possible to take the assessment of examiners as the criteria for assessing specific motor knowledge of alpine skiing at examinees of this study. Also, it can be said that satisfying homogeneity of examiners in all four variables is achieved. On the other hand, we can say that sample homogeneity regarding the specific motor knowledge of alpine skiing is the evidence of appropriately implemented teaching process, since good knowledge of alpine skiing was observed. In similar studies, Franjko et al. (2006) also came to similar results where a remarkably high homogeneity of examiners through the parameters of objectivity is visible, while Cigrovski et al. (2012) argue that it is possible to assume that obtained factor represents skiing knowledge because it best explains the complete variance of elements of skiing technique.

The data of the Spearman's rank correlation of variables of latent space of specific motor knowledge of alpine skiing and the results of the criterion variable modified giant slalom race point to statistically significant ($p = 0.01$) correlations of all used variables. An explanation of these results can be found in the fact that the movement structures during the execution of elements of skiing and giant slalom skiing are very similar. Similar research results of correlation between specific motor knowledge of alpine skiing and criterion variable giant slalom performance of Croatian national skiing demonstrators (demo instructors), confirmed by Franjko et al. (2006), where the highest values of correlation coefficients achieved in variables dynamic long radius turns r: –0.32 and mogul skiing r: –0.45, at statistically significant level of $p < 0.05$. Also, they say that precisely these elements divide population of demo instructors to average and above average.

Based on the presented values of the parameters of the regression analysis stepwise method, the size of multiple correlation and number of valid partial regression coefficients, it can be concluded that the realization of the criterion variable modified giant slalom race depends primarily on two variables, dynamic long radius turns and skiing with the changes of rhythm and tempo. As we can see from Table 5, two models composed, Model 1 and Model 2, showing that the variables dynamic long radius turns and skiing with the changes of rhythm and tempo together have greatest predictor validity at statistically significant level ($p < 0.01$) and that they are critical for success in modified giant slalom race in students. This means that the best time scores for students' performance in modified giant slalom race had students with higher level of mastering of specific motor knowledge of alpine skiing. Given that they must overcome giant slalom course quickly and accurately with constantly present rhythm of skiing with different turning radius and turn shapes, it can be said that the examinees have the necessary level of overall specific motor knowledge of alpine skiing that are crucial in the modified giant slalom race. According to Franjko et al. (2006), significant correlation of realization of the giant slalom performance and dynamic long radius turns at demo instructors allow us to look for a movement pattern of giant slalom, because dynamic long radius turns shape the movement pattern of giant slalom. Moreover, activation of the inner ski, which is performed during the execution of advanced elements of ski technique, we can prevent or reduce the skidding of skis. Ultimately, evenly load of skis provides better, smoother and more constant contact of skis with the snow and minimizes skidding of skis and a skier is faster. Results clearly indicate the need to increase the level of mastering of specific motor knowledge of alpine skiing in order to ski faster and more successfully in competitive giant slalom. According to Kuna et al. (2010), for success in competitive giant slalom, crucial is the high level of overall specific motor knowledge of alpine skiing. Franjko et al. (2006) state that a crucial impact on the result in giant slalom performance at demo instructors has the art of mogul skiing because this element only divides this population into two groups. In their research authors Mujanović and Krsmanović (2008) state that students with higher levels of motor abilities, such as balance, agility, flexibility and repetitive strength, have more success in mastering dynamic short radius turns. Therefore, it is obvious that there are different mechanisms based on which demo instructors and students operate. We can say that the students at this level of skiing, unlike demo instructors, have specific motor knowledge of alpine skiing performed with some deviations from the ideal movement pattern in the phase where motor knowledge is strengthened.

Based on the above, we can assume that the examinees in this study were at a higher level of basic motor abilities and thus at a higher level of specific motor knowledge of alpine skiing that have a crucial impact on the result in the modified giant slalom race. Also, if we know that the elements – dynamic long radius turns and skiing with the changes of rhythm and tempo – are elements of advanced ski technique according to the curriculum of skiing and based on an expert model of advanced ski school (Kuna 2012), it can be said that the students have mastered the technique of skiing at the advanced level.

Conclusion

On the basis of our results, it can be concluded that the impact on the result in the modified giant slalom race for students have a specific motor knowledge of alpine skiing, in fact the level of mastering of advanced elements of ski technique according to the curriculum of skiing and based on an expert model of advanced ski school, which at this level of knowledge is crucial in giant slalom competition.

Physical education teachers, ski instructors and coaches can use this information in order to create different programs for different levels of mastering of skiing techniques in both advanced ski school and some stages of competitive skiing, which is of great importance for the result in giant slalom and skiing in general. The results are also critical for the students in their realization and understanding of crucial factors for better skiing in general.

References

Adams J.A. A closed – loop theory of motor learning. J motor behav. 1971; 3: 111–150.

Cigrovski V., Matković B. Specific fitness preparation of skiers. (In Croatian) In: Proceedings Conditioning of athletes. Eds. D. Milanović, I. Jukić. Faculty of Kinesiology, University of Zagreb. Zagreb 2003: 518–520.

Cigrovski V., Božić I., Prlenda N. Influence of motor abilities on learning of alpine ski technique. SportLogia. 2012; 8 (2): 108–115.

Dizdar D. Quantitative methods (In Croatian). Faculty of Kinesiology, University of Zagreb, 2006

Elliot J.M., Connolly K.J. Hierarchical structure in skill development. In: The growth of competence. Eds. K.J. Connolly, J. Bruner. Academic Press. New York 1974: 135–168.

Franjko I., Maleš B., Kecerin I. The level of the specific motor skills directly determine the giant slalom performance in skiing demonstrators (In Croatian). Proceedings of the 1st International Conference “Contemporary Kinesiology”, Kupres 2006: 98–101.

Horga S. Psychology of sport (In Croatian). Faculty of physical education. Zagreb 1993.

Jurković N., Jurković D. Skiing: The Technique, Methodology and Training. Graphis d.o.o. Zagreb 2005.

Kovač M. Assessment of Gymnastic Skills at Physical Education – The Case of Backward Roll. Science of Gymnastics Journal. 2012; 4 (3): 25–35.

Krističević T., Živčić K., Cigrovski V., Simović S., Rački G. Correlation of motor acrobatic skills with success in slalom and giant slalom in young alpine skiers. Croatian Sports Medicine Journal. 2010; 25: 9–15.

Kuna D., Franjko I., Maleš B. Influence of motor knowledge and ability on the result in the giant slalom of skiing demonstrators with different skiing quality (In Croatian). Proceedings of the 18th Summer school of kinesiology of Croatia, Croatian Kinesiology Association. Zagreb 2009: 166–171.

Kuna D., Franjko I., Lozančić I., What primarily determines situational efficiency of ski demonstrators – speed, agility and explosive strength or ski-specific knowledge? (In Croatian). 8th Annual International Conference Condition Training of Athletes. Zagreb 2010: 208–210.

Kuna D. Forming of an expert model of the elements of basic and advanced ski school (In Croatian). 4th International Scientific Conference “Contemporary Kinesiology”, Faculty of Kinesiology, University of Split. Split 2012: 145–152.

Lešnik B., Žvan M. A turn to move on – Alpine skiing – Slovenian way. Theory and methodology of alpine skiing. SZS – Združenje učiteljev in trenerjev smučanja. Ljubljana 2007.

Majerič M., Kovač M., Dežman B., Strel J. Analysis of three different ways of assessing motor abilities with the testing assignment of long jump with approach. In: Proceedings book. Eds. D. Milovanović, F. Prot. 4th International Scientific Conference on Kinesiology, Faculty of Kinesiology, University of Zagreb. Zagreb 2005: 98–102.

Mejovšek M. Introduction to the methods of scientific research (In Croatian). Faculty of Education and Rehabilitation Sciences University of Zagreb, Naklada Slap. Zagreb 2003.

Mujanović E., Krsmanović R. Predictive value of motor abilities on the result in criteria variable ski short turn. Sport – scientific and practical aspects, international scientific journal of kinesiology. 2008; 5 (1&2): 61–65.

Mujanović E., Nožinović Mujanović A., Šabović A. Alpine skiing: methodology, techniques and tactics (In Bosnian). Off-set. Tuzla 2012.

Schmidt R.A. The schema as a solution to some persistent problems in motor learning theory. In: G.E. Stelmach. Motor Control, Academic Press. New York 1976: 41–65.

Schmidt R.A., Wrisberg C.A. Motor learning and performance (2nd ed.). Human Kinetics Publishers. Champaign IL 2000.

Cite this article as: Mujanović E., Atiković A., Nožinović Mujanović A., Nurković N. Predicting students performance in giant slalom. Centr Eur J Sport Sci Med. 2014; 7 (3): 45–54.