# LEVELS OF CONNECTION BETWEEN MOTOR SKILLS AND PERFORMANCE OF SPECIFIC SKIING SKILLS IN SKI INSTRUCTOR CANDIDATES AND CANDIDATES FOR SKI INSTRUCTOR TRAINEES

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## Abstract

*On a sample of 51 ski instructor candidates and 28 candidates for ski instructor trainees, a research was conducted in order to determine the levels of connection between certain motor skill assessment tests and the performance of specific skiing skills. Motor skills in candidates for trainees and instructors of skiing were evaluated by using 5 standard motor skill measuring instruments for assessing agility, explosive strength, repetitive and static strength and balance. In order to estimate the quality of their skiing knowledge, 3 elements from the advanced ski school were selected and their performance was evaluated independently by the judges. The success in competitive skiing disciplines was measured by the candidates' score of the competitive run in the giant slalom and in a newly designed ski polygon. After the preliminary processing procedures, the connections between the variables of specific skiing skills and motor skills were calculated for each of the groups by using correlation analysis. It was determined that ski instructor candidates, who possess a higher level of skiing technique in relation to ski instructor trainees, use various motor potentials while performing certain elements in skiing. A general conclusion can be made that a good performance in skiing depends on the level of knowledge of specific skiing skills, which on the other hand determines the domination of exploitation of agility, coordination, speed, explosive strength and muscle endurance.*

***Key words:*** *alpine skiing, ski instructors and ski instructor trainees, motor skills, skiing skills*

## Introduction

As a competitive sports activity, alpine skiing takes place in specific conditions of various ski slopes and it is defined by means of different competitive disciplines. Being successful in alpine skiing depends on the integrative effect of the overall anthropological set of a skier, which involves having a high level of knowledge of specific motor skills. Due to the evolution in the development of ski equipment, skiers are faced with increasing demands in terms of their physical fitness.

New, more efficient, faster and safer methods of developing motor skills and specific physical conditioning which are directly or indirectly related to this sport are constantly researched.

The results of numerous studies have confirmed a strong correlation between the level of adopted specific motor skills, agility, coordination, strength and endurance with the success of competitors in alpine skiing (Bosco, 1997; Reid and Johnson, 1997; Dolenec and Žvan, 2001; Malliou et al., 2004; Emeterio and González-Badillo, 2010; Müller et al., 2011).

Good skiers thus possess a high level of characteristic motor skills, which is recognized as a skill of performing characteristic elements in skiing. Therefore, when performing any of these elements, good skiers use less energy than that is the case among skiers who demonstrate lower levels of specific skiing knowledge.

As there are certain specific characteristics in the motor functioning of different populations, the question arises as to the level of situational efficiency of ski instructors who are expected to demonstrate well, but also show a high level of kinesiological engagement.

Previous research (Franjko, Maleš and Kecerin, 2006; Kuna, Franjko and Maleš, 2008, Cigrovski, Matković and Prlenda, 2009; Kuna, Franjko and Maleš, 2009; Kuna, Franjko and Lozančić, 2010; Maleš, Franjko and Kuna, 2013) demonstrate that the competitive effectiveness of ski instructors of different levels solely depends on a high level of adoption of skiing knowledge.

As these are people who, besides teaching alpine skiing, are generally also involved in low level recreational activities, such findings are more than logical.

In addition to the specific motor skill, the performance of skiing elements in ski instructors is also determined by the level of their overall anthropological characteristics (Neumayr et al., 2003).

Since alpine skiing takes place in variable environmental conditions, which only makes the performance of skiing elements more difficult, evaluating the knowledge, that is, the actual quality of ski instructor candidates is a very complex problem.

On the other hand, competition effectiveness integrates relevant skiing skills, whereas its measurement is based on the speed of execution: the one who is faster in mastering the run is a better competitor (Kostelić, 2005).

From a practical point of view of motor learning in ski instructors, only feedback about the result of performance can often be redundant to the skier and can even be inhibitory, especially if there is no progression in learning, as the ski instructors are already themselves saw are of the stagnation.

It is precisely for this reason why it is necessary to construct a model that would provide both feedbacks on the success of the result as well as on the quality of the performance which would then be relevant for the assessment of specific skills of ski instructors of all levels.

In addition, the contribution of each individual dimension of the anthropological status to the technique of alpine skiing is not clearly defined.

Therefore, it is exceptionally important to exactly determine the impact of individual abilities and characteristics on the skiing quality of ski instructors.

In this regard, the basic objective of the research is to determine the levels of connection between certain motor skill assessment tests and the performance of skiing elements in ski instructors and ski instructor trainees.

**Methods**

The sample which was examined in this study consisted of participants in the first and second part of the specialized education for ski instructors of the Croatian Snow Sport Instructors and Trainers Association (HZUTS).

The sample can also be called a sub-group of the overall population of trainees and ski instructors, or in other words, a representative of the population which is defined exclusively by the level of skiing skills.

The research included a total of 28 candidates for ski instructor trainees and 51 ski instructor candidates.

As the activities of a ski instructor in the area of motor abilities are largely based on movement structures which require a well-developed agility, balance and psychomotor speed and power, specific variables were selected that best estimate the mentioned abilities (Metikoš et al., 1982, 1989; Franjko, 2007).

The structure of motor space in candidates for trainees and instructors of skiing was evaluated by using the following 5 standard motor measuring instruments:

for assessing agility - *Slalom run* (SR); for assessing explosive strength - *Standing board jump* (SBJ); for assessing repetitive and static strength - *Trunk bending* (TB) and *Endurance in half squats* (EHS); for assessing balance - *Hopping on a balance beam with both feet* (HBB).

Also, the following elements from the advanced ski school were chosen for the purpose of determining the skiing quality: *Short turns* (ST), *Dynamic parallel turns* (DPT) and *Off-piste skiing* (OPS). The performance of these three elements was independently assessed by the judges, after watching video clips, using a 5 point Likert scale.

The level of success in the competitive disciplines was determined with their sult of the competition run in the giant slalom and in a newly designed ski polygon, and it referred to the results achieved during the run measured in hundredths of a second (1/100 sec), using a photocells Brower measuring device which stops the time in the moment when the participants passes through the finish line.

The ski polygon was constructed and placed on a well-kept ski slope at the angle of 30-35% and with a total length of 150 meters. A Brower Timing System starting block was set up at the starting line.

After the start, there were 4 slalom (SL) gates placed, with a distance between the start and the first gate, as well as the distance between each SL gate, of 10 meters and at an angle of (relative to the fall line) 40-45°.

After that, there was a set of 4 giant slalom (GS) gates which were placed with a distance of 15 meters between the last SL gate and the first GS gate, whereas the distance between all the other GS gates was 20 meters, and at the same angle of 40-45°as on the SL part of the track.

After this set of 4 GS gates, a set of 4 gates was placed, all at a 15-meter distance between each other and at an angle of 40-45°, which is a distance that is not defined either by SL or GS techniques, but a distance which in some way connects these two techniques, while the participants themselves had a special task in this part of the track (a description follows in the continuation).

What followed next was a set of 4 SL vertical-technique gates. The distance between the last gate with the special task and the first vertical gate was 15 meters and at an angle of the 40-45°, while the distance between the 4 vertical gates was 6 meters at an angle of 0°. After the last vertical gate and at a distance of 6 meters, the finish line, which was 10 meters wide, was placed so that the middle of the finish line was right below the last gate. All the gates were placed on the small poles in such a way that all slalom gates and the gates with the special task were placed using one pole, whereas the four giant slalom gates were placed using two poles.

The data analysis methods were chosen in accordance with the objective of the research. The basic descriptive statistical parameters where calculated and the normality of the distribution was checked by using the Kolmogorov-Smirnov test (KS). With the goal of determining the objectivity of the judges, the Cronbach's alpha coefficient and the inter-item correlations were calculated.

The connections between motor variables and the variables for assessing the skiing effectiveness of ski instructor candidates and candidates for ski instructor trainees was determined by using the correlation analysis, for the purpose of which the Pearson coefficient of linear correlation (r) was calculated. Data analysis was performed by using the software package Statistica 8.0.

**Results and discussion**

By reviewing Table 1, where the basic descriptive statistical parameters of physical fitness and motor variables for assessing the skiing efficiency of the ski instructor candidates and the trainees for ski instructors are presented, the conclusion can be made that all the applied tests demonstrate a distribution of results for which it can be said that it does not significantly deviate from the average.

According to the results of the K-S test, none of the variables significantly differs from the average curve of the 0.05 significance level, except the Endurance in half squats (EHS) variable in candidates for ski instructor trainees.

A superficial examination of the results shows that the candidates for ski instructor trainees demonstrate a higher level of physical fitness compared to the ski instructor candidates, while in the area of skiing variables the situation is diametrically opposed. Namely, as it was to be assumed, the ski instructor candidates, due to their earlier education and a longer experience in skiing, possess a higher level of skiing competence in relation to the candidates for ski instructor trainees

whose professional education is at the starting level.

Table 1. Descriptive statistical parameters of physical fitness and motor variables and variables for assessing the effectiveness of ski instructor candidates (N=51) and candidates for ski instructor trainees (N=28)

| VARIABLES | Ski instructors (N=51) | | | | Ski instructor trainees (N=28) | | | |
|---|---|---|---|---|---|---|---|---|
| | AM±SD | MIN | MAX | D | AM±SD | MIN | MAX | D |
| SR (sec) | 7.37±0.52 | 6.23 | 8.64 | 0.06 | 7.35±0.64 | 6.37 | 8.82 | 0.15 |
| SBJ (cm) | 210.12±24.73 | 152.00 | 278.00 | 0.11 | 217.93±21.70 | 167.00 | 257.00 | 0.09 |
| TB (f) | 40.08±11.74 | 0.00 | 60.00 | 0.13 | 41.89±11.27 | 20.00 | 60.00 | 0.11 |
| EHS (sec) | 58.04±30.27 | 10.00 | 136.00 | 0.16 | 79.50±62.58* | 33.00 | 301.00 | 0.28* |
| HBB (f) | 4.49±1.39 | 2.00 | 8.00 | 0.19 | 4.54±1.29 | 2.00 | 7.00 | 0.18 |
| GS (sec) | 29.19±2.55 | 23.97 | 36.27 | 0.10 | 29.48±2.30 | 25.77 | 36.46 | 0.10 |
| POLYGON(sec) | 28.17±3.32 | 21.14 | 34.77 | 0.06 | 29.11±3.39 | 22.42 | 35.95 | 0.10 |
| OPS | 2.41±0.67 | 1.00 | 3.80 | 0.10 | 2.28±0.54 | 1.20 | 3.40 | 0.16 |
| ST | 2.36±0.73 | 1.00 | 3.80 | 0.09 | 2.49±0.66 | 1.20 | 3.80 | 0.18 |
| DPT | 2.49±0.74 | 1.00 | 4.00 | 0.10 | 2.16±0.51 | 1.20 | 3.40 | 0.15 |

Legend: AM - arithmetic mean; SD - standard deviation; MIN - minimum result, MAX - maximum result, D - determined value of K-S test - p<05. Limit value of the K-S test for the sample of 51=0.19; Limit value of the K-S test for the sample of 28=0.26.

In order to establish the metrical characteristics of the variables for assessing skiing skills, the Cronbach's alpha coefficient and the inter-item correlations were calculated for the OPS, ST and DPT tests, and they were within the limit values of between 0.86 and 0.89 and between 0.56 and 0.63, based on which the conclusion can be made that the motor skills parameters of the participants were methodologically correctly assessed and that the obtained results are suitable for use in further analysis.

Table 2. Correlations between motor variables and variables for assessing the performance of skiing elements in ski instructor candidates and candidates for ski instructor trainees - p<0.05

| VARIABLES | Ski instructors (N=51) | | | | | Ski instructor trainees (N=28) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | GS | POL | OPS | ST | DPT | GS | POL | OPS | ST | DPT |
| SR | 0.40 | 0.33 | -0.40 | -0.23 | -0.39 | 0.46 | 0.30 | -0.52 | -0.52 | -0.37 |
| SBJ | -0.22 | -0.15 | 0.25 | 0.29 | 0.25 | -0.34 | -0.09 | 0.11 | 0.19 | -0.03 |
| TB | -0.12 | -0.09 | 0.18 | 0.12 | 0.31 | -0.47 | -0.29 | 0.47 | 0.51 | 0.33 |
| EHS | -0.13 | -0.07 | 0.28 | 0.12 | 0.24 | -0.16 | -0.04 | 0.01 | 0.12 | -0.18 |
| HBB | -0.37 | -0.09 | 0.23 | 0.25 | 0.22 | 0.03 | 0.09 | -0.12 | 0.11 | 0.14 |

Legend: SR - Slalom run; SBJ - Standing board jump; TB - Trunk bending; EHS - Endurance in half squats; HBB - Hopping on a balance beam with both feet; GS - Giant slalom; POL - Polygon; OPS - Off-piste skiing; ST - Short turns; DPT - Dynamic parallel turns.

By reviewing the results presented in Table 2, one can notice the existence of specific statistically

significant correlations between the variables for assessing motor skills and the variables for assessing the performance of skiing elements in ski instructor candidates and trainees for instructors.
The results of ski instructor candidates revealed statistically significant correlations between the slalom run test and the following variables: *Giant slalom, Polygon, Off-piste skiing and Dynamic parallel turns*.

The question is raised why it is precisely this motor manifestation that is a good indicator of skiing effectiveness in ski instructor candidates? Probably due to the fact that the performance of the Slalom run test first of all depends on agility and coordination which are the basis for a successful realization of the tested skiing elements and the newly constructed polygon.

In the other words, a good result achieved in the performance of the Slalom run test by a ski instructor candidate is associated with a faster and more harmonious overcoming of the given directions in the mentioned skiing elements.

Furthermore, a statistically significant positive correlative association was found between the Standing board jump test and the Short turns test.

The reason for this is that a good result in the Standing board jump test, besides on the explosiveness and the distance of the jump, also depends on the preparation and the performance technique which is reflected in the vertical movement of the body.

A successful execution of skiing technique in the Short turns test is defined by the integration of all specific skiing movement, especially vertical movements, and fast and timely changes of direction which explains the determined correlation with the Standing board jump test.

Another positive statistically significant correlation was also determined between the Trunk bending test and the Dynamic parallel turns test.

It is assumed that the reason for this high degree of correlation lies in the high adoption level of skiing knowledge in ski instructor candidates, who during the performance of dynamic parallel turns use their core body strength in order to control specific skiing movements and to achieve core stabilization.

The performance of the Endurance in half squats test is in a positive statistically significant correlation with the results of the Off-piste skiing test. This correlation is presumably a result of the fact that during off-piste skiing, a skier mainly uses the strength of his legs as he is trying to overcome a demanding and unpredictable ski terrain.

The Hopping on a balance beam with both feet test showed to be in a positive statistical correlation with the Giant slalom test. One can assume that the resulting connection arises precisely from the movement structures of both manifestations. Furthermore, a successful performance of the Giant slalom test is defined by rapid and precise changes of the given direction in the shortest time period possible, which is as well the main characteristic of the Hopping on a balance beam with both feet test.

The results of candidates for ski instructor trainees clearly demonstrate that the motor variables of Slalom run and Trunk bending are significantly associated with the results in the Giant slalom, Off-piste skiing and Short turn´s variables.

The obtained results refer to a confirmation of the previously stated conclusion that the Slalom run and the Trunk bending tests are good indicators of a successful skiing performance.

Ultimately, it can be constituted that the skiing efficiency in participants at the starting level of instructor teaching, who poses a lower level of overall skiing knowledge and who have not yet reached the level of stabilization in the process of motor skill adoption, significantly depends on their level of physical fitness.

## Conclusion

Upon comparing the levels of connection between motor variables and variables for assessing the performance of skiing elements in ski instructor candidates and in candidates for ski instructor trainees, it can be concluded that these two groups, although similar, use different motor potentials in their performance of skiing elements.

Therefore, in ski instructor candidates, who possess a higher level of skiing technique in relation to candidates for ski instructor trainees, motor functioning during the performance of various elements depends on a different activation of potential, where as in candidates for ski instructor trainees we can find an almost unique pattern of functioning during the execution of the skiing elements, and it is one which is based on agility and core body strength.

Overall, it is important to emphasize that the Slalom run is the best indicator for the performance level of skiing elements in both groups of participants, and that its influence is ever more significant in skiers who possess a lower level of skiing knowledge, namely in candidates for ski instructor trainees.

Its relevance is reflected in the performance success level which primarily depends on the level of fitness readiness, coordination and agility, while in terms of its movement structure, it is very similar to skiing movements and motions which cause changes of direction.

Other tests for assessing the motor potentials in candidates for instructors and trainees are statistically significant associated with skiing elements and performances, depending on the levels of adoption and integration of skiing knowledge.

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# RAZINE POVEZANOSTI IZMEĐU MOTORIČKIH VJEŠTINA I IZVEDBE SPECIFIČNIH SKIJAŠKIH VJEŠINA KOD KANDIDATA ZA INSTRUKORA SKIJANJA I KANDIDATA ZA PRIPRAVNIKA INSTRUKTORA SKIJANJA

**Sažetak**

*Istraživanje je provedeno na uzorku od 51 kandidata skijanja i 28 kandidata za instruktora pripravnika skijana kako bi se utvrdile razine povezanosti između pojedinih testova za procjenu motoričkih vještina i izvođenje određenih skijačkih vještina. Motoričke sposobnosti kod kandidata za pripravnike i instruktore skijanja su procijenjene upotrebom 5 standardnih motoričkih vještina mjernih instrumenata za procjenu agilnosti, eksplozivne snage, ponavljaja i statičke snage i ravnoteže. Kako bi se procijenila kvaliteta svog skijaškog znanja, 3 elementa iz napredne škole skijanja su izabrana i njihova učinkovitost je ocijenjena samostalno od sudaca. Uspjeh u natjecateljskim skijaškim disciplinama mjeren je rezultatima kandidata od konkurentnog rada u veleslalomu i na novodizajniranim skijaškim poligonima. Nakon preliminarne obrade procedure, veza između varijabli specifičnih za skijaške vještine i motoričke sposobnosti izračunate su za svaku od skupina korištenjem korelacije. Utvrđeno je da instruktori skijanja kandidata, koji posjeduju višu razinu skijaške tehnike u odnosu na pripravnika skijanja, koriste različite motoričke potencijale pri obavljanju određenih elemenata u skijanju. Opći zaključak može biti da dobar nastup u skijanje ovisi o stupnju poznavanja specifičnih skijaških vještina, što s druge strane utvrđuje dominaciju iskorištavanja okretnosti, koordinacije, brzine, eksplozivne snage i izdržljivosti mišića.*

***Ključne riječi:*** *alpsko skijanje, instruktori skijanja i pipravnici instruktori skijanja, motoričke sposobnosti, skijaške vještine*

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