

BASIC STEPS AND SPATIAL-TEMPORAL DIMENSIONS **OF MOTOR LEARNING** - THE PROCESS OF SKILLS ACQUISITION - **IN ALPINE SKIING**

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SITAS - Slovenian Ski Instructor & Trainer Association

IVSS - International Association Snowsports at Schools and Universities



Skiing? – Learning? – Fun?

- Biomechanical – hill problems?
- Motor learning – skill problems?
- Didactical – will problems?

Framework...

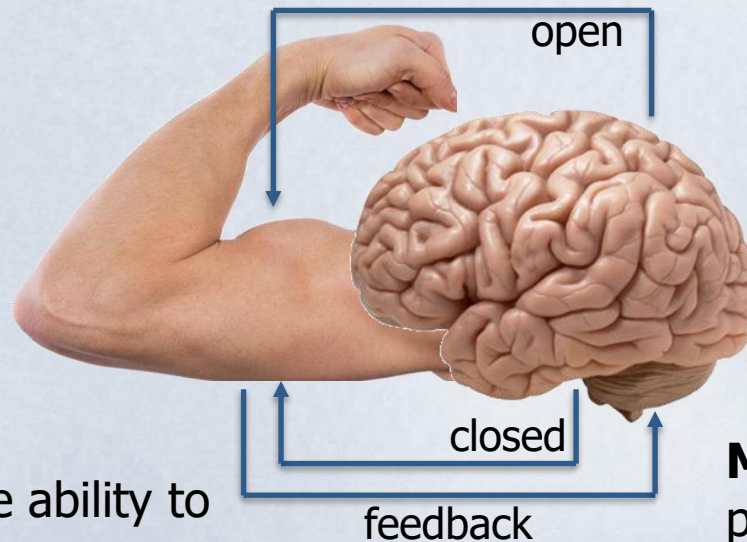
- Motor learning (ML) – aspects, facts, mechanisms, ...
- Phases of ML, motor transfer and spatio-temporal dimensions of ML – cognitive motor crosstalk...
- ML in Alpine Skiing – the holistic process of skills acquisition in alpine skiing ...
- Learner centered approach - Skiing is a game ...

*Schools should **not be adapted** to teachers
to teach, but to students to learn!*

Briggs Mc Lean in H. Abraham, 1983



open- and closed-loop control systems



Motor control - the ability to control or direct the mechanisms responsible for movement (Shumway-Cook & Woollacott, 2001). Also - "neurodevelopmental" or "hierarchical" or "bottom-up" definition of voluntary movements.

Motor learning - A set of processes related to exercise aimed at predominantly **permanent changes in an individual's motor competences.** (Shumway-Cook & Woollacott, 2001). It **combines neuroscience with theories of development and learning.**

Motor learning (ML) – aspects, facts, mechanisms, ...

We **acquire motor skills** in the process of **motor learning**. Motor learning is a complex process in which an individual during the implementation of simple new, conscious movements or. of complex movements acquires **new motor information** (expertise) **enriches motor memory** and changes motor behavior. Expertise is a set of organized information that leads to understanding. (Pišot, 2010)

Motor learning is a cognitive process related to exercise, training or. experience, which are reflected in **relatively permanent changes** in an individual's **motor behavior/competences**. (Skinner, Taylor, Dart; 2004)



Motor learning (ML) – aspects, facts, mechanisms, ...

Motor behavior - Observable **attempt at voluntary action**. Level of performance is susceptible to fluctuation in temporary factors such as motivation, arousal, fatigue, and physical condition (Pišot, 2010)

Motor learning - Changes in internal processes that **determine an individual's capability of solving motor task**. The level of motor learning improves with practice and is often inferred by observing **relatively stable levels of motor performance – MOTOR COMPETENCES!**



M SKILLS – M COMPETENCES

MOTOR BEHAVIOR



MOTOR BEHAVIOR



Motor learning (ML) – aspects, facts, **mechanisms**, ...

Motor learning is a sensorimotor process that enables the achievement of motor knowledge and functional abilities based on:

SENSORY INPUT - obtaining a lot of information from the senses on the surface of and within our body and transmitting these stimuli to the brain


SENSORY INTEGRATION - organization of incoming sensory stimulations and integration of the new with the old – memory

MOTOR INTERPRETATION - internal movement decision making - recalibration - based on sensory (current) and memory (past) information

MOTOR ACTIVATION - execution of a movement (action)

FEEDBACK - movement estimation based on many sensory details - source of feedback to sensory input - allows process evaluation and restart of the entire cycle

Learner ↔ Teacher



Motor learning (ML) – aspects, **FACTS**, mechanisms

- It is valuable to bring recent insights from various approaches together to identify a coherent way forward that can result in optimized learning **from humans' earliest encounters with new motor skills** to the **lifelong development of motoric expertise**. (G.Wulf, R. Lewthwaite, 2016)
- While the **task-related informational functions** of augmented feedback, model presentations, or variable or random practice, etc. **are likely important**, it has **become clear that motivational** (e.g., social-cognitive, affective) factors associated with various practice conditions **have an important influence on learning as well** (Lewthwaite & Wulf, 2010a, 2012).
- Enhanced **expectancies resulting from visual illusions** can **facilitate sport skill learning**. (Chauvel, Wulf, Maquestiaux, 2015)

Motor learning (ML) – aspects, **FACTS**, mechanisms

- **Motor imagery (MI)** practice where subject mentally simulates a specific motor action **without any actual corresponding motor output** can be successfully implemented as a training tool in order to **improve maximal voluntary strength**.

Paravlič, Pišot, Marušič, Plos One, 2019

- **MI** training, when added to RPT, led to improvements in **multiple measures of patients' physical functional capabilities** following four weeks of self-administered practice in a home-based environment.

MI practice, when added to physical therapy, improves both **objective and subjective measures of patients' physical function** after TKA, and facilitates the transfer of MI strength training to functional mobility.



Fig. 3 Experimental setup for the measurement of isometric strength and voluntary activation of the quadriceps femoris muscle

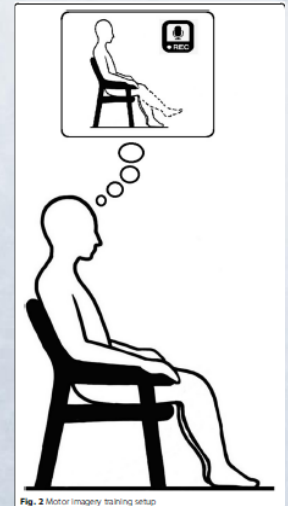


Fig. 2 Motor imagery testing setup

Motor learning (ML) – aspects, **FACTS**, mechanisms

AO (action observation) therapy requires subjects **to observe** a video clip or watch actions performed by an operator while **MI** represents the **mental simulation** of motor actions **without** any corresponding **motor output** - **AO + MI** approach was an efficient tool to **enhance the functional rehabilitation outcomes** of postsurgical orthopedic patients.

Marusic, U., S. Grosprêtre, A. Paravlic, S. Kovač, R. Pišot, W. Taube, Neural Plasticity, 2018

Training processes **using the exergame** as a complementary training tool with novice players **help to achieve additional training effects related to executive functions**. Attention must be paid during the **first tennis development phase** (6–8 years) **when no technique recognition patterns are already established**. Involving **beginners** in an in-game context may control their attitudes that **predetermine their interpretations** and **increase subsequent confidence** in game events.

Šlosar, de Bruin, Bodnariuc Fontes, Plevnik, Pišot, Šimunic, Marušić, Frontiers in Psychology March 2021



Framework...

- Motor learning (ML) – aspects, facts, mechanisms, ...
- Phases of ML, motor transfer and spatio-temporal dimensions of ML – cognitive motor crosstalk...
- ML in Alpine Skiing – the holistic process of skills acquisition in alpine skiing ...
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SKIING PRACTICING MOTIVATION FACTORS -basic motives for involvement

1. Acquisition of new **knowledge**.
2. Enhancing motor **abilities**.
3. Increasing **physical fitness** and **efficiency**
4. **Friendship/team atmosphere**
5. **Fun**

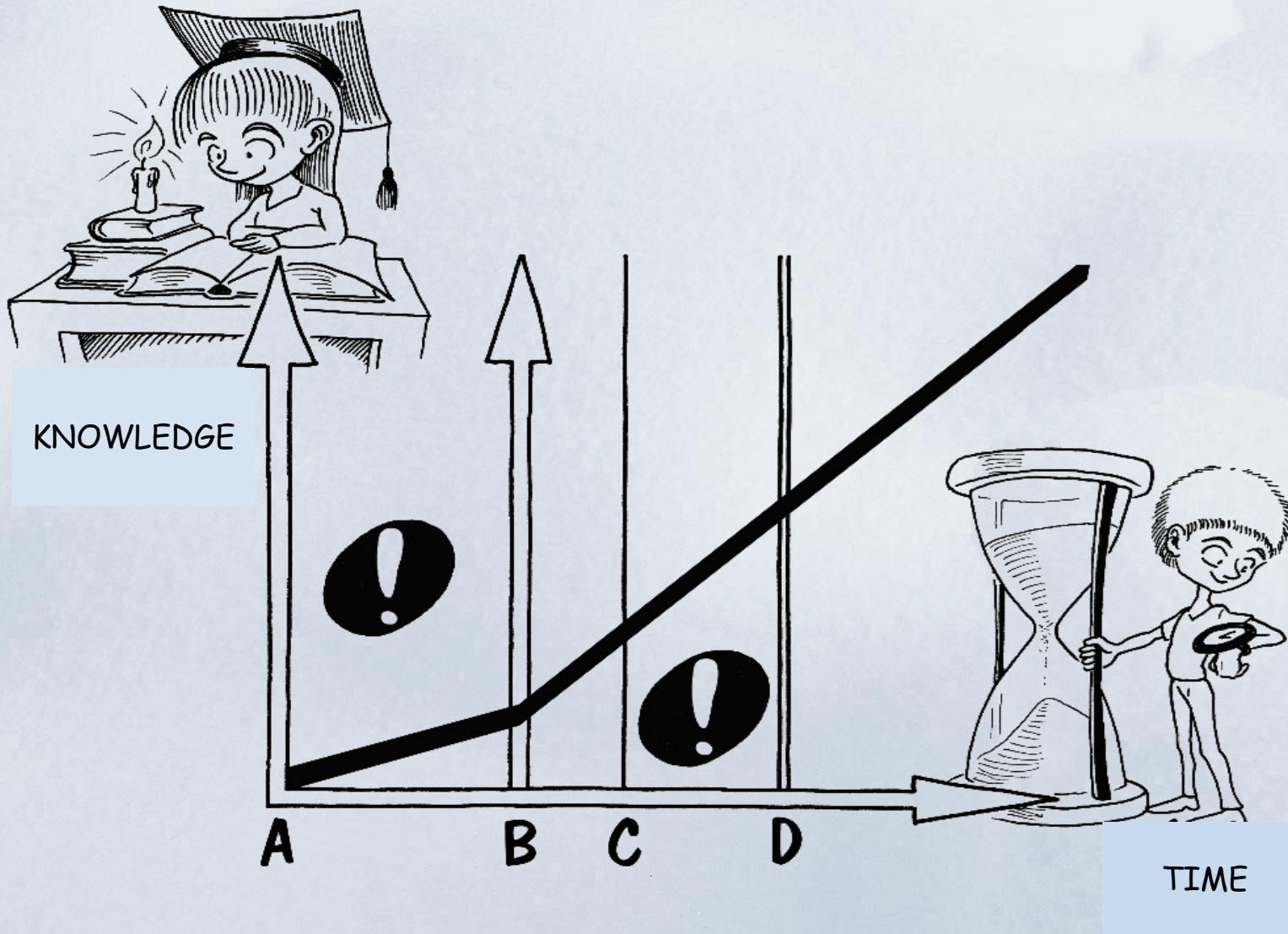
(Gill et al., 1983)

Students, kids, ..

Ski instructor, parent



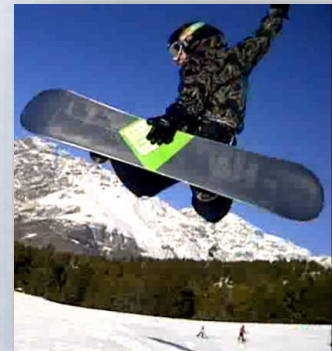
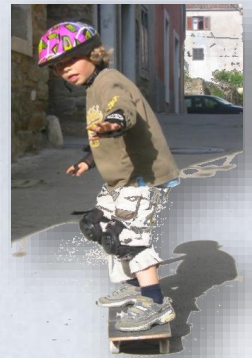
MOTOR LEARNING – PROCESS



MOTOR LEARNING – COGNITIVE PROCESS

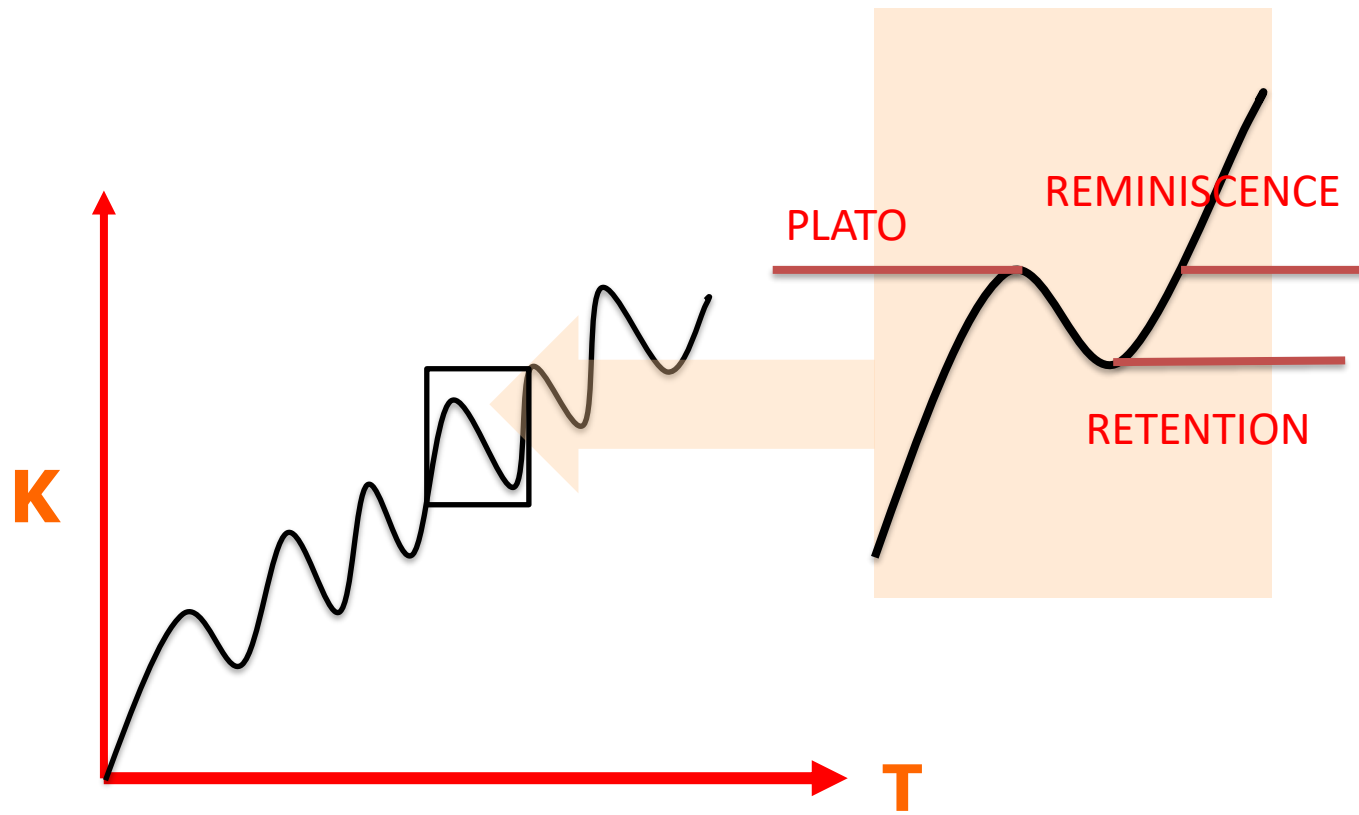
- ***Phases of motor learning***

- *Pre phase* – FAMILIARIZATION – adaptation, observation, first experiences – trunk stability, ...
- INITIAL PHASE – first simple movement acquisition, rough movements
- BASIC PHASE – automatization of simple movement patterns; energy rationalization and acquisition of complex movements structures
- FINAL PHASE – high quality movements; high efficiency with low energy loss in changing conditions – never ending phase





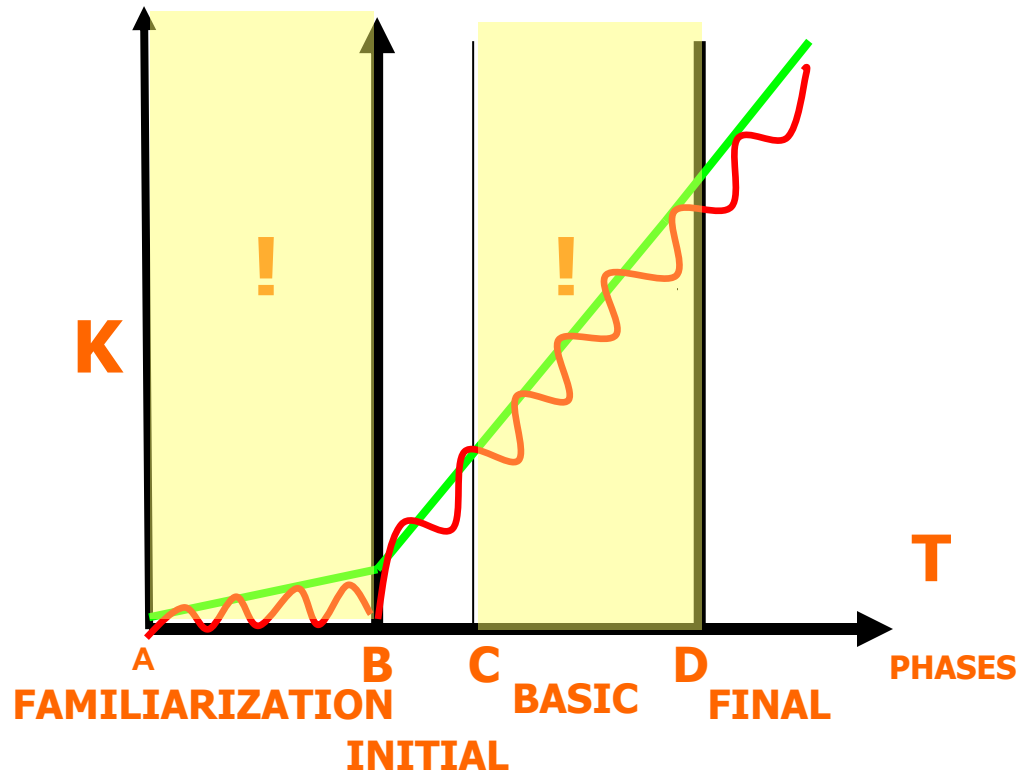
SIGMOID CURVE OF MOTOR LEARNING





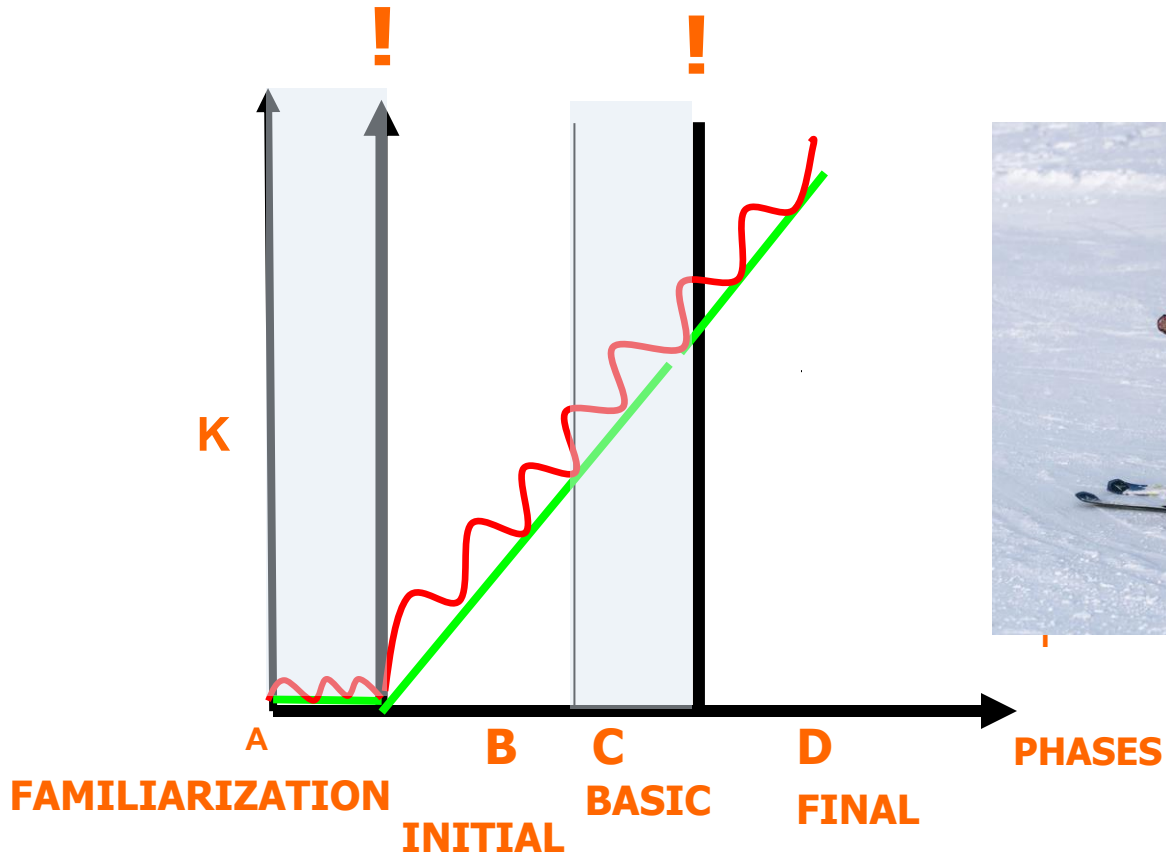
PHASES OF MOTOR LEARNING

**EVERY CHANGE OF MOVEMENT -
NEW EXPERIENCE - NEW
PSYCHOMOTOR LEARNING**

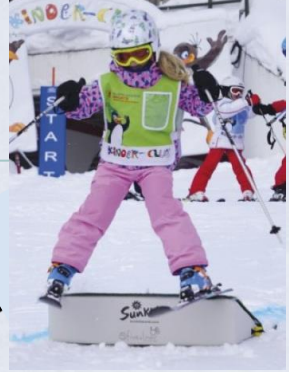
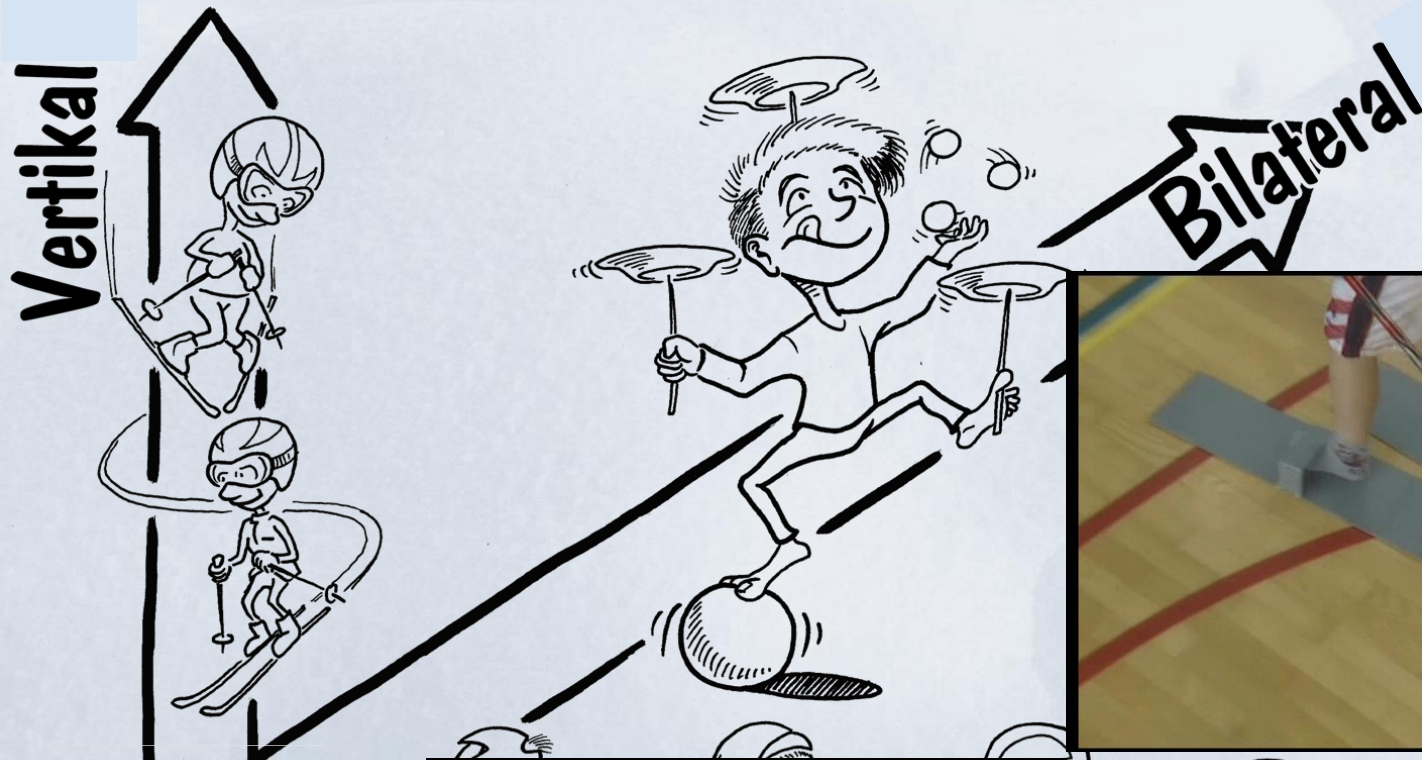




PSICHOMOTOR LEARNING ADULTS



MOTOR TRANSFER



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- Learner centered approach - Skiing is a game ...

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BASIC STEPS AND SPATIAL-TEMPORAL DIMENSIONS IN THE PROCESS OF SKILLS ACQUISITION IN ALPINE SKIING

BASIC STEPS

SPATIAL-TEMPORAL DIMENSIONS

COORDINATED TURN

MANAGING THE CENTER OF MASS

CHANGING DIRECTION

FAMILIARIZATION

SOFTNESS

RHYTHM

TIMING

SPEED

ACCURACY

TEKMOVALN
• Vijug
hodr
NADALJEV
IZPELJANKE
n hodniku
o vijuganje
lice
nja

**SKI
SCHOOL
-
DIFFERENT
APPROACH**

BASIC STEPS OF ML IN AS



COORDINATED SKIING

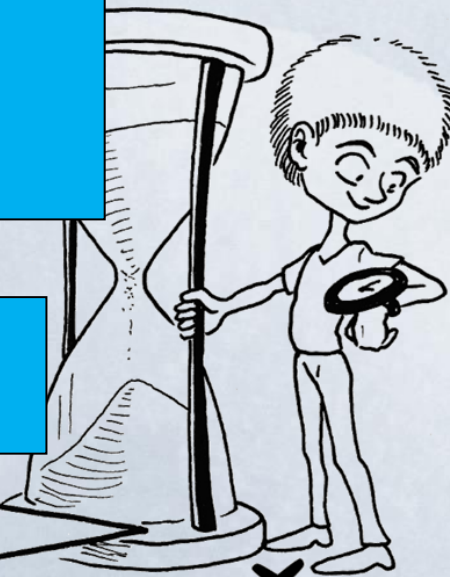
KNOWLEDGE

MANAGING THE CENTER OF MASS

CHANGING DIRECTION - TURNING

ADAPTATION / FAMILIARIZATION

TIME



BASIC STEPS OF ML IN AS



KNOWLEDGE

1

ADAPTATION / FAMILIARIZATION

A

B

C

D

TIME



ADAPTATION 1



SLIDING – TRUNK STABILITY

BASIC STEPS OF ML IN AS

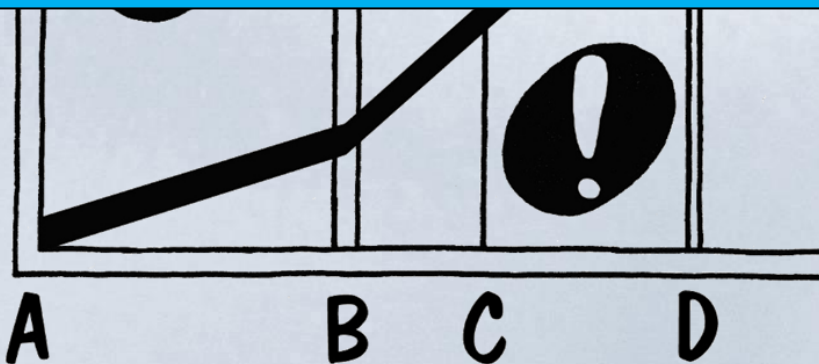


KNOWLEDGE

2



CHANGING DIRECTION - TURNING



BASIC STEPS OF ML IN AS



KNOWLEDGE

3



MANAGING THE CENTER OF MASS

B C D



BASIC STEPS OF ML IN AS



KNOWLEDGE

4

COORDINATED SKIING



TIME

BASIC STEPS AND SPATIAL-TEMPORAL DIMENSIONS IN THE PROCESS OF SKILLS ACQUISITION IN ALPINE SKIING

BASIC STEPS

SPATIAL-TEMPORAL DIMENSIONS

COORDINATED TURN

SOFTNESS

MANAGING THE CENTER OF MASS

RHYTHM

CHANGING DIRECTION

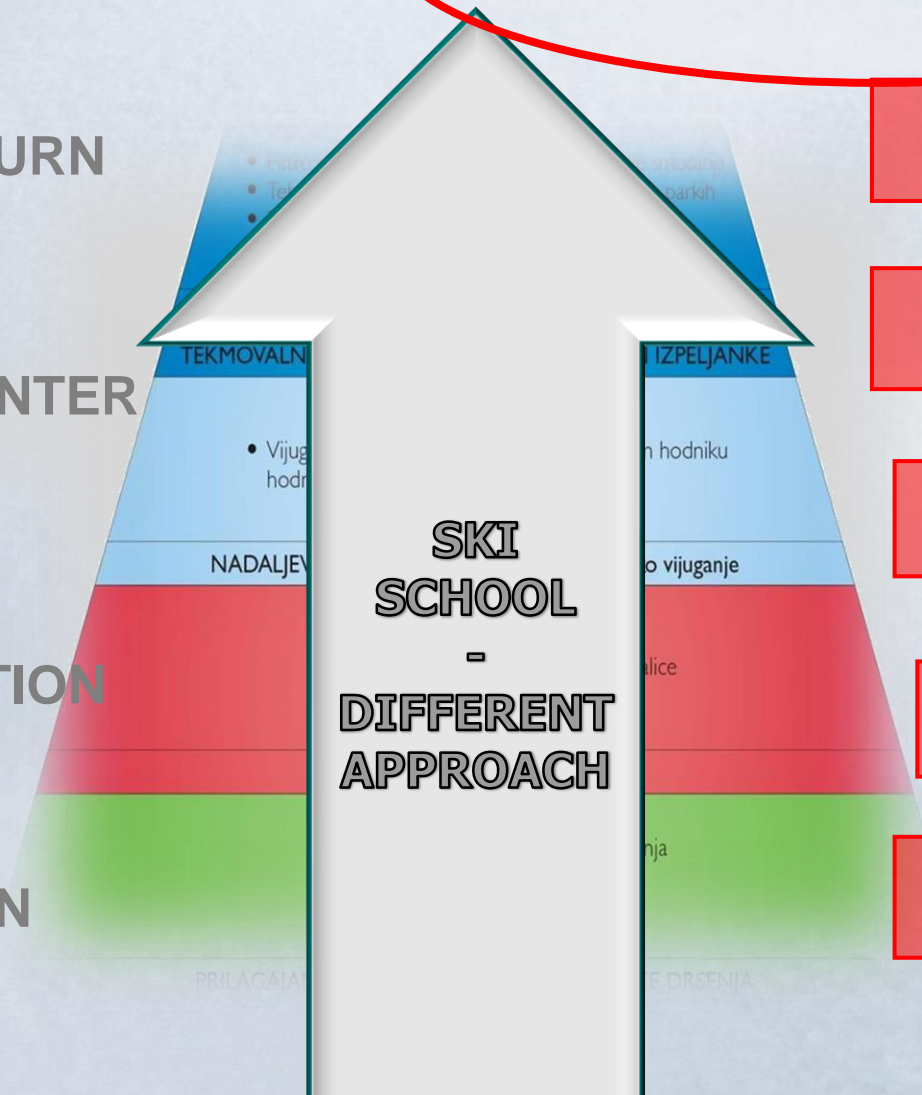
TIMING

FAMILIARIZATION

SPEED

ACCURACY

SKI SCHOOL
-
DIFFERENT APPROACH



SPATIAL-TEMPORAL DIMENSIONS IN THE PROCESS OF SKILLS ACQUISITION IN ALPINE SKIING

The process of motor learning – from the first steps of familiarization through preparation of the movement scheme, development and realization of a simple movement task to adaptation and automatization of these tasks, development of complex movement structures and realization of these in changing conditions – goes through 5 spatial-temporal dimensions:

- **accuracy** of movement realization,
- **speed** of movement realization,
- **timing** of movement realization,
- **rhythm** of movement realization,
- **softness/high coordination** of movement realization.



SPATIAL-TEMPORAL DIMENSION

SOFTNESS

RHYTHM

TIMING

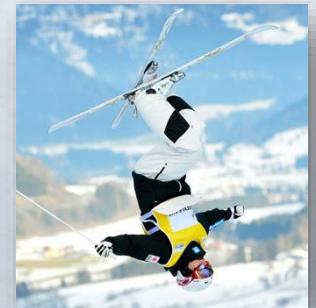
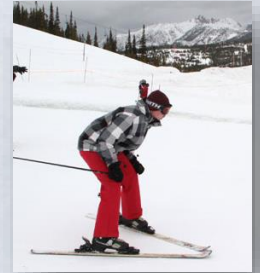
SPEED

ACCURACY

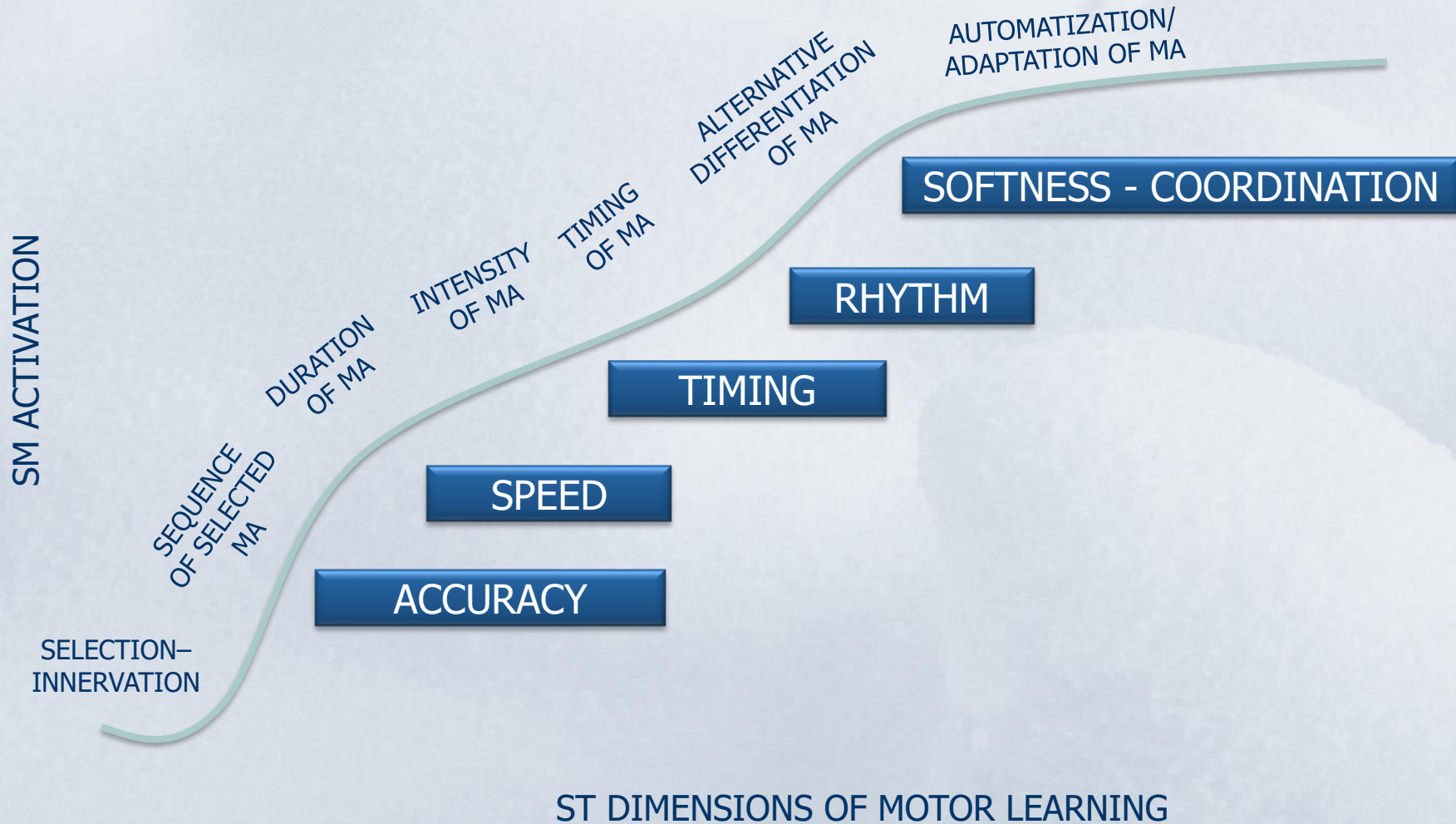


MAGILL'S 7 PHASES OF SKELETAL MUSCLE ACTIVATION (SM) IN THE PROCESS OF MOTOR LEARNING

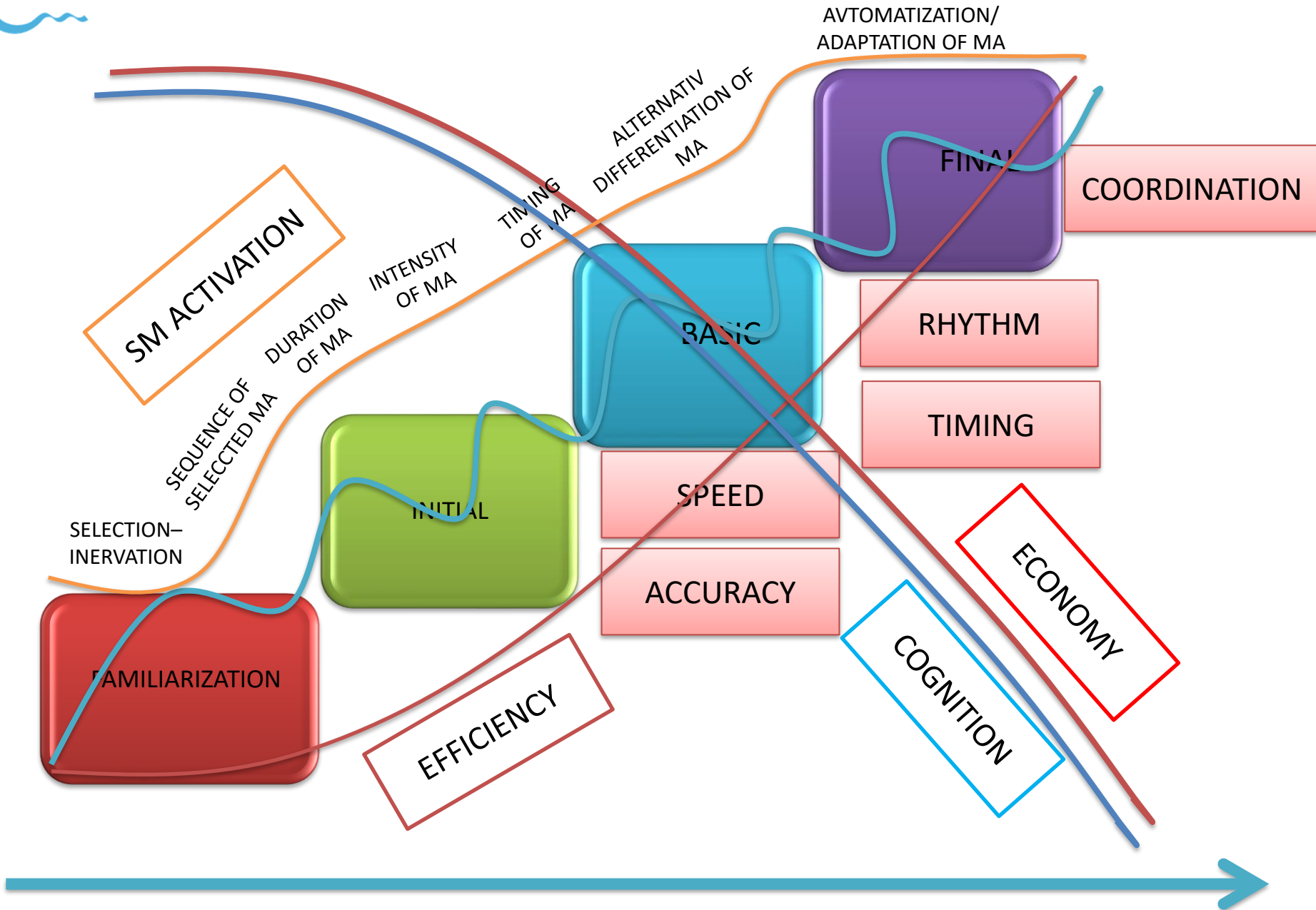
- **selection and innervation** of SM for movement realization;
- **sequence** of selected SM activation;
- **duration** of SM activation in movement realization;
- **intensity** of SM of activation;
- **timing** of SM activation – adaptation to the external conditions – coactivation;
- **alternative** SM activation - optimization of the selected SM activation depending on the specific situation;
- **automatization** of SM activation and adaptation to the changing conditions – high level of motor control.



SPATIAL-TEMPORAL DIMENSIONS AND SKELETAL MUSCLE **ACTIVATION** IN THE PROCESS OF ML



HOLISTIC PROCESS OF MOTOR LEARNING



Framework...

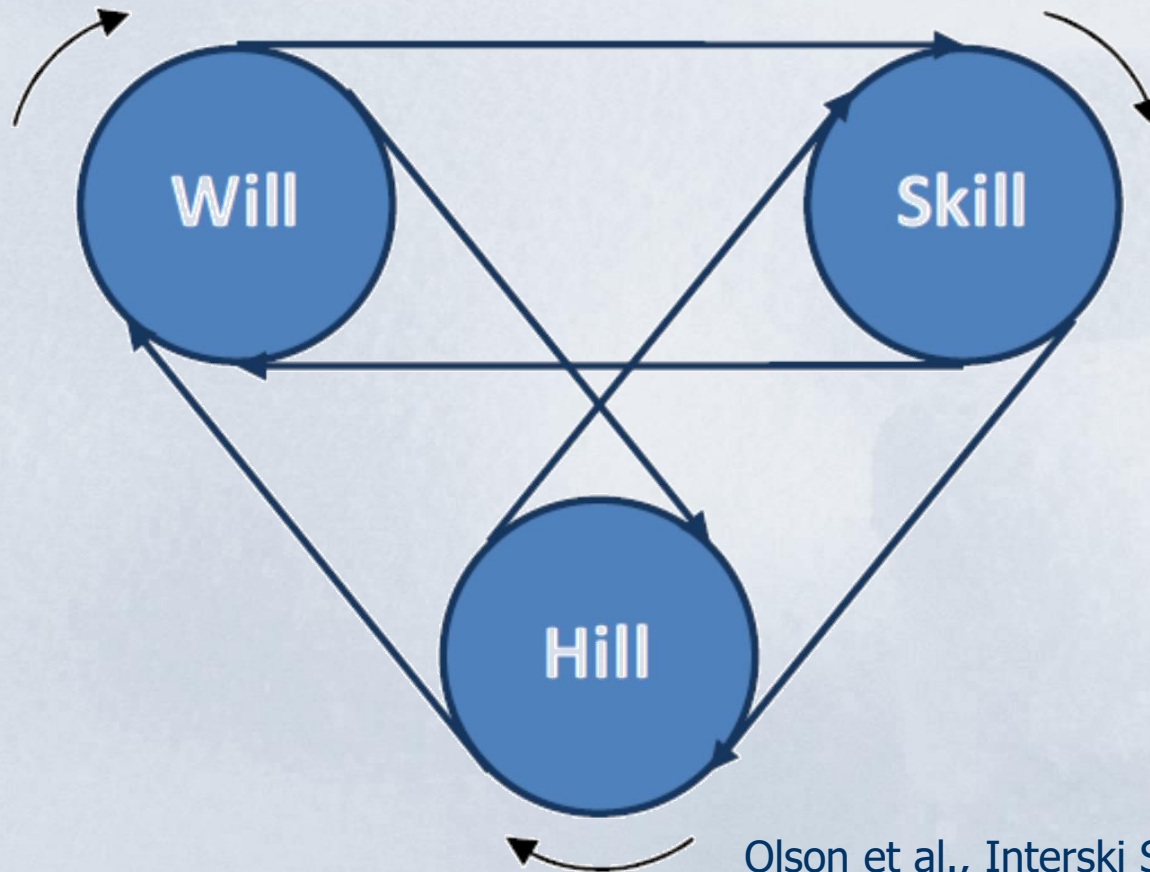
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- **HILL, WILL & SKILL - Learner centered approach - Skiing is a game ...**

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Briggs Mc Lean in H. Abraham, 1983



The system with the factors which reinforce and interact with each other.





SKIING – THE AIM!!!??

Overcoming the hill -

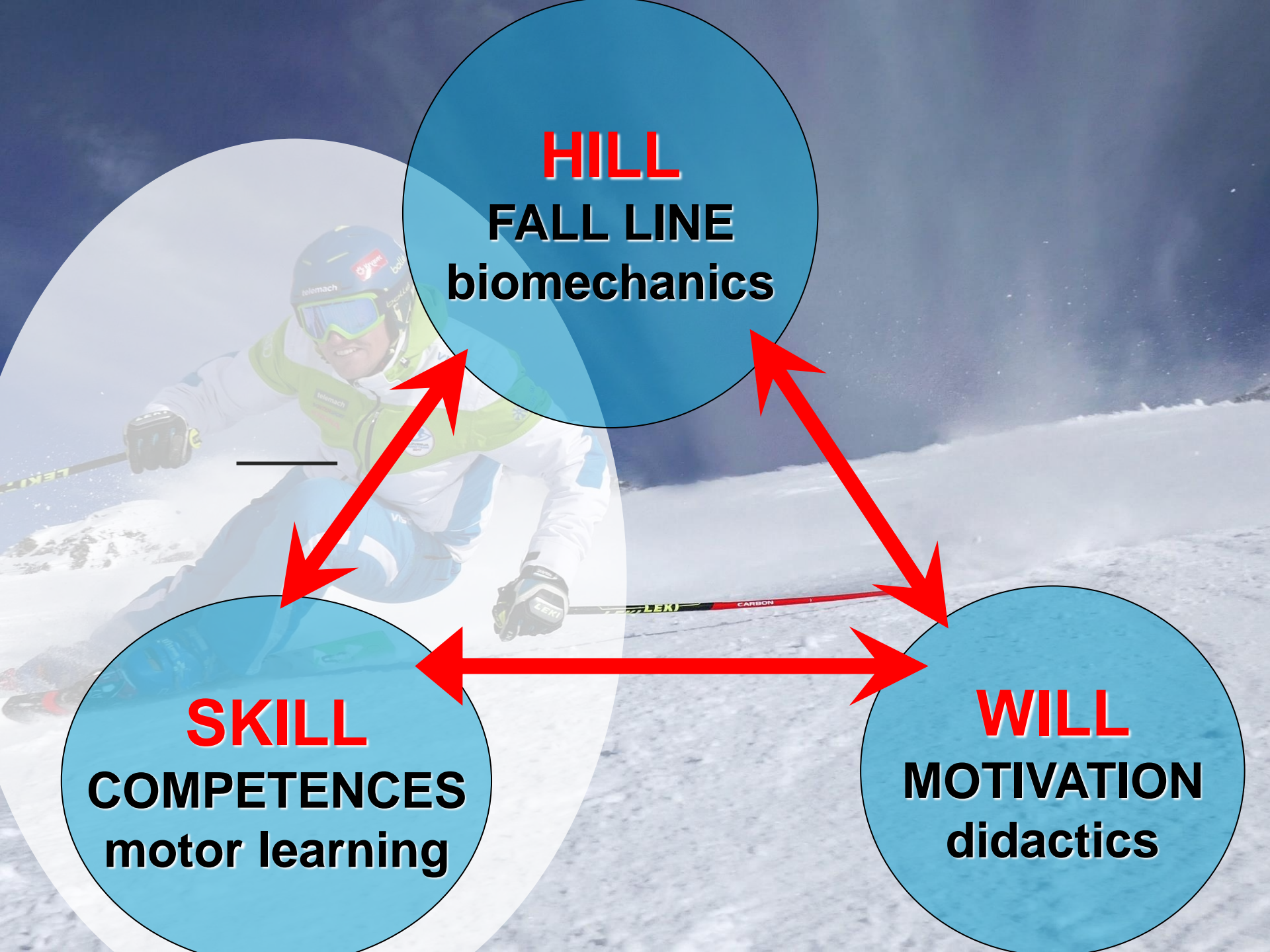
- ❖ safely and effectively,
- ❖ with joy and fun,
- ❖ rationally and quickly.



Courtesy of A. Guček

„They were sliding down on their curved wooden planks and overcame the hill also when the snow was soft and deep.“

J. V. Valvasor (1689)



HILL
FALL LINE
biomechanics

SKILL
COMPETENCES
motor learning

WILL
MOTIVATION
didactics



EXERCISE TASK



MECHANICS

FOR LEARNING

FOR CONTROL

BASIC STEPS

WILL

FORMS/TYPES OF SKI SCHOOL

ST DIMENSIONS

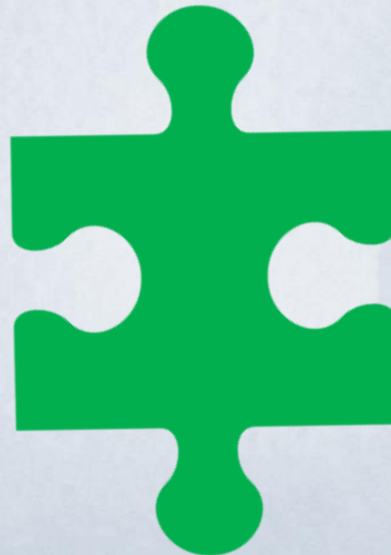
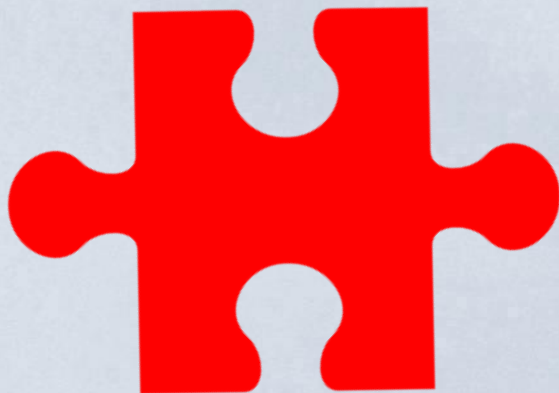
GOAL 4

TEACHING SKIING

GOAL 2

GOAL 1

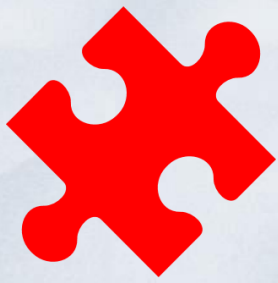
GOAL 3





GOAL 1





**COORDINATION –
DYNAMICS**

**MANAGING
THE CENTER
OF MASS**

**CHANGING
DIRECTION**

FAMILIARIZATION

**KNOWLEDGE
...TO KNOW**

**COMPETENCES
...TO BE
COMPETENT**

**ABILITIES
...TO BE ABLE**

GOAL 2



GOAL 3

SOFTNESS

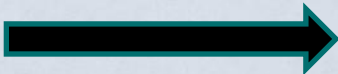
RHYTHM

TIMING

SPEED

ACCURACY

TIME



SPACE



GOAL 4

**SOCIAL
INCLUSION**

LANGUAGE

CULTURE

AGE/DEVELOPMENT

**TOLERANCE AND
RESPECT**

OTHER NEEDS

FUN



CHALLENGES

METHODICS - DIDACTICS

GOAL 1

GOAL 2

GOAL 3

GOAL 4



SKI SCHOOL
LEARNER CENTERED APPROACH

THINK ABOUT....

- BASIC AIM – OVERCOMING THE FALL LINE
- 4 BASIC STEPS IN ML
- 5 ST DIMENSIONS – MULTIPLICATORS....
- GAMES AND PLAY
- PULL DIDACTICS NOT PUSH

PULL



PUSH



More.....

Skiing is a game



dr. Rado Pišot

Warm-up may include walking to the slope. After that we can continue with different games and activities such as playing chase (with or without skis). What follows are energetic activities for a specific warm-up. In alpine skiing, leg muscles and joints are stressed the most. We can achieve an adequate warm-up of the legs by most activities that involve the legs (e.g., playing chase). When this happens, specific warm-up may not be necessary. You can achieve an adequate warm-up of the legs by most activities that involve the legs (e.g., playing chase). When this happens, specific warm-up may not be necessary.



dr. Ron Klipp

Ron Klipp did his Ph.D. work in motor control at the University of Utah, where he started working with the U.S. Ski Team's Sports Science Department. From 1996 to 2000 he was Director of Athlete Preparation for U.S. Skiing. In 2000 he went to work for the U.S. Ski Team's Men's Alpine World Cup Team. He finished his tenure with the U.S. Ski Team in 2003 as Assistant Director of Coaches Education. Currently Ron works with the Norwegian Men's Alpine National Team as an on-hill coach and as a sport science consultant when he is not teaching at Deer Valley in Utah. Presently he is Education Manager for the Intermountain Division of PSIA Professional Ski Instructor's of America. Ron has authored or co-authored over 40 scientific published papers on skiing, and has given over 80 presentations nationally and internationally on skiing.



dr. Matej Supej

Warm-up may include walking to the slope. After that we can continue with different games and activities such as playing chase (with or without skis). What follows are energetic activities for a specific warm-up. In alpine skiing, leg muscles and joints are stressed the most. We can achieve an adequate warm-up of the legs by most activities that involve the legs (e.g., playing chase). When this happens, specific warm-up may not be necessary. You can achieve an adequate warm-up of the legs by most activities that involve the legs (e.g., playing chase). When this happens, specific warm-up may not be necessary.



Skiing is a game

Rado Pišot, Ron Klipp & Matej Supej

Rado Pišot, Ron Klipp & Matej Supej

Skiing is a game



Pišot, Klipp, Supej, 2011, 2015



More.....

<http://www.spe-balkan-ski.com/>

Pamporovo, BULGARIA
March 2022



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SKI EASY

Development of a Simpler, Accessible and Youthful European-wide Alpine Skiing Teaching Concept

EASY - Education, Accessible, Simple,
Youthful



Co-funded by the
Erasmus+ Programme
of the European Union

Thank to....

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- V. Podgornik for the help and preparation of the video clips...
- Coauthors of books and papers, ...
- To all members of the IVSS board and other colleagues involved in webinar organization....



Thank you and many greetings

from **Slovenia!**

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