

# Using AI Applications to Optimize Performance Efficiency in Exercises Aimed at Developing Certain Health-Related Fitness Elements with Resistance Bands in a Sample of 19-Year-Old Students

## A Case Study of the "Muscle & Motion – Strength Training" Mobile App

<sup>1</sup>Abdelkarim Bakri, <sup>2</sup>Omar Bouadjila, <sup>3</sup>Oussama bouhali

<sup>1</sup>Abdelkarim Bakri / Institute of Sciences and Techniques of Physical and Sports Activities, University of M'sila  
[abdelkarim.bakri@univ-msila.dz](mailto:abdelkarim.bakri@univ-msila.dz)

<sup>2</sup>Omar Bouadjila / Institute of Physical Education and Sports, University of Constantine 2  
[Bouadjila.omar@univ-constantine2.dz](mailto:Bouadjila.omar@univ-constantine2.dz)

<sup>3</sup>Oussama bouhali / Institute of Physical Education and Sports, University of Constantine 2  
[Bouhali.Oussama@univ-constantine2.dz](mailto:Bouhali.Oussama@univ-constantine2.dz)

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### Abstract:

Our current study aimed to examine the impact of using artificial intelligence applications to enhance the performance efficiency of exercises designed to develop specific health-related fitness elements using resistance bands. The study relied on the "Strength Training App" as a tool for regulating, organizing, and correcting movement performance. The app provides a range of exercises focused on improving health-related fitness elements, along with features for performance demonstration, correction, and muscular analysis, the research further explored the effect of these exercises, performed with resistance bands, on the development of certain health-related fitness components among first-year students at the Institute of Physical Activity and Sports Science.

-The findings revealed that the "Strength Training App" had a significant impact on improving the performance efficiency of exercises targeting health-related fitness elements. Specifically, the exercises inspired by the app, utilizing resistance bands, had a positive effect on the development of fitness components such as muscular endurance, strength, flexibility, and cardiovascular efficiency among student athletes.

**Keywords:** Artificial Intelligence; Strength Training App; Health-Related Fitness; Resistance Band Exercises.

## 1. Introduction and Research Problem:

Driven by scientific research and field experience in sports, artificial intelligence (AI) has transitioned from a conceptual idea to a tangible reality in the sports domain. AI now not only simulates human intelligence but sometimes surpasses it. This advancement is no longer confined to specific fields but has permeated all aspects of life, including sports, where it has witnessed significant development in recent years. AI has revolutionized athletic performance and training by providing unprecedented analytical insights through wearable devices, motion capture systems, and intelligent analysis tools, including mobile applications.

Coaches can now develop precise and customized training plans for each athlete. Moreover, AI has enhanced injury prevention and improved tactical strategies during matches. Thanks to these tools and technologies, AI has become a cornerstone for achieving success and excellence in various sports disciplines. Additionally, AI applications have become integral in gyms, offering personalized training programs, performance monitoring, and instant feedback via intelligent training systems.

Smart technologies leverage data collected by wearable devices, such as smartwatches and fitness trackers, to monitor performance metrics like speed, distance, and heart rate variability. This data assists coaches in designing tailored training programs, improving performance, and tracking athletes' physical conditions. For instance, in endurance sports like running or swimming, AI uses data models to analyze athletes' speed and recovery time, thereby enhancing strategic performance. (Tom Farnschlager, 2024)

As such, smart tools and technologies have become indispensable in athlete training and performance enhancement. They provide precise analytics and instant information, enabling coaches to make strategic decisions. Wearable devices, including smartwatches and fitness trackers, monitor metrics such as heart rate, distance covered, and calories burned. These real-time insights allow athletes and coaches to adjust training plans and track performance. (Tools and Gadgets That Shape Champions, 2024)

Given that health-related fitness has become essential for everyone—whether athletes or non-athletes—it is regarded as a vital aspect of overall fitness. It encompasses mental, psychological, and social qualities that enable individuals to live balanced lives within society. The concept of improving general fitness refers

to developing its core components to elevate an individual's physical performance. This involves designing programs to enhance components such as strength, speed, flexibility, endurance, and agility. Training serves as the primary method to influence individuals physiologically and anatomically, elevating their performance levels. It also aids in developing physical capabilities and motor skills. Training, in essence, involves purposeful physical exertion aimed at producing specific physical and neurological effects. (Eman, Mohammed, 2013, p. 363)

The development of physical fitness components relies on diverse training methods and exercises. With advancements in sports—whether in skills, training methodologies, or equipment—athletes can achieve their desired results. In this context, we utilized the "Strength Training App" as a training organizer and movement performance regulator to develop health-related fitness elements using resistance bands.

This study is guided by the following research question, which forms the core of its problem:

Do the exercises inspired by the "Strength Training App" using resistance bands positively impact the development of certain health-related fitness elements among amateur athletes?

## **2. Study Objectives:**

- To implement health-related fitness exercises using resistance bands from the "Strength Training App" as a regulator, organizer, and corrector of movement performance.
- To examine the impact of exercises with resistance bands on the development of certain health-related fitness components among first-year students at the Institute of Physical Activity and Sports Sciences.

## **3. Importance of the Study:**

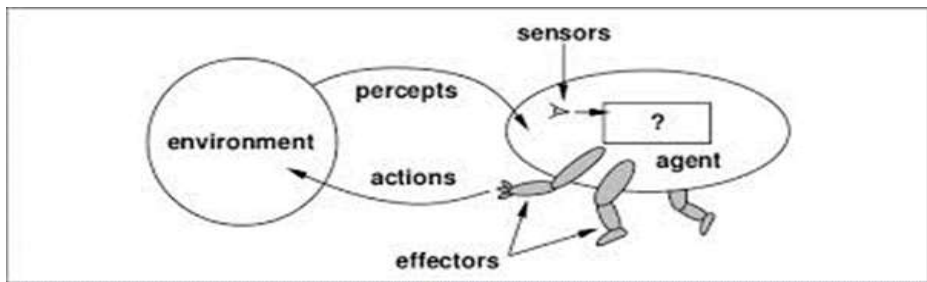
- Highlighting the role of AI-based exercises in organizing and facilitating sports training and motor learning processes.
- Emphasizing the role of resistance bands in developing and improving specific health-related fitness components among students.

## 4. Study Terminologies:

### 4.1. Concept of Artificial Intelligence (AI):

The term "artificial intelligence" refers to the abstraction of software, ideas, or concepts, akin to pure terms like methods, functions, and objects. The concept of AI provides a convenient and robust way to describe complex programs as entities capable of operating with a certain degree of autonomy to accomplish tasks on behalf of users. Unlike objects, which are defined in terms of methods and attributes, AI is characterized by its behavior. (Zaytoon, 2021, p. 59).

**Figure (1) illustrates the concept of artificial intelligence in a simplified manner:**



(Source: Al-Namri, 2024)

### 4.2. Application Used: (MUSCLE & MOTION – Strength Training App):

A dynamic visual resource that makes musculoskeletal anatomy and kinesiology easier to learn, remember and understand. (Designed by Amit Gal 2011), Anatomy of Strength Training, Exercise Encyclopedia, 3D Musculoskeletal Anatomy, and more – All in one Visualization Tool.

-This visualization tool creates complete visual integration between the various fields of strength training using multimedia tools.

-250 Strength Exercise Videos ,Anatomical analysis of each strength training exercise ,Interactive 3D anatomy of the muscular and skeletal systems

-Kinesiology: 3D analysis of body movements ,Test and Principles of workout theory ,Strength and Endurance workout methods ,Strength Training Workouts Programs.

### **4.3 Concept of Health-Related Fitness:**

The ability to perform daily tasks energetically without fatigue or exhaustion, while maintaining additional energy for recreational activities and readiness for any emergency situations required by life circumstances.

### **4.4. Concept of Physical Exercise:**

Physical exercises are a series of positions and movements aimed at shaping the body and developing various motor abilities to help athletes achieve the highest levels of performance—both athletic and functional—as well as in different areas of life. These exercises are grounded in educational and scientific principles.

### **4.5. Resistance Bands:**

Resistance bands are made from any long fibrous thread-like material. In this context, we focus on exercises using elastic resistance bands, which are characterized by flexibility. Such exercises, like those involving "sando" or elastic bands, serve as external resistances that contribute to the development of specific types of muscular strength. (Susan, 2014, p. 26)

## **5. Previous and Related Studies:**

### **5.1. Study by Essam Hegab and Moussa Bouthera (2024):**

This study aimed to highlight the conceptual framework of artificial intelligence, along with its features, significance, and applications in the fields of training and physical preparation. The research particularly focused on the scientific applications of smartphone tools for analyzing sports performance, exemplified by the (VMA Running App). The app was employed to measure the physical and functional abilities of certain athletes.

### **5.2. Study by Mohamed Ibrahim El-Meligy (2023):**

This article explored the numerous potential benefits of using artificial intelligence in the sports industry. It demonstrated how AI could help sports teams save time and money while also enhancing performance. For instance, AI can reduce the costs associated with video analysis required by coaches for performance review. Additionally, it enables the creation of personalized training programs tailored to the specific needs of athletes.

## 6. Methodological Procedures of the Study:

### 6.1. Study Population and Sample:

The study sample consisted of a group of amateur athletes intentionally selected, comprising 12 students from the Institute of Physical Activity and Sports Sciences.

### 6.2. Research Methodology:

The researchers employed the experimental method using the **one-group design** to suit the nature of the research. This experimental design involves a single experimental group subjected to a pre-test to determine its initial state before introducing the experimental variable. The group is then exposed to the experimental variable, followed by a post-test to assess the effects.

### 6.3. Data Collection Tools:

- Resting heart rate was measured using a pulse monitor.
- Weight and height were recorded using appropriate measuring devices.
- Body circumferences were assessed with body circumference measuring tools.
- Skinfold thickness was measured using a skinfold caliper to assess subcutaneous fat layers.

### 6.4. Applied Tests in the Study:

- **Flexibility Test:** Forward trunk bending from a standing position.
- **Arm Strength Test:** Arm bending and extending from a front support position for 30 seconds (to measure arm muscle endurance).
- **Vertical Jump Test:** Squat position (full knee bend) jumping for 30 seconds (to measure muscle endurance of the legs and back).
- **Push-Up Test:** Measuring the strength of arm and chest muscles.
- **Abdominal Endurance Test:** From a lying position with hands interlocked behind the head, alternating torso raises to touch the knees (to measure abdominal muscle endurance).
- **Harvard Step Test:** Assessing heart rate after exertion.

## **6.5. Field Application Procedures:**

### **Pre-tests:**

Pre-tests were conducted in the gymnastics hall on the research sample. These tests included:

- Recording resting heart rate.
- Measuring weight and height.
- Measuring body circumferences.
- Assessing skinfold thickness under the skin.
- Conducting functional tests.
- Flexibility tests.
- Muscle strength and endurance tests.

### **Training Program:**

A training program was implemented based on the AI-powered application (Strength Training App), which was downloaded onto the smartphones of the study participants. The program included 8 practical units, with two sessions per week (Monday and Thursday) over a period of eight weeks. The exercises outlined in the curriculum were performed using resistance bands. Each training session lasted approximately **25 minutes**, incorporating time for performance correction, as provided by the app. The app features **Exercise Videos** and **Common Mistakes** icons to guide the correction process. (See Appendices)

### **Post-tests:**

The post-tests were conducted on the study participants in the gymnastics hall, ensuring that all spatial and temporal conditions were consistent with those of the pre-tests.

## **7. Presentation and Analysis of Results:**

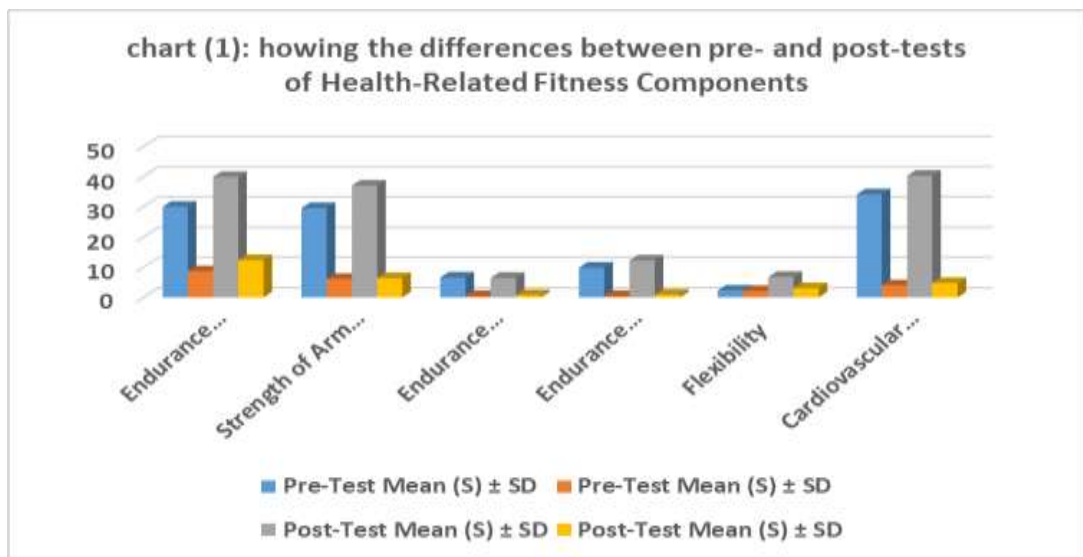
### **7.1. Presentation of the Hypothesis Results:**

The hypothesis posited that exercises derived from the (Strength Training App) using resistance bands would have a positive impact on the development of certain health-related fitness components among amateur athletes.

**Table (1): Mean, Standard Deviation, and Calculated t-value for Health-Related Fitness Components**

Variables  Statistical Measures	Pre-Test		Post-Test		Calculated t-Value	Unit Of Measurement
	Mean (S) ± SD		Mean (S) ± SD			
Endurance Strength of Abdominal Muscles	30.00	8.66	39.85	12.31	14.29	Repetitions
Strength of Arm Muscles	29.55	6.12	37.00	6.37	22.58	Time (Seconds)
Endurance Strength of Leg and Back Muscles	6.57	0.466	6.46	0.72	0.45	Repetitions
Endurance Strength of Arm and Chest Muscles	9.87	0.46	12.23	0.88	15	Repetitions
Flexibility	2.28	2.12	6.78	3.04	4.03	Centimeters
Cardiovascular Efficiency	34.07	4.00	40.21	4.74	32.80	Heartbeats (Per Minute)

Note: The tabular t-value at a significance level of  $\leq 0.05$ .



## 7.2. Discussion of Results in Light of the Hypothesis:

Based on the results presented in the table above, a noticeable improvement in arm muscle strength is observed. Researchers attribute this improvement to the fact that muscle strength is a crucial indicator and vital component of physical fitness for health. The strength developed significantly due to the training program followed using the (Strength training app), which features exercises based on time intervals, along with models for displaying exercises and common mistakes to avoid. The exercises also rely on three types of resistance bands (red, blue, and green), with each color representing a specific intensity: red for low resistance, blue for medium resistance, and green for high resistance, depending on the elasticity of the band. Additionally, strength training focused on muscle contractions, with the goal being to perform as many repetitions as possible within a set time period. This approach stimulates a greater number of motor units due to rapid muscle contractions, leading to neural adaptation, which is key for improving maximum strength. Maximum strength depends mainly on recruiting a greater number of motor units. As noted in previous studies, strength is directly linked to the number of muscle fibers engaged in muscle contractions and their overall size.

The training program, supported by artificial intelligence for correcting positions and adjusting performance time, encompassed multiple physical attributes. Previous studies have shown that improvements in one physical attribute can positively affect others when they are trained together, such as strength and endurance. In contrast, focusing solely on developing a single attribute may not yield rapid results as expected. (Iman, Mouhammad, 2013, p. 370)

Regarding **endurance strength**, the results in the table show clear improvement in post-test scores compared to pre-test results. Researchers attribute this to the effective contribution of the training program in enhancing muscle strength and subsequently increasing endurance. Muscle strength is correlated with endurance; when strength improves, muscles are capable of performing more repetitions than before.

As for **flexibility**, the effectiveness of the exercises in the training program and their proper execution contributed to an improvement in flexibility. Flexibility refers to "the ability to perform movements across a wide range of motion" (Iman, Mouhammad, 2013, p. 371). Increasing the difficulty or slowing down the

execution of motor skills due to inadequate flexibility can hinder performance in competitive exercises.

Supporting the results, the researchers reference the use of artificial intelligence in the training program, which helps clarify the correct movement patterns for each exercise through video demonstrations and muscle anatomy breakdowns. Additionally, videos highlighting common mistakes help improve performance. This approach played a key role in improving selected components of physical fitness, including flexibility, strength, endurance, and cardiovascular efficiency. Furthermore, resistance band exercises are primarily designed to engage muscles, with the elasticity of the bands being essential for flexibility training. These exercises promote joint extension, enabling the muscle to reach its maximum range of motion, which enhances muscle flexibility. Correct execution of these exercises, along with the appropriate hold duration, further contributes to muscle development and flexibility improvement.

The training program (Strength training app) ensures that the correct position and duration for each exercise are maintained, promoting an effective and safe workout routine. This strengthens the study's findings that the best methods for improving flexibility include performing exercises with continuous force and extended performance time, which facilitates the necessary tissue adaptations (Iman, Mouhammad, 2013, p. 370).

## **8. Conclusions:**

The use of the smartphone application (Muscle & Motion - Strength Training app) had a significant impact on improving the performance efficiency of exercises aimed at developing some elements of health-related fitness using resistance bands. These exercises, inspired by the app, showed positive effects in enhancing elements of health-related fitness (endurance strength, muscular strength, flexibility, and cardiovascular fitness) among first-year students at the Institute of Science and Techniques of Physical Activities and Sports.

## **9. Suggestions and Recommendations:**

- It is recommended to rely on artificial intelligence applications as tools to regulate the training and motor learning process by displaying movement and skill models, as well as correcting motor errors to facilitate the training process.

- Resistance band exercises can be adopted as a means to develop all elements of health-related fitness, making daily life activities easier and helping maintain overall physical fitness.
- Similar research should be conducted on other applications and sports.

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**Appendices:** The training program applied in our current study using the Artificial Intelligence mobile application (Muscle & Motion - Strength Training app).

The image displays four screenshots from the Muscle & Motion app. The top-left screenshot shows the '2 Weeks Suspension Trainer Program' overview, including a description and a 'Workouts schedule' section with a grid for weeks 1-4. The top-right screenshot shows 'SuperSet 5' with exercises: Biceps Curls (Straps) and Triceps Kick Back, Advanced Var... The bottom-left screenshot shows 'Warm Up' with 'Circuit 1 X2 Cycles' including: Squat (Straps), Hip Flexor Stretch, Jump (Rope), and Forward Bend Lat Stretch. The bottom-right screenshot shows another 'Warm Up' screen with the same exercises. Each exercise entry includes an anatomical diagram, name, set/rep information, and a 'Detailed sets' link.

**2 Weeks Suspension Trainer Program**

Comparing this plan to previous ones, this makes a significant leap in difficulty, intensity, and creativity. We will develop strength and muscular endurance through a full range of motion of the joints. Suitable for intermediate t...

Workouts schedule | Workouts list

workout < Week 1 - 4 >

W1	1	2	3	4	5	6	7
W2	1	2	3	4	5	6	7
W3	1	2	3	4	5	6	7
W4	1	2	3	4	5	6	7

**Rest 1 min**

**SuperSet 5**

**Arms**

**Biceps Curls (Straps)**  
2 sets: 8 reps, 8 reps

**Triceps Kick Back, Advanced Var...**  
2 sets: 8 reps, 8 reps

**Rest 1 min**

**SuperSet 6**

**Kneeling Rollout (Straps)**  
2 sets: 8 reps, 8 reps

**Oblique Crunch (Straps)**  
2 sets: 8 reps, 8 reps

**Warm Up**

**Circuit 1 X2 Cycles**

**Squat (Straps)**  
2 sets: 8 reps, 8 reps

**Hip Flexor Stretch**  
2 sets: 10 sec, 10 sec

**Jump (Rope)**  
2 sets: 20 sec, 20 sec

**Forward Bend Lat Stretch**  
2 sets: 10 sec, 10 sec

**Rest 1 min**

<h3>Knelling Rollout (Straps)</h3> <p>Exercise Videos Common Mistakes</p> <p>Knelling Rollout (Straps)</p> <p>The Knelling Rollout with Straps is an exercise aimed to strengthen your abdominal muscles and your shoulder extensor muscles.</p> <p>Begin by kneeling on the floor with your feet flat on the ground and hold the strap in.</p> <p>Active muscles: 4.5 Alternative exercise: 4.5</p> <p>Next Exercise</p>	<h3>Biceps Curls (Straps)</h3> <p>Exercise Videos Common Mistakes</p> <p>Exercise Videos Common Mistakes</p> <p>Exercise Videos Common Mistakes</p> <p>Active muscles: 4.5 Alternative exercise: 4.5</p> <p>Next Exercise</p>	<h3>Biceps Curls (Straps)</h3> <p>Exercise Videos Common Mistakes</p> <p>Exercise Videos Common Mistakes</p> <p>Active muscles: 4.5 Alternative exercise: 4.5</p> <p>Next Exercise</p>
<h3>Back Row (Straps)</h3> <p>Exercise Videos Common Mistakes</p> <p>Common mistakes: Sliding the body forward and backward through the pike. In other words, flexion and extension of the hip joint caused by lack of awareness in awareness of the core muscles or of the target muscles.</p> <p>Active muscles: 4.5 Alternative exercise: 4.5</p> <p>Next Exercise</p>	<h3>Back Row (Straps)</h3> <p>Exercise Videos Common Mistakes</p> <p>Exercise Videos Common Mistakes</p> <p>Reasons: Compensation for weakness in the abdominal muscles or lack of awareness.</p> <p>Active muscles: 4.5 Alternative exercise: 4.5</p> <p>Next Exercise</p>	<h3>Chest Press, Single-leg Extend...</h3> <p>Exercise Videos Common Mistakes</p> <p>The target muscle in this exercise is not only the pectoralis major but also the stabilizing muscles - the core muscles. The core muscles are indirectly active in all exercises to which the entire body serves as a "bridge" between arms and legs. The more parallel the bridge is to the ground, the harder the core muscles will work to stabilize the body.</p> <p>Active muscles: 4.5 Alternative exercise: 4.5</p> <p>Next Exercise</p>
<h3>Chest Press, Single-leg Extend...</h3> <p>Exercise Videos Common Mistakes</p> <p>Right: Spinal awareness by compensation for weak already muscles or weak core muscles (mainly abdominals), in this case of lack of awareness. In the condition of compensation, the same goal was not reached properly. The load on the lumbar vertebrae increases and therefore compensation between the two muscles is impaired.</p> <p>Active muscles: 4.5 Alternative exercise: 4.5</p> <p>Next Exercise</p>	<h3>Knelling Rollout (Straps)</h3> <p>Exercise Videos Common Mistakes</p> <p>Characteristic mistake Spinal flexion.</p> <p>Active muscles: 4.5 Alternative exercise: 4.5</p> <p>Next Exercise</p>	<h3>Knelling Rollout (Straps)</h3> <p>Exercise Videos Common Mistakes</p> <p>Knelling Rollout (Straps)</p> <p>The Knelling Rollout with Straps is an exercise aimed to strengthen your abdominal muscles and your shoulder extensor muscles.</p> <p>Begin by kneeling on the floor with your feet flat on the ground and hold the strap in.</p> <p>Active muscles: 4.5 Alternative exercise: 4.5</p> <p>Next Exercise</p>
<h3>Chest Fly (Straps)</h3> <p>Exercise Videos Common Mistakes</p> <p>Exercise Videos Common Mistakes</p> <p>Exercise Videos Common Mistakes</p> <p>Active muscles: 4.5 Alternative exercise: 4.5</p> <p>Next Exercise</p>	<h3>Squat (Straps)</h3> <p>Exercise Videos Common Mistakes</p> <p>Exercise Videos Common Mistakes</p> <p>Exercise Videos Common Mistakes</p> <p>Active muscles: 4.5 Alternative exercise: 4.5</p> <p>Next Exercise</p>	<h3>Suspended Crunch</h3> <p>Exercise Videos Common Mistakes</p> <p>Exercise Videos Common Mistakes</p> <p>Active muscles: 4.5 Alternative exercise: 4.5</p> <p>Next Exercise</p>