THE IMPORTANCE OF INNOVATIVE TECHNOLOGY IN TRAINING TECHNICIANS TO REPAIR AND MAINTAIN VARIOUS TYPES OF CARDIOVASCULAR FITNESS EQUIPMENT

Abstract. This article explores the importance of using innovative technologies to train technicians in repairing and maintaining various types of cardiovascular fitness equipment. The study aims to identify the current educational needs for preparing technicians in fitness equipment repair and to examine how modern technologies can improve training processes and meet the demands of a growing market. General scientific methods of cognition, such as market analysis, a systematic approach, comparative analysis, and modeling, were utilized in the research. The findings show that the fitness equipment market in the USA demonstrates consistent growth, driven by an increasing interest in healthy lifestyles and technological advancements that make home workouts more accessible and effective. This trend, particularly spurred by the COVID-19 pandemic, has led many to prefer home workouts. Consequently, the rising demand for fitness equipment results in more frequent breakdowns, especially in cardiovascular machines, necessitating regular servicing and repairs. These needs create a high demand for skilled technicians in fitness equipment repair, yet the labor market faces a shortage of such professionals, as evidenced by the high wages in this sector. There is significant demand for educational courses that can train new specialists, but the supply is limited. Modern short-term training programs employing innovative technologies, such as virtual simulators, play a crucial role in providing the necessary skills for quick entry into the profession, supporting the growth of small and medium-sized businesses, and reducing unemployment rates. The practical significance of the research lies in its potential use for developing effective training programs for technicians, enabling them to meet the market's demand for qualified professionals.

Keywords: innovative technology; fitness equipment; virtual simulators; technical training; cardiovascular equipment repair.

Problem statement. In recent years, the awareness of a healthy lifestyle has significantly increased, with a particular focus on fitness at home. This trend is
driving the expansion of the fitness equipment market, offering more innovative solutions for home use. The growth of this market not only sustains consumer interest in maintaining physical fitness but also stimulates the integration of cutting-edge technological solutions in the fitness industry. The rapid expansion of the fitness industry directly impacts related sectors, notably the services for repairing and maintaining sports equipment. In the context of fitness centers, this also includes providing quality service, which in turn supports the health of visitors and enhances the reputation of the facilities. The stable operation of fitness equipment is directly linked to its regular technical maintenance and timely repairs. Against the backdrop of high service quality requirements for fitness equipment, there is a shortage of qualified specialists in this field. This challenge highlights the need for innovative technologies for quicker and more effective technician training. Utilizing technologies like virtual reality, augmented reality, and interactive training platforms can significantly accelerate the preparation process and ensure a higher level of competence among professionals in this niche.

Analysis of recent research and publications. The topic of integrating innovative technologies in training technicians for repairing and maintaining various types of cardiovascular equipment in the fitness industry is under-researched in scientific literature. Numerous publications address technical aspects of maintenance, market trends, and the professional training of specialists in this field. A significant contribution to the topic was made by the article from Advantage Fitness [1], which analyzes the frequency of equipment updates in gyms. Fortune Business Insights [2] explores the growth of the home fitness equipment market in the USA, further emphasizing the need for qualified technicians to service this equipment. According to data presented by Glassdoor [3], salary issues for fitness technicians are a crucial aspect of analysis. The high demand for these professionals underscores the necessity for proper training that includes innovative technologies [3,4]. Research by GymTech [5] highlights the importance of regular maintenance services for fitness equipment to ensure its long-term use and user safety. They note that the complexity of modern fitness equipment requires more specialized training for technicians, reaffirming the need for utilizing advanced technologies in training [5]. Statista [9] provides statistical data demonstrating the growth of the fitness equipment market. This further underscores the need for continuous updating of technicians' knowledge and skills as the market expands and technical training requirements increase [9,10]. Publications in contemporary online media, such as ZipRecruiter [12], Indeed [6], and SimplyHired [8], also highlight current aspects of the topic, particularly the labor market for fitness equipment repair technicians. These sources point out the importance of specialized skills and the incorporation of new technologies in training and employment processes. Therefore, there is a lack of systematic material on this research topic that covers all aspects of innovative technologies in training technicians for cardiovascular equipment maintenance.
Using various scientific cognition methods, the information has been analyzed, categorized, and systematized, and presented in the context of the research theme.

**Purpose of the article.** The aim of this article is to illustrate the current state and innovative directions in training specialists for repairing fitness equipment.

**Research results.**

**Overview of the fitness and fitness equipment market.**

The fitness equipment market in the USA has shown significant growth, underscoring its importance within the context of modern healthy living. In 2023, the market size was estimated at $5.43 billion, indicating a substantial number of consumers interested in maintaining their physical fitness at home. Projections suggest that by 2028, the market will grow to $6.79 billion, highlighting its dynamic development and the increasing popularity of home workouts (Fig.1).

![Fitness equipment market dynamics in the USA, billion USD](image)

**Fig.1. Fitness equipment market dynamics in the USA, billion USD [9]**

Note: Systematized by the author

The primary drivers of market growth include rising awareness of health and fitness among the population and the development of technologies that make fitness equipment more accessible and effective. Technologies such as integration with mobile apps, virtual trainers, and augmented reality enhance user motivation and make home workouts more engaging. The COVID-19 pandemic significantly influenced consumer behavior, particularly their attitude towards fitness, as evident in Fig.2. The closure of gyms and stay-at-home restrictions led many people to transition to home workouts, causing a sharp increase in demand for home fitness equipment. Although the pandemic is waning, the habits formed during this period persist, maintaining steady market demand.
Overall, the fitness equipment market in the USA can be divided into several main segments: cardio equipment, strength training machines, and other general fitness equipment. Cardio equipment, such as treadmills, stationary bikes, and elliptical trainers, continues to lead, accounting for 55% of the market, due to its versatility and effectiveness in maintaining overall physical fitness (Fig.3).

The fitness equipment market features several key players, including Peloton, NordicTrack, and Bowflex. These companies not only offer high-quality equipment but also actively develop innovative solutions, such as interactive workouts and online communities, which help expand their customer base [2].
Breakdowns and repairs of fitness equipment: the relevance of the problem

The frequency of breakdowns and repairs of fitness equipment in gyms depends on several factors, including the type of equipment, its usage intensity, and the frequency of maintenance [5]. Typically, cardiovascular machines, such as treadmills, stationary bikes, and elliptical trainers, are most prone to breakdowns due to high wear and tear from intense usage. Below are the most common issues with fitness equipment:

- **Treadmills**: One of the most frequent problems is belt stretching, which can lead to belt misalignment, uneven friction, and eventually, motor or roller failure. This often requires frequent adjustments or replacements. Additionally, electrical components, such as control boards and motors, may fail after prolonged use or due to inadequate maintenance.

- **Elliptical trainers**: These machines often suffer from worn bearings and belts due to the accumulation of sweat and dirt, as well as a lack of regular cleaning and lubrication.

- **Strength equipment**: Machines for strength training, such as multi-station gyms and cable systems, may require frequent checks and adjustments of cables and bolts to ensure user safety [5].

To further understand these issues, data from service centers across the USA has been systematized into a comparative table of the technical features of fitness equipment usage.

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Average Lifespan</th>
<th>Recommended Maintenance</th>
<th>Signs for Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>7-12 years</td>
<td>Regular cleaning and lubrication of moving parts, checking belt tension, monitoring engine and electronic conditions</td>
<td>Belt stretching or misalignment, uneven movement, increased noise</td>
</tr>
<tr>
<td>machines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength equipment</td>
<td>10+ years</td>
<td>Regular inspection of cables and bolts, replacement of worn parts, checking stability and structural integrity</td>
<td>Worn cables, instability or wobbling, structural damage</td>
</tr>
<tr>
<td>Functional equipment</td>
<td>High durability</td>
<td>Regular inspection for signs of wear and damage, replacement of worn or damaged elements</td>
<td>Surface damage, worn handles or straps, cracks or tears</td>
</tr>
<tr>
<td>Accessories and small items</td>
<td>1-5 years</td>
<td>Frequent checks for wear, regular cleaning, replacement as needed</td>
<td>Surface wear, stretching or loss of elasticity, compromised integrity</td>
</tr>
</tbody>
</table>

Note: Systematized by the author [5]
Fitness equipment in gyms requires regular maintenance and repair to ensure safe and effective operation. The frequency of repairs and equipment replacement depends on the type of equipment, its usage intensity, and the quality of maintenance (Table 2).

Table 2

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Maintenance Frequency</th>
<th>Replacement Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardio equipment</td>
<td>Quarterly or semi-annual. Check belt tension, engine, electronics, regular cleaning and lubrication</td>
<td>Every 3-5 years depending on quality and usage level</td>
</tr>
<tr>
<td>Strength equipment</td>
<td>Annual inspection for cable and bolt wear, lubrication of moving parts</td>
<td>Can last over 10 years. Replace as parts wear out or become unavailable</td>
</tr>
<tr>
<td>Functional equipment</td>
<td>Annual inspection for damage, regular cleaning</td>
<td>Replace as it wears out, typically every 2-5 years</td>
</tr>
<tr>
<td>Accessories (mats, bands)</td>
<td>More frequent, every 6-12 months, especially under intensive use</td>
<td>Every 1-2 years or when significant wear is obse</td>
</tr>
</tbody>
</table>

Note: Systematized based on [5]

An analysis of the frequency of breakdowns and the need for fitness equipment repairs indicates a high volume of work required to maintain the effective and safe operation of this equipment in gyms. Considering the numerous components prone to wear, such as treadmill belts, elliptical trainer bearings, and strength equipment cables, the need for regular maintenance and repairs is critical. However, there is a shortage of qualified technicians in the labor market, making it challenging to provide timely and effective service. This underscores the importance of leveraging innovative technologies to train new professionals in this field.

Overview of the U.S. market for fitness equipment repair personnel

The U.S. market for personnel engaged in the repair and maintenance of fitness equipment reveals a significant and steady demand for specialists in this area. Market analysis indicates that the number of technicians required to meet current repair and maintenance needs is substantial, given the widespread presence of fitness centers (over 31,000) and home gyms across the country. The labor market for fitness equipment repair technicians shows a stable demand with various opportunities and salary ranges throughout the United States. According to ZipRecruiter [12], as of 2024, there is a continuous demand for more than 3,000 specialists nationwide. The average hourly wage for a fitness equipment repair technician in the U.S. is approximately $22.35. This can vary by location, with some regions offering higher wages based on demand and the cost of living. Glassdoor (2024) reports that the annual salary for fitness equipment maintenance technicians.
ranges from approximately $45,000 to $65,000, depending on experience, location, and specific employer requirements. Indeed [6] lists numerous job openings for fitness equipment repair technicians across different states. These positions often require skills in diagnosing, repairing, and maintaining fitness equipment such as treadmills, elliptical trainers, and stationary bikes. ZipRecruiter [12] emphasizes that these roles are available in both residential and commercial settings, with some technicians working in fitness centers, others for repair companies, or independently.

**Competencies of fitness equipment repair specialists**

Based on research across various job listing sites, a list of key competencies required by employers for fitness equipment repair specialists has been identified.

*Table 4*

<table>
<thead>
<tr>
<th>Competency / Requirement</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical knowledge</td>
<td>Deep understanding of the mechanical, electrical, and electronic systems used in modern fitness equipment.</td>
<td>Indeed</td>
</tr>
<tr>
<td>Problem diagnostics</td>
<td>Skills in identifying and diagnosing technical faults in fitness equipment, using tools for testing and diagnostics.</td>
<td>SimplyHired</td>
</tr>
<tr>
<td>Repair and maintenance</td>
<td>Performing repairs and regular maintenance on fitness equipment, including part and component replacement.</td>
<td>Glassdoor</td>
</tr>
<tr>
<td>Customer service skills</td>
<td>Ability to communicate effectively with clients, providing advice on the use and maintenance of equipment.</td>
<td>ZipRecruiter</td>
</tr>
<tr>
<td>Physical stamina</td>
<td>Capability to lift and move heavy equipment, perform physical tasks related to repairs.</td>
<td>Indeed</td>
</tr>
<tr>
<td>Certifications and licenses</td>
<td>Holding professional certifications or licenses in equipment repair, such as manufacturer-specific certificates.</td>
<td>Glassdoor</td>
</tr>
<tr>
<td>Tool proficiency</td>
<td>Experience in using a variety of hand and power tools for equipment repair and maintenance.</td>
<td>ZipRecruiter</td>
</tr>
<tr>
<td>Time management</td>
<td>Ability to efficiently manage time to handle multiple tasks simultaneously, ensuring timely completion of repair work.</td>
<td>Indeed</td>
</tr>
<tr>
<td>Basic IT skills</td>
<td>Knowledge of software and applications that can be used for diagnostics and managing work processes.</td>
<td>SimplyHired</td>
</tr>
</tbody>
</table>

Systematized based on [4,6,8,12]

**Features of professional training for fitness equipment repair specialists**

Training for fitness equipment repair specialists in the USA involves several key stages, focusing on specialized training and continuous education. These stages equip technicians with the necessary skills and knowledge to effectively service and repair modern fitness equipment.

After acquiring basic knowledge and some work experience, fitness equipment repair specialists undergo specialized training offered by major equipment manufacturers. For instance, Life Fitness (2024) provides comprehensive certification courses lasting about five days. These courses, though designed for technicians who handle
other types of machinery, combine theoretical instruction with practical sessions, allowing technicians to gain an in-depth understanding of the operation and repair of fitness equipment. Life Fitness programs cover fault diagnosis, preventive maintenance, and software update instructions.

As the field of fitness equipment repair continuously evolves, technicians must keep their knowledge up-to-date. Ongoing education is a crucial part of every specialist’s career in this industry. Equipment manufacturers frequently conduct training webinars, offer online courses, and provide access to training materials to help technicians stay current with new technologies and repair methods. Life Fitness has launched its e-learning platform, offering numerous instructional videos, guides, and technical information essential for technicians. These resources allow professionals to acquire new knowledge at their own pace and convenience. Additionally, companies often offer recertification programs to ensure that technicians' skills and knowledge remain relevant.

Technicians can also participate in conferences and specialized training sessions organized by leading brands. These opportunities enable them to not only gain new insights but also share experiences with industry colleagues [11].

The use of innovative technologies in training fitness equipment repair specialists

Innovative technologies accelerate the training process for fitness equipment repair technicians. Accelerated training programs focus on developing qualified specialists capable of effectively maintaining and repairing fitness equipment. For trainees without technical experience, the training should begin with a short foundational course that includes working with virtual simulators. These simulators allow learners to acquire the necessary skills without risking actual equipment. Completing the foundational course provides the competencies needed for independent practice and skill enhancement.

Continuing education within a comprehensive course includes a deeper study of the mechanics and electronics of fitness equipment, as well as methods for its modernization and preventive maintenance. Course participants who have access to virtual reality also gain access to a technical library, online and offline expert consultations, and monthly master classes, fostering continuous professional growth.

Special attention in training programs is given to the use of innovative technologies such as virtual simulators and artificial intelligence. Completing the course enables technicians to be included in a database of certified specialists, significantly increasing their employment prospects in fitness centers, gyms, or in establishing their own service companies. This approach promotes the growth of small and medium-sized businesses and reduces unemployment.

The training program also includes a project on recycling fitness equipment, allowing the collection and restoration of old or unused equipment for reuse. These
courses are crucial not only for providing education and professional training but also for ensuring safe and reliable maintenance of fitness equipment. This, in turn, reduces the risk of injury during use and ensures a high level of customer satisfaction in fitness centers.

**Conclusions.** The U.S. fitness equipment market was valued at $5.43 billion in 2023, with an expected growth to $6.79 billion by 2028. A significant increase in demand was noted during the COVID-19 pandemic, which spurred a trend towards home workouts. This led to more frequent equipment breakdowns, especially in cardiovascular machines, which comprise 55% of the market. The need for regular maintenance and repairs drives demand for qualified technicians. Despite the high average hourly wage for equipment repair technicians in the U.S., there is a shortage of professionals in the field due to a lack of educational programs. Given the high demand for technicians, short-term training programs lasting less than a week and including practical sessions are gaining popularity. However, these courses are aimed at upskilling technical personnel. At the same time, there is also a need for courses that prepare specialists without a technical background. Virtual simulators are effective training tools for this purpose, facilitating the rapid acquisition of necessary skills and meeting the growing demand in the fitness repair market. Modern short-term training programs utilizing innovative technologies, such as virtual simulators, play a crucial role in providing the necessary competencies for quick entry into the profession. They support the development of small and medium-sized businesses and reduce unemployment.

**References:**
