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STEAM&Sports

Co-funded by the European Union

STEAM&SPORTS PROCEEDINGS OF THE FINAL CONFERENCE

UNIVERSIDAD DE BURGOS

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2026

STEAM and Sports: A Goal for Education Equity
Erasmus+ 2024-1-ES01-KA220-SCH-000243408

This work forms part of the educational and research activities developed within the framework of the STEAM&Sports project (STEAM and Sports: A Goal for Education Equity). STEAM&Sports is funded under the Erasmus+ Programme, Key Action 2: Cooperation Partnerships in School Education (Reference: 2024-1-ES01-KA220-SCH-000243408).

The project is coordinated by the University of Burgos (Spain) and involves the following partner organisations: Learning Hub Friesland (The Netherlands), Future Minds Skopje (North Macedonia), Osnovna škola "Branko Radičević" (Serbia), Osnovna škola Bakar (Croatia), and Osnovno Učilište Jan Amos Komenski (North Macedonia).

The project aims to promote educational equity through the integration of STEAM education and sports, fostering interdisciplinary learning, increasing student engagement in STEAM subjects, and supporting innovative teaching practices across diverse educational contexts.

The STEAM&Sports project is co-funded by the European Union. The views and opinions expressed in this publication are solely those of the author(s) and do not necessarily reflect those of the European Union or the Spanish Service for the Internationalisation of Education (SEPIE). Neither the European Union nor the SEPIE National Agency can be held responsible for the views expressed herein.

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PREFACE

The rapid evolution of contemporary societies requires educational systems to prepare young people not only with disciplinary knowledge, but also with the capacity to connect ideas across fields, solve complex problems, collaborate effectively, and engage actively with the world around them. In this context, interdisciplinary approaches such as STEAM education have emerged as powerful frameworks for fostering creativity, critical thinking, innovation, and lifelong learning.

The Erasmus+ Cooperation Partnership project **STEAM and Sports: A Goal for Education Equity (STEAM&Sports)** was conceived with the belief that sports can serve as a natural and highly motivating gateway to STEAM learning. While science, technology, engineering, arts, and mathematics are often taught as separate disciplines, sports offer authentic situations in which these fields intersect meaningfully. Through movement, competition, cooperation, health, performance, and problem-solving, students encounter scientific principles, mathematical reasoning, technological applications, engineering challenges, artistic expression, and social values in ways that are tangible and relevant to their everyday lives.

The project brought together six organisations from five European countries: Spain, the Netherlands, Croatia, Serbia, and North Macedonia. Coordinated by the University of Burgos, the consortium worked collaboratively over two years to design, implement, evaluate, and disseminate innovative educational resources capable of strengthening student engagement with STEAM subjects while promoting inclusion, participation, and educational equity.

The central ambition of the project was threefold: to provide equitable learning opportunities for diverse learners, including those traditionally underrepresented in STEAM fields; to encourage educators to explore meaningful connections between sports and STEAM disciplines; and to increase students' interest, motivation, and understanding of STEAM concepts through engaging and authentic learning experiences.

To achieve these goals, the consortium developed a comprehensive teaching guide integrating sports and STEAM education, created a mobile application designed to support autonomous and interactive learning, implemented hands-on learning experiences in partner schools, and produced a variety of dissemination materials to share project outcomes with educational communities across Europe and beyond.

The Final Conference (June 18-19, 2026. Burgos (Spain)) represented the culmination of this collaborative effort. More importantly, it provided a forum for educators, researchers, and practitioners to share innovative experiences inspired by the project's philosophy. The contributions collected in this volume demonstrate the remarkable diversity of ways in which sports can become a catalyst for interdisciplinary learning. Across the chapters, readers will encounter initiatives connecting physical activity with mathematics, biology, environmental sustainability, engineering design, artificial intelligence, digital technologies, health promotion, creativity, and inquiry-based learning.

Several contributions illustrate how sports contexts can make abstract STEAM concepts more accessible and meaningful. Others show how emerging technologies, including artificial intelligence and mobile applications, can enhance educational experiences while maintaining a strong focus on student-centred and experiential learning. Together, these works highlight a common conviction: meaningful education occurs when knowledge is connected to authentic experiences, when students are active participants in the learning process, and when disciplinary boundaries become opportunities for collaboration rather than barriers to understanding.

Beyond the specific educational proposals presented here, the STEAM&Sports project advocates a broader vision of education. It argues that educational equity is not only a matter of access, but also of engagement. Students are more likely to participate, persist, and succeed when learning is connected to their interests, experiences, and aspirations. Sports, with their universal appeal and capacity to unite individuals across cultures and backgrounds, provide a powerful vehicle for achieving this goal.

The editors hope that this volume will serve as both a record of the project's achievements and a source of inspiration for teachers, researchers, school leaders, and policymakers seeking innovative ways to promote interdisciplinary learning. We also hope that the ideas presented here will encourage further collaboration among educators who share the conviction that learning should be active, inclusive, meaningful, and accessible to all.

Finally, we would like to express our sincere gratitude to all partner organisations, teachers, students, researchers, and stakeholders whose commitment made this project possible. Their creativity, enthusiasm, and willingness to explore new educational pathways have transformed an ambitious idea into a rich collection of practices and resources that will continue to benefit educational communities long after the project's conclusion.

May these proceedings contribute to the ongoing dialogue on educational innovation and inspire future initiatives that place curiosity, participation, inclusion, and human development at the heart of learning.

The Editors
STEAM and Sports: A Goal for Education Equity
Final Conference Proceedings
University of Burgos, 2026

ACKNOWLEDGEMENTS

The editors would like to express their sincere gratitude to all individuals and institutions who contributed to the successful development and implementation of the Erasmus+ Cooperation Partnership project **STEAM and Sports: A Goal for Education Equity (STEAM&Sports)**.

First and foremost, we acknowledge the support of the **European Union**, whose Erasmus+ Programme made this initiative possible. Through this support, the project consortium was able to explore innovative ways of connecting STEAM education and sports, promoting interdisciplinary learning and educational equity across diverse educational contexts.

We extend our deepest appreciation to all partner organisations for their commitment, professionalism, and collaborative spirit throughout the project:

University of Burgos (Spain) – Project Coordinator

Learning Hub Friesland (The Netherlands)

Future Minds Skopje (North Macedonia)

Osnovna škola "Branko Radičević" (Serbia)

Osnovna škola Bakar (Croatia)

Osnovno Učilište Jan Amos Komenski (North Macedonia)

The success of this project is the result of the dedication of numerous teachers, researchers, educational professionals, school leaders, and administrative staff who invested their expertise, creativity, and enthusiasm in every stage of the initiative. Their willingness to collaborate across national, cultural, and disciplinary boundaries exemplifies the values that underpin European educational cooperation.

Special recognition is due to the educators who embraced innovation by integrating sports, science, technology, engineering, arts, and mathematics into their daily practice. Their work demonstrates that educational innovation is not solely the product of new technologies or methodologies, but of committed professionals willing to create engaging learning opportunities for all students.

It is our hope that the partnerships established, the resources developed, and the experiences documented in this volume will continue to inspire future initiatives aimed at fostering educational equity, active learning, and interdisciplinary collaboration throughout Europe and beyond.

CHAPTER 1

The STEAM&Sports Project

PROJECT OVERVIEW

STEAM and Sports: A Goal for Education Equity (STEAM&Sports) is an Erasmus+ Cooperation Partnership in School Education (KA220-SCH) funded by the European Union and implemented between September 2024 and August 2026. Coordinated by the University of Burgos (Spain), the project brought together six organisations from five European countries with the shared objective of promoting innovative, inclusive, and interdisciplinary educational practices through the integration of STEAM education and sports.

The project emerged from a growing concern regarding student engagement in STEAM subjects and the persistent challenges associated with educational equity. Despite the increasing importance of science, technology, engineering, arts, and mathematics in contemporary societies, many students continue to perceive these disciplines as abstract, disconnected from their daily lives, or inaccessible. The STEAM&Sports consortium identified sports as a powerful and universally appealing context capable of making STEAM learning more meaningful, practical, and engaging for diverse groups of learners.

The project pursued three main objectives. First, it aimed to provide equitable learning opportunities that appeal to a broad range of students, including those traditionally underrepresented in STEAM fields. Second, it sought to encourage teachers to explore meaningful connections between sports and STEAM disciplines, fostering a more holistic understanding of knowledge and its real-world applications. Third, it aimed to increase students' interest, motivation, and engagement in STEAM subjects through active and interdisciplinary learning experiences.

To achieve these objectives, the consortium developed a comprehensive set of educational resources and learning experiences structured around four main work packages. These included the creation of a **STEAM and Sports Teaching Guide**, the development of a **mobile application** to support autonomous learning, the implementation of **hands-on learning experiences** in partner schools, and the production of various **dissemination tools** designed to share the project's outcomes with educators and stakeholders across Europe.

The project involved educational institutions, schools, and educational organisations from Spain, the Netherlands, Serbia, Croatia, and North Macedonia, allowing for the testing and validation of resources across different cultural and educational contexts. This international collaboration enriched the development process and provided valuable insights into the transferability and adaptability of interdisciplinary educational approaches.

The results presented in this volume represent the culmination of two years of collaborative work and provide evidence of the potential of interdisciplinary approaches to enhance both educational quality and educational equity.

MAIN OUTCOMES

The STEAM&Sports project produced a comprehensive set of educational resources and learning experiences designed to strengthen student engagement in STEAM subjects through the motivating context of sports. The project's outcomes were developed collaboratively by the consortium and tested across different educational settings to ensure their relevance, accessibility, and transferability.

The first major outcome was the **STEAM and Sports Teaching Guide**, a pedagogical resource containing interdisciplinary lesson plans, implementation frameworks, and assessment tools that support teachers in integrating sports with STEAM education. The guide promotes inquiry-based, project-based, and experiential learning approaches while providing practical examples adaptable to different educational contexts and age groups. Pilot implementations demonstrated significant improvements in student learning outcomes, engagement, and satisfaction.

A second key outcome was the **STEAM and Sports Mobile Application**, designed as an interactive learning resource that enables students to explore STEAM concepts through sports-related activities. The application combines topics from physics, biology, mathematics, nutrition, environmental sciences, and physical activity, allowing students to collect data, analyse results, and connect theoretical knowledge with real-world experiences. Evaluations conducted in partner schools showed high levels of usability, motivation, and student participation.

The project also generated a collection of **Hands-on Learning Experiences** implemented across partner schools. These experiences encouraged students to investigate authentic problems, conduct experiments, develop technological solutions, and engage in physical activities while applying interdisciplinary knowledge. The activities demonstrated the flexibility of the STEAM&Sports approach and provided evidence of its applicability in diverse educational environments.

Finally, the consortium developed a range of **Dissemination and Communication Resources**, including video stories, promotional materials, online content, and the project website. These resources were designed to share project results with teachers, schools, researchers, policymakers, and the wider educational community, ensuring the sustainability and long-term impact of the project's achievements.

Together, these outcomes demonstrate the potential of integrating STEAM education and sports as a strategy for increasing student engagement, fostering educational equity, and promoting innovative teaching and learning practices across Europe.

CHAPTER 2

Conference Contributions

INTEGRATING STEAM EDUCATION WITH SPORTS FOR INTERDISCIPLINARY LEARNING

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ABSTRACT

This paper presents the development, implementation, and evaluation of the STEAM and Sports interdisciplinary curriculum, developed under the Erasmus+ project "STEAM and Sports: A Goal for Education Equity" (Project No. 2024-1-ES01-KA220-SCH-000243408). The project integrates STEAM with sports-based learning, providing educators with structured lesson plans, implementation frameworks, and assessment tools designed to make STEAM subjects more relevant, engaging, and accessible. A comprehensive teaching guide comprising 14 ready-to-use lesson plans was developed within the project. Pilot testing was conducted across three schools in three countries, engaging 362 students in grades 3–9 and 18 teachers across diverse disciplines. Using a rigorous pre-test/post-test methodology with matched pilot and control groups, the curriculum demonstrated remarkable effectiveness: pilot groups achieved average learning gains of 22.0 to 54.5 percentage points, reaching post-test performance of 87.6% to 99.3%, while control groups showed minimal gains of 3.9 to 14.5 percentage points. Teacher and student feedback surveys further confirmed high levels of engagement, clarity, and satisfaction, with 96.4% of students reporting they enjoyed the lessons and 79% expressing enthusiasm for more similar learning experiences. These results provide compelling evidence for the robustness and cross-cultural applicability of STEAM-integrated sports education as an innovative pedagogical approach.

KEYWORDS

STEAM education; interdisciplinary curriculum; inquiry-based learning; project-based learning; equity

1. INTRODUCTION

When students learn mathematics, science, and other subjects separately, they often struggle to see how these ideas connect to each other or to real life. Integrated learning addresses this problem by teaching multiple subjects together around a single topic or theme. Research shows that students understand ideas better and can apply what they learn in new situations when their classes show connections across subjects rather than treating each discipline on its own (see [1].) The reasoning is straightforward: in the real world, people don't solve problems using only math or only science. They draw on knowledge from multiple fields at once. When schools organize learning the same way, students develop deeper understanding and stronger problem-solving skills [2].

The STEAM framework—combining Science, Technology, Engineering, Arts, and Mathematics—is one popular approach to integrated learning. STEAM education tries to address real problems in science and math classrooms: students are disengaged, participation rates are dropping, and fewer students pursue STEAM careers. By connecting these five disciplines, educators hope to make learning more meaningful and interesting [3]. Yet many STEAM programs still feel abstract and disconnected from students' lives. That's where sports come in. Sports are something most students care about and understand. Sports also provide a natural setting for applying scientific principles, mathematical thinking, and technological problem-solving. Students are motivated to learn when they see direct connections to activities they enjoy, and this motivation can lead to better, longer interest in STEAM subjects [4]. Despite growing research on integrated and STEAM learning, we still know very little about whether these approaches actually work in different countries and with different groups of students. Most studies focus on single classrooms or single schools in one educational system. This pilot study fills that gap by testing a STEAM and sports curriculum across three different countries, providing evidence about whether this approach can travel across different educational contexts and cultures.

2. STEAM EDUCATION AND SPORTS: A FRAMEWORK FOR INTEGRATED LEARNING

Sports provide an excellent setting for integrated STEAM learning because every aspect of sports touches every STEAM discipline. Science appears in the physics of movement—how bodies accelerate, jump, and throw—as well as in biology, where muscles, energy systems, and recovery all matter. Technology is everywhere in sports now: athletes wear sensors that track their heart rate and movement, coaches use video software to analyze performance, and GPS trackers show where players run on the field. Engineering is central to training methods, injury prevention, and the design of equipment and sports facilities. Arts shows up in the rhythm and balance of gymnastics and figure skating, in the creative strategies teams use, and in the visual design of uniforms and branding. Because sports are something most students already enjoy and understand, they provide a natural bridge for connecting STEAM concepts to students' own interests and experiences.

The STEAM and Sports curriculum rests on three teaching methods that research has shown to work well for student learning. These are not new ideas, but they have strong evidence behind them, and they work particularly well when combined with sports content.

2.1. Inquiry-Based Learning: Learning Through Questions and Experimentation.

In inquiry-based learning, teachers start with real questions that students actually want to answer. Rather than the teacher explaining an idea and then having students practice problems, students are given a question and figure out how to answer it themselves. In a sports context, this might mean asking: "Why do soccer players put spin on the ball?" or "How does a pitcher throw a curveball?" Students make guesses about the answer, design tests to check their guesses, collect data, and then figure out what the data shows. The teacher becomes less of a lecturer and more of a guide who helps students think through their experiments [5]. This approach works because students care more about finding answers to questions they've asked themselves. It also makes science feel less like memorizing facts and more like actual problem-solving, which is what scientists really do.

2.2. Project-Based Learning: Solving Real Problems.

Project-based learning asks students to tackle substantial, real-world problems that require them to think hard and use knowledge from multiple subjects. Instead of solving textbook problems, students might be asked to design a better basketball shoe for playing on different court surfaces, or build a computer model to figure out the best angle for shooting a basketball. These are not simple tasks with one right answer—students have to make decisions, solve problems as they come up, and create something that actually works [6]. The value of this approach is that students see why they need to learn mathematics, science, and engineering: these tools help them solve a problem they care about. Working on a project also teaches students skills that matter in real life—teamwork, communication, and dealing with problems that don't have obvious solutions.

2.3. Technology-Enhanced Learning: Using Digital Tools.

Modern technology gives students powerful ways to see and measure things that would be hard to understand otherwise. A slow-motion video camera shows exactly how a tennis racket hits a ball or how a gymnast's body moves through space. Fitness trackers let students collect real data about their own heart rate, speed, and steps. Spreadsheet software helps students organize and analyze data.

Virtual simulations let students test ideas without having to build something physical first. These tools matter because they let students interact with STEAM ideas in ways that are both engaging and rigorous—students aren't just watching videos passively, they're using these tools to answer their own questions and solve problems [7]. Technology also makes abstract ideas concrete: a student who struggles with graphing can see it come alive when they graph their own running data.

2.4. How These Three Approaches Work Together?

Used separately, each of these methods has value. But in the STEAM and Sports curriculum, they work together. A student might start with an inquiry question about sports performance, use technology to collect and analyze data, and then complete a project where they apply what they learned to design or optimize something. This combination keeps students engaged because they see how different pieces of learning connect to a larger purpose.

3. PILOT TESTING

Our project partner school participated in the pilot testing.

- Branko Radicevic School, Novi Sad, Serbia — October 13 to December 2025
- Primary School Bakar, Bakar, Croatia — November 15 to December 20, 2025
- Jan Amos Komenski School, Skopje, North Macedonia — November 15 to December 20, 2025

In total, 362 students across grades 3–9 (ages 10–15) participated, with an approximately even gender distribution (50.3% girls, 48.1% boys, 1.6% preferring not to say). Eighteen teachers from diverse disciplinary backgrounds — including Biology, Chemistry, Physics, Mathematics, Art, Physical Education, Natural Science, Macedonian Language, and Primary Education — implemented the curriculum.

Each school implemented four distinct lessons, carefully selected to represent different STEAM disciplines and to be appropriate for the targeted grade levels. Lessons were drawn from the STEAM and Sports Teaching Guide portfolio.

Standardized pre-test and post-test instruments were developed for each lesson, assessing conceptual knowledge, STEAM understanding, and content-specific learning objectives. Tests were administered immediately before and after lesson implementation to both pilot and control groups. Teacher feedback questionnaires (12 respondents) and student satisfaction surveys (362 respondents) provided additional qualitative and quantitative evaluation data.

4. RESULTS

Branko Radicevic School engaged 120 students in grades 3, 5, and 7 with four experienced teachers. Pilot groups entered lessons with an average pre-test score of 61.8%, reflecting intermediate baseline knowledge. Following curriculum implementation, pilot groups achieved an average post-test score of 99.3%, representing a mean learning gain of 37.5 percentage points. Notably, three of the four lessons produced perfect or near-perfect post-test performance (100%, 100%, and 97.2%), indicating complete content mastery. Control groups at the same school showed identical baseline performance (61.8% average pre-test) but only reached 76.2% post-test — a gain of 14.5 percentage points — yielding a pilot-control differential of 23.1 percentage points

Primary School Bakar engaged 120 students across grades 4–8 with five teachers, implementing lessons on nutrition, posture, biomechanics, and data literacy. Pilot groups entered with low baseline knowledge (average pre-test: 33.1%). Following curriculum implementation, pilot group performance improved dramatically to an average post-test score of 87.6% — a mean learning gain of 54.5 percentage points, the largest gain among the three schools. Control groups showed minimal improvement: from 35.8% to 39.7% (a gain of 3.9 percentage points). The pilot-control differential of 50.6 percentage points represents conclusive evidence of curriculum impact. All four lessons achieved pilot group post-test scores exceeding 80%, with most reaching 90% or higher.

Jan Amos Komenski School engaged 120 students (109 in pilot groups) across grades 4–9 with nine teachers from nine different disciplines. Students entered with substantially stronger baseline knowledge (average pre-test: 73.7%), reflecting this school's student population profile. Despite this higher starting point, pilot groups achieved an average post-test score of 95.7% — a mean gain of 22.0 percentage points — demonstrating the curriculum's ability to produce significant learning gains even for students with strong prior knowledge. Control groups improved from 70.3% to 76.3% (a gain of 6.0 percentage points). The pilot-control differential of 16.0 percentage points is smaller in absolute terms than Bakar's, consistent with the ceiling effect experienced at higher baseline levels, yet remains substantial and statistically meaningful.

Twelve teachers across all three schools completed a structured feedback questionnaire. The results demonstrate consistently high levels of confidence in the curriculum across all evaluation dimensions:

Table 1. Teacher Questionnaire Results (n = 12)

Evaluation Dimension	Key Findings
Clarity of Interdisciplinary Elements	42% found elements very clear and easy to implement; 58% found them mostly clear with minor adjustments needed. No teachers reported significant difficulty.
Student Engagement	83% of teachers observed very high student engagement and motivation to hands-on/collaborative components; 17% reported positive participation from most students.
Age-Appropriateness	67% rated learning objectives as perfectly suited to students' age and abilities; 25% found them slightly simple but effective; only 8% indicated content was slightly advanced.
Inclusivity and Accessibility	83% confirmed lessons provided full inclusion and accessibility support; 17% reported mostly inclusive implementation with minor challenges.
STEAM-Sports Connection	83% affirmed the lessons very effectively connected physical activity with STEAM concepts; 17% confirmed effective conceptual connections.

All 362 student participants completed a satisfaction and learning self-report questionnaire. The results demonstrate overwhelmingly positive reception across all dimensions measured:

- 96.4% of students reported enjoying the STEAM & Sports lessons (64.9% "Yes, a lot!"; 31.5% "Yes, it was okay")
- 95.6% found the lessons clear and understandable (74.3% "everything was clear"; 21.3% "mostly clear")
- 94.5% confirmed they learned something new (61.6% "learned a lot"; 32.9% "learned a few new things")
- 79.0% expressed enthusiastic desire for more lessons like this ("Yes, definitely!"); an additional 18.0% responded "Maybe, it depends."
- The most popular lesson components were: working in a team (48.1%), doing sports activities (29.8%), and learning STEAM content (19.6%)

Open-ended student comments highlighted particular enthusiasm for hands-on and collaborative activities, sports-based learning, video creation, outdoor orienteering, digital cookbook creation, and interactive laboratory activities.

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STEAM AND SPORTS: A MOBILE APPLICATION FOR INTEGRATED LEARNING

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ABSTRACT

This paper evaluates a mobile app created within the Erasmus + project that brings together STEAM subjects through sports. The app has six lessons that combine physics (how pressure affects a bouncing ball, throwing angles), biology (how your heart and muscles respond to exercise), math (calculating calorie needs, analyzing fitness data), nutrition, and environmental impact. What makes this approach different is that instead of teaching these subjects separately, students learn them together through sports activities. When you're measuring your running distance or calculating food energy, you're doing physics, math, and biology awt the same time. This matters because it's how knowledge actually works in the real world.

We tested the app with more than 100 students across three schools in Serbia, Croatia, and North Macedonia. We wanted to see if this combined approach worked across different countries and educational systems. The results were strong: 76% of students said the app was very easy to use, 74% found the graphs and calculations helpful in understanding their results, and 86% felt much more motivated to learn about STEAM after using it. Students could see why these subjects mattered; they were measuring real things happening in their own bodies and performance. The app successfully connected abstract concepts to things students actually care about.

KEYWORDS

STEAM education; interdisciplinary curriculum; mobile app

1. INTRODUCTION

Most schools teach science, math, and other subjects by themselves. A student learns physics in one class and doesn't see how it connects to anything they care about. The same happens with math and biology. Because of this separation, many young people lose interest in these subjects. They don't see why they matter. Sports are different. Nearly all teenagers play sports or follow them. They're interested in how their body works when they exercise, why a ball bounces differently depending on how much air is in it, or how to improve their performance. When you combine sports with STEAM subjects, suddenly math, science, and engineering aren't abstract anymore—they're answering questions students have (see [1], Jia, Zhou, and Zheng, 2021). This approach works because it makes learning feel relevant and connected to real life.

The European Commission's Erasmus+ program funds educational projects that try new things across Europe. This paper looks at one of these projects: a mobile app that teaches STEAM subjects through sports activities. The app was created by a team working on a project called "STEAM AND SPORTS: A GOAL FOR EDUCATION EQUITY" (Project Number: 2024-1-ES01-KA220-SCH-000243408). We tested the app with students in three schools in Serbia, Croatia, and North Macedonia, countries with different education systems and languages. The students were 10-15, in grades 4-9. What we wanted to know was simple: Does this approach work? Do students learn better? Do they get more interested in STEAM (see [3], Hsiao and Su 2021)? Do they understand why these subjects matter (see [2], Lin and Tsai, 2021)? This paper shares what we found.

2. APPLICATION OVERVIEW AND DESIGN

The STEAM and Sports mobile application consists of six interactive lessons, each designed to explore a specific intersection of STEAM disciplines and sports contexts.

Table 1. Content of the STEAM and Sports mobile app

Lesson	Focus Area
1. Under Pressure	Physics - pressure and elasticity in sports
2. Shoot for the Stars	Physics - projectile motion and angles
3. The Human Body in Action	Biology - cardiovascular, respiratory, and muscular systems
4. Fuel Your Body	Mathematics and Nutrition - BMR calculation and macronutrients
5. Measure Your Body	Mathematics - performance metrics and data visualization
6. Green Stadium Travel	Environmental Science - carbon footprint analysis

Each lesson incorporates interactive activities where students perform real sports or fitness tasks, collect data, and analyze results using the application's built-in visualization tools (graphs, charts, and calculations). This hands-on approach directly addresses the pedagogical need for experiential learning in STEAM education.

3. METHODOLOGY

This research employed a descriptive evaluation approach using student feedback collected through an in-app survey. Participants were more than 100 secondary school students from three schools: Primary school Branko Radičević (Novi Sad, Serbia), Primary school Bakar (Bakar, Croatia), and Primary school Jan Amos Komenski (Skopje, North Macedonia). Students ranged from grades 4 to 9 (ages 9-15), representing diverse academic levels and backgrounds.

Following engagement with the application, students completed a structured survey assessing:

(1) lesson effectiveness in explaining real-world applications of STEAM,

(2) app usability,

(3) effectiveness of visualizations,

(4) motivation changes,

(5) engagement levels, and

(6) recommendations for improvement.

Responses were collected between October and November 2025.

4. RESULTS AND FINDINGS

Approximately 76% of students rated the application as "Very easy" to use, with 18% rating it as "Easy." Only 6% reported difficulty. When asked about visualization effectiveness, 74% of students agreed that graphs, charts, and calculations helped them understand results "a lot," while 20% reported partial benefit.

A striking 86% of students reported feeling "much more motivated" to learn about STEAM applications to sports after using the app. Only 8% reported no change in motivation. This finding suggests the application successfully achieves its primary objective of increasing engagement with STEAM content through contextualization.

"How Green Is Your Sports Stadium Travel?" (Lesson 6) was the most frequently selected favorite activity (28% of responses), followed by "The Human Body in Action" (Lesson 3, 26%) and "Measure Your Body, Measure Your Progress" (Lesson 5, 23%). Physics-focused lessons showed moderate engagement (17% combined for Lessons 1 and 2), indicating that complex physical concepts may benefit from enhanced pedagogical scaffolding.

5. DISCUSSION

The high usability ratings and elevated motivation levels indicate that the application successfully achieves its pedagogical objectives. The integration of experiential learning through hands-on sports activities with computational analysis of data appears to resonate with adolescent learners. This aligns with constructivist learning theory, which posits that students develop a deeper understanding through active engagement with authentic problems.

The strong preference for environmental and biological lessons suggests that students find relevance in personally meaningful contexts. Lessons directly addressing health (Lesson 3), environmental responsibility (Lesson 6), and fitness (Lesson 5) generated more enthusiasm than abstract physics concepts. This indicates the importance of problem-based learning frameworks that explicitly connect content to student interests and perceived real-world utility.

The consistent requests for enhanced visual design and multilingual support highlight important localization considerations for Erasmus Plus projects serving diverse student populations. While the application's pedagogical structure is sound, its presentation layer requires refinement to appeal to younger users and accommodate non-native English speakers. The suggestion for gamification reflects evidence that reward systems can enhance engagement and persistence in educational technology.

6. CONCLUSIONS

The STEAM and Sports application demonstrates significant promise as an educational tool for integrating STEAM concepts with student interests. The strong positive feedback regarding usability, visualization effectiveness, and motivation gains validates the pedagogical approach. The application successfully bridges theory and practice, enabling students to observe abstract concepts (pressure, energy, carbon emissions) operating in familiar sports contexts.

This research contributes to the growing body of evidence supporting technology-enhanced STEAM education, particularly through mobile applications that enable data collection and real-time analysis. Future research should investigate long-term retention of STEAM concepts among app users compared to traditional instruction, and whether increased motivation translates to sustained interest in STEAM coursework.

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AI TOOLS IN INTEGRATIVE MODELS OF EDUCATION

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ABSTRACT

The integration of artificial intelligence within educational systems represents a paradigm shift in pedagogy, moving beyond mere technological adoption to a fundamental restructuring of teacher responsibilities. Central to this evolution is the understanding that while AI will not replace the human element, educators who leverage these tools are poised to replace those who do not. By adopting the UNESCO AI Competency Framework for Teachers, this research examines how professional roles transition from traditional instructors to high-level facilitators and coaches. Empirical data suggests that current AI technologies can automate between 20% and 40% of routine teacher tasks, equivalent to approximately 13 hours of reallocated time per week. This study explores the methodological integration of generative tools to streamline preparation and evaluation, thereby enabling educators to prioritize human-centric engagement and personalized learning pathways. Ultimately, the synthesis of these tools into integrative models fosters educational equity by allowing for deeper one-on-one mentorship and social-emotional development. By mastering AI foundations and ethics, teachers can move from basic technological acquisition to the creation of innovative, student-centered learning environments.

KEYWORDS

Generative AI; Integrative Education; Teacher Automation; UNESCO AI Competency Framework

1. THEORETICAL FRAMEWORK

This inquiry is grounded in the UNESCO AI Competency Framework for Teachers (UNESCO, 2024), which identifies five critical dimensions: a human-centered mindset, AI ethics, AI foundations and applications, AI pedagogy, and AI for professional learning. Beyond basic AI literacy, the framework emphasizes progressive competence development through the stages of Acquire, Deepen, and Create, culminating in the capacity to design innovative AI-supported pedagogical practices and educational resources (UNESCO, 2024). In the "Create" phase, teachers utilize generative platforms such as SchoolAI, Perplexity, and ChatGPT to customize learning experiences. Specific applications within SchoolAI, including the "Coteacher," "Space Designer," "Digital Literacy Coach," and "Essay Grading Assistant," support the generation of lesson plans, worksheets, and formative feedback tailored to individual student needs.

2. OBJECTIVES

The primary objective of this study is to examine how artificial intelligence tools can be systematically integrated into educational models to enhance instructional effectiveness, support personalized learning, and optimize teacher time allocation.

3. METHODOLOGY

This study adopts a qualitative conceptual and comparative research design. The analysis is based on a review of international policy documents, research reports, and scholarly literature addressing the integration of artificial intelligence in education. Particular emphasis is placed on the UNESCO AI Competency Framework for Teachers (UNESCO, 2024), OECD reports on AI and educational equity, and empirical findings regarding teacher workload and automation potential (Bryant et al., 2020).

A comparative analysis was conducted to examine the relationship between AI-supported automation of routine teaching tasks and the development of human-centered pedagogical practices. The study evaluates the potential of generative AI tools, including ChatGPT, Perplexity, and SchoolAI, to support lesson planning, assessment design, feedback generation, and instructional differentiation.

The analytical procedure involved three stages: (1) identification of key competencies and pedagogical principles outlined in the UNESCO framework; (2) examination of empirical evidence concerning teacher time allocation and automation potential; and (3) evaluation of practical applications of AI tools in educational settings. The findings were synthesized to propose an integrative educational model that balances technological innovation with human-centered teaching practices.

4. COMPETENCES

The integration of AI tools in educational practice contributes to the development of several key competences for both teachers and students. Teachers strengthen their digital competence, instructional design skills, and ability to personalize learning experiences. Students develop critical thinking, creativity, collaboration, communication, and digital literacy skills. Furthermore, AI-supported activities encourage learners to evaluate information critically, formulate effective prompts, and engage in problem-solving processes that require reflection and decision-making.

Furthermore, AI-supported activities encourage learners to evaluate information critically, formulate effective prompts, and engage in problem-solving processes that require reflection and decision-making (Holmes et al., 2019; Luckin, 2018).

5. OUTCOMES

The findings indicate that AI tools can significantly enhance lesson preparation, instructional differentiation, and student engagement. Recent international studies report that approximately two-thirds of teachers use AI-assisted technologies for educational purposes, particularly for generating learning materials and supporting individualized instruction (OECD, 2024). AI technologies also reduce administrative workload and enable more efficient feedback mechanisms (Bryant et al., 2020) AI technologies also reduce administrative workload and enable more efficient feedback mechanisms. However, the study highlights the importance of maintaining teacher oversight to ensure accuracy, ethical use, and pedagogical relevance. The findings suggest that AI achieves its greatest educational value when employed as a complementary pedagogical resource that supports, rather than replaces, professional teacher judgment and human interaction that complements human expertise and promotes innovative, inclusive, and learner-centered educational practices.

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INTEGRATING AI, PHYSICAL EDUCATION AND BIOLOGY TO PROMOTE HEALTHY POSTURE IN PRIMARY SCHOOL STUDENTS

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ABSTRACT

This proposal presents an interdisciplinary teaching unit implemented within the Erasmus+ STEAM&Sports project at a Croatian primary school. The unit connects Biology, Informatics and Physical Education to help students understand spinal health and improve their everyday posture. In Biology, students explored body positions, spinal anatomy, common postural problems and the consequences of poor sitting habits. In Informatics, they investigated these topics using web browsers and applied newly acquired knowledge of artificial intelligence to train a Teachable Machine model with a custom image dataset showing correct and incorrect posture. Using their own photographs increased motivation and fostered a sense of ownership of the learning process. During Physical Education, students used mobile phone cameras to “scan” their classmates while sitting and exercising, receiving immediate feedback from the AI model about their posture. The activity promoted critical thinking, digital literacy and health awareness, while showing students how AI can be used for meaningful, real-life applications. Initial observations indicate high engagement, improved understanding of posture and increased transfer of healthy habits into everyday classroom behaviour.

KEYWORDS

Artificial intelligence; posture; STEAM&Sports; primary education

1. MAIN TEXT

This teaching proposal was developed as part of the Erasmus+ STEAM&Sports project, which aims to link STEAM education with sports and physical activity to foster student engagement and educational equity. The unit was implemented at Osnovna škola Bakar in Croatia, with a focus on promoting healthy posture among primary school students through the integration of Biology, Informatics and Physical Education.

The main objectives were to raise students’ awareness of spinal health and the consequences of poor posture, to develop digital literacy and introductory artificial intelligence competences, and to encourage students to apply their knowledge in real-life contexts. The theoretical framework combines a STEAM approach, health education and constructivist learning principles, emphasising active student participation and the use of authentic problems from students’ everyday lives. [1]

In Biology lessons, students first learned about the structure and function of the spine, typical postural deviations and the difference between correct and incorrect sitting positions in the classroom. They analysed examples of body positions and discussed how prolonged sitting, use of digital devices and lack of physical activity can affect the musculoskeletal system. This phase provided the scientific basis necessary for the later technological and practical activities.

During Informatics lessons, students expanded their knowledge by researching spinal health and posture using reliable online sources through web browsers. At the same time, they were introduced to basic concepts of artificial intelligence and machine learning in an age-appropriate way. As part of a unit on artificial intelligence, students created a simple supervised learning project using Google's Teachable Machine platform, which allows users to build machine learning models without coding by collecting and labelling images from a webcam. [3]

Students worked in small groups to photograph themselves and their classmates in examples of both correct and incorrect sitting posture. They then uploaded and labelled these images to create two classes in Teachable Machine: "good posture" and "bad posture". This process required them to apply their biological understanding of posture to distinguish clearly between the two categories, thereby deepening their conceptual knowledge. After collecting a sufficiently varied dataset, students trained the model and tested it using webcams to evaluate how accurately it classified new images. [2]

The next phase took place during Physical Education lessons, where students used mobile phone cameras and the trained AI model to scan their classmates while they were sitting in the classroom and performing various exercises. The immediate visual feedback from the model allowed students to observe which positions were recognised as healthy or unhealthy and to adjust their posture accordingly. This hands-on experience connected physical movement, health education and digital technologies in a concrete and motivating way. [3]

Through this interdisciplinary approach, students developed subject-specific knowledge in biology and health, digital competence and media literacy, introductory AI literacy, critical thinking and collaboration. The activity also addressed educational equity by showing how freely available digital tools can be used in regular classrooms to create innovative, student-centred learning experiences without advanced technical infrastructure.

Informal feedback from students indicated high levels of engagement and surprise at how well the model could distinguish between good and bad posture usingonly images captured in the classroom. Many students reported that they became more aware of how they sit during lessons and started correcting each other's posture in a supportive way. Although systematic quantitative evaluation has not yet been carried out, classroom observations suggest improved awareness of spinal health and more frequent adoption of proper sitting positions. In future iterations, the activity could be expanded with additional pose classes, simple analysis of model predictions, or collaboration with school health professionals to track longer-term impact. [2]

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ENERGY DETECTIVES WITH MICRO:BIT – LINKING TESLA, SCHOOL ENERGY USE AND STEAM&SPORT

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ABSTRACT

Within the Rijeka Science Festival 2026, dedicated to the theme of energy and the legacy of Nikola Tesla, eighth-grade students carried out an inquiry-based project entitled 'Energy Detectives with micro:bit'. Using the built-in light and temperature sensors on the micro:bit board, they measured environmental conditions in different classrooms and school spaces, recorded the data in a digital spreadsheet and analysed where energy was used efficiently and where it was being wasted. Based on their findings, students designed proposals for energy saving and presented them through digital posters or short video presentations. In an extended 'STEAM & sport' component, students transferred their investigation to the school gym, where they measured environmental conditions during simple physical activities and recorded basic indicators of movement intensity, linking energy use in the space with their own physical exertion. The project connects Informatics, Physics, Physical Education and the cross-curricular topic of Sustainable Development, encouraging students to think critically and responsibly about their impact on energy consumption in school and in everyday life.

KEYWORDS

Energy; micro:bit; inquiry-based learning; sustainable development; STEAM&Sports

1. MAIN TEXT

The project 'Energy Detectives with micro:bit' was implemented as part of the Rijeka Science Festival 2026, which focused on the theme of energy and highlighted the contribution of Nikola Tesla to the development of modern electricity. For many students, the concept of energy and its consumption in everyday school life remains abstract, so the aim of this project was to bring the topic closer through concrete investigation of the school environment. Using micro:bit boards with built-in light and temperature sensors, students were able to collect data on classroom conditions in asimple and accessible way and to see how technology can support informed decisions about energy saving.

To further emphasise the link between energy and physical activity, the project was extended with elements of sport. In the school gym, students took part in simple exercises and games and observed how their perceived fatigue, heart rate and environmental conditions related to the concept of energy in daily life. The activity was implemented mainly in Informatics lessons, with strong connections to Physics, Physical Education and the cross-curricular topic of Sustainable Development, and can be adapted to different levels of prior knowledge and school equipment.

The main objectives of the project were to develop students' digital competences through micro:bit programming and data handling, to raise awareness of energy consumption in school and possibilities for saving, to promote an inquiry-based approach to learning, and to link Tesla's contribution to energy with concrete examples from students' lives. Expected learning outcomes included programming the micro:bit to measure light and temperature, recording and organising data in a digital spreadsheet, creating simple charts and interpreting measurement results, identifying places where energy is wasted and proposing measures for more efficient use, and using digital tools to create posters or videos with recommendations. Students were also expected to participate in simple physical activities in the gym, describe movement intensity and compare activities in terms of perceived fatigue and basic indicators of effort.

The activity began with a class discussion on what energy is, the forms in which it appears and where students encounter it at school (lighting, heating, devices, computers). Nikola Tesla and his inventions were introduced as a starting point for reflecting on how we can use these achievements responsibly today. The teacher then presented the micro:bit, highlighting the built-in light and temperature sensors and explaining how they could be used to investigate different spaces in the school. Students worked in pairs in the MakeCode environment to create a simple program: button A displayed the current light level, while button B displayed the current temperature on the LED matrix. After downloading the program to the device, they tested it in the classroom under different conditions, comparing measurements for artificial and natural light and for different positions in the room.

In the next phase, students in small groups visited pre-defined locations around the school (various classrooms, corridors, library, canteen) and used the micro:bit to measure light and temperature. For each location they recorded the time, the measured values and brief notes on the conditions (lights on/off, natural light, open windows). The collected data were entered into a shared digital spreadsheet, which allowed for comparison and analysis. Based on the data, students created simple charts, discussed where lighting levels seemed higher than necessary, where electricity might be wasted and which rooms were over- or under-heated. They then formulated concrete proposals for energy saving, such as turning off lights when rooms are not in use, relying more on natural light or adjusting heating settings in particular rooms.

As a final product, students created digital materials to communicate their results and recommendations: digital posters in Canva, short presentations or story- based formats, and brief videos highlighting key messages about energy saving in school. These materials could be shared on the school website or presented to other classes as part of the Science Festival.

In the final 'STEAM & Sports: energy in motion' phase, the investigation moved to the school gym. Students engaged in a series of simple physical activities (walking, light jogging, simple obstacle courses, relay games). They measured light and temperature at different points in the gym and noted the conditions in which they were exercising. In a table they recorded the location, light and temperature values, duration of each activity and a subjective rating of fatigue on a simple scale. When appropriate, they estimated heart rate by counting beats over a fixed time and converting this to beats per minute. Comparing data across activities and locations, students discussed in which conditions it was more comfortable and healthier to exercise and what an energy-efficient but healthy gym might look like. They linked these findings with measurements from classrooms and reflected on the conditions under which it is most comfortable and effective to learn versus to exercise.

The project showed that simple, student-friendly technologies can support deep understanding of energy and the importance of responsible consumption. Through the use of micro:bit as a tool for measurement, data collection and analysis, students developed digital skills, strengthened logical thinking and learned to draw conclusions based on real data from their environment. Including the school gym and physical activities helped them see that energy is not only consumed through lighting and heating, but also through their own movement, naturally connecting STEAM content with sport. At the same time, students became more aware of their role in energy saving and took an active part in creating a 'smarter', healthier and more sustainable school environment.

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FIND YOUR ANIMAL

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ABSTRACT

Following STEAM concept this unit integrates knowledge and skills in Mathematics, Biology / Engineering, Art and Design, Sports, one session (5 lessons), approximately (45min.) is divided into five stages. Engagement (30min), Explore (60min) Elaboration (60 min), Evaluation (45 min) and Extention (15 min- optional). Going throw the unit procedure, students deal with map making (Engineering - visual program language) supporting by compass training method, design and paint animal masks implying all characteristics of the animal. (Art and design, Biology). Students move across the playground, do exercises based on variety of derived and innate human motions (walking, lifting, carrying, squatting), Sports, follow required cognitive and motor procedures, answer the questions (applying their theoretical and functional knowledge in, Biology)going throw the task procedure leaning on their own body and landmarks (body awarenes and landmark recognition), structure correct spatial information they go forward to the objective, solve the puzzle, measure the time of action, compare and contrast the results and give some basic information about the (animals foot print) animal.

KEYWORDS

Spatial orientation; Spatial Cueing; Biology; Sport; Art; IT; Design; Project-Based learning; Mathematics

1. THEORETICAL FRAMEWORK

Spatial orientiring tasks imply cognitive and motor procedures to enable individual perception and navigation between our body (body awarnwss) and landmarks (landmark recognition) esentialy for daily functioning – to miantain oriented during movement and for planning routs. Implying egocentric frame method suggests student how people use their own body (egocentric) to external landmarks (allocentric) to structure their spatial information. Spatial cueing (birdsounds) indicates where target might be and the prompts (input) take the students step-by-step throw the task, towards their objective.

2. OBJECTIVES

Improve spatial orientation, advance cognrtive and motor procedures, perception, recognize the importance of external land marks (land mark recognition) and our body structuring spacial information (body awarness) improvement of digital competence and creativity potential, revision and funcional applying of merge knowledge. öf different subject areas, decision - making tasks.

3. METHODOLOGY

One session approximately 5 lessons (45 min) is divided into five stages: Engagement (30min), Explore (60 min) Elaboration (60 min), Evaluation (45 min) Extention (15 min), optional. Engagement - students consider landmark recognition, body awarness, spacial orientation, Explore - students cross the polygon collect jigsaw puzzle, solve tasks, Elaboration - mask making, Evaluation - knowledge presentation and map making, Extention (optional).

4. COMPETENCES

Spatial orienteering skills, cognitive and motor skills improve their theoretical and functional knowledge, Environmental awareness,, critical opinion, exploring, digital competence, team spirit, social inter relationship.

5. OUTCOMES

Usıng functonal knowleage from defferent subject areas in appropriate way, recognize the importance of diversity of plant and animal life and set an example,cooperation , team spirit, improve cognitive and motor skills, creativity potential, digital competence, spatial orientation (using maps, compass for determine direction, spatial cucing) , problem task solving, envinomental care, inclusion, body awarness (understanding your body's position in relation to the surrounding environment and navigation 3D space, effectively).

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MATHEMATICS OF WELL-BEING: SCIENCE, HEALTH, AND ACTIVE LIFE

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ABSTRACT

Framed within a STEAM perspective, this instructional unit integrates Mathematics, Natural Sciences, Ethics, and Physical Education to enable students to measure and interpret key biometric indicators—body mass index, heart rate, and estimated energy expenditure—and to make evidence-informed health decisions aligned with SDG 3 (Good Health and Well-Being). Grounded in Project-Based Learning, Universal Design for Learning, and cooperative structures, the design prioritizes accessibility, sustained engagement, and rigorous knowledge construction. Across five 50-minute lessons, teams of four students discuss what it means to "be healthy," collect consented personal data (BMI from weight and height; resting and post-effort heart rate; sleep, diet, and physical-activity logs), estimate daily energy expenditure using reference equations, and justify a personalized healthy-habits plan; the sequence culminates in a school awareness campaign featuring posters, infographics, and step challenges. Tracking applications (e.g., for heart rate, step counts, and diet) and spreadsheets support data capture, time-series visualization, and structured feedback, while wearables are intentionally positioned as formative supports—motivational but not an end in themselves—given inconsistent evidence for objective gains in school-based physical activity. The unit maps to the EU Key Competences (mathematical, digital, personal-social-learning to learn, citizenship) and targets measurable improvements in data literacy, mathematical reasoning, motivation and participation, biomechanical awareness for safer technique, operational understanding of WHO recommendations for youth activity (≥ 60 min/day MVPA), and equity-focused reflection connecting classroom evidence with the social determinants of health.

KEYWORDS

BMI; cooperation; heart rate; physical education; project-based learning; school health; SDG 3; STEAM; UDL

1. THEORETICAL FRAMEWORK

This unit is anchored in SDG 3 (Good Health and Well-Being), which calls for educational action to promote healthy lifestyles and reduce sedentary behaviour, positioning sport as an authentic context for meaningful learning (United Nations, n.d.; United Nations Development Programme [UNDP], n.d.). It operationalises the WHO (2020) guidance for youth—≥ 60 minutes/day of moderate-to-vigorous physical activity, regular muscle-strengthening, and limited sedentary time—through student-generated data and evidence-informed decision-making.

Design decisions follow Universal Design for Learning (UDL), providing multiple means of engagement, representation, and action/expression to balance accessibility with appropriate cognitive challenge and to structure formative assessment (CAST, 2018).

The pedagogical approach is supported by meta-analytic evidence: project- and problem-driven learning enhances achievement, attitudes, and motivation in STEM/STEAM settings, while cooperative learning yields moderate gains across cognitive, social, affective, and physical domains;

these findings justify a 5E sequence, authentic tasks, four-student teams, and co-/self-assessment (Boke et al., 2025).

The health data literacy strand uses validated measures and models: Body Mass Index (BMI) and WHO BMI-for-age standards (5–19 years) offer population-level screening when applied prudently, and resting energy expenditure can be estimated with the Mifflin–St Jeor equation, connecting proportional reasoning and units to practical health decisions (WHO, 2025; Mifflin et al., 1990).

Technology is framed with a formative purpose. Tracking apps and optional wearables support self-regulation and feedback, yet recent syntheses report motivational benefits but mixed effects on objectively measured school-based physical activity; consequently, devices are embedded within robust pedagogical sequences (Au et al., 2024; Chen et al., 2025).

Finally, the unit aligns with the EU Key Competences for Lifelong Learning (mathematical, digital, personal-social-learning to learn, and citizenship), reinforcing transversality among quantitative analysis, digital literacy, collaboration, and civic responsibility around health and well-being (Council of the European Union, 2018).

2. OBJECTIVES

This proposal pursues a coherent three-part aim: it integrates Mathematics, Natural Sciences, Ethics, and Physical Education so that students can measure and analyse biometric data—BMI, heart rate, and estimated energy expenditure—and, on that evidence base, make informed choices about healthy habits in alignment with SDG 3 (Good Health and Well-Being) (United Nations, n.d.; World Health Organization [WHO], 2020). In parallel, it develops critical thinking and data-analysis competences by structuring learning around Project-Based Learning and cooperative work, leveraging research that documents positive effects on achievement and motivation in STEM/STEAM contexts (Zhang & Ma, 2023). Finally, it fosters health literacy and equity by explicitly connecting personal decisions (diet, sleep, physical activity) to social and environmental determinants and to international recommendations for youth physical activity, thereby situating individual behaviour within a broader public-health frame (Bull et al., 2020; United Nations Development Programme [UNDP], n.d.).

3. METHODOLOGY

A five-session sequence (50 minutes each) follows the 5E structure (Engage, Explore, Elaborate, Evaluate, Extend). In teams of four, students: (a) discuss what it means to "be healthy" and interpret charts on obesity, physical activity, and access to health; (b) collect personal data with consent (BMI from weight/height; resting and post-effort heart rate; logs of sleep, diet, and activity); (c) estimate daily energy expenditure using reference equations for basal metabolism and activity factors; (d) design a healthy-habits plan justified with data; and (e) present conclusions and deliver a school awareness campaign (posters, infographics, step challenges).

4. COMPETENCES

The unit develops the four EU Key Competences in an integrated, continuous way. It addresses mathematical, scientific, technological, and engineering competence by engaging students with BMI and age-specific percentiles, time-series analysis, measures of central tendency and dispersion, and the estimation of basal metabolism and total energy expenditure (WHO, 2026; Mifflin et al., 1990). It builds digital competence through the purposeful use of apps/sensors and spreadsheets to capture, organise, visualise, and communicate data (Council of the European Union, 2018). It advances the personal, social, and learning-to-learn competence by cultivating self-regulation, realistic goal-setting, and data-informed reflection, alongside cooperation and shared responsibility in teams, all consistent with Universal Design for Learning and supported by evidence on cooperative learning in Physical Education (CAST, 2018; Boke et al., 2025). Finally, it nurtures citizenship and ethical-values competence by analysing health inequities and debating individual and collective responsibility for promoting well-being, situating classroom inquiry within international public-health frameworks (UNDP, n.d.; WHO, 2022).

5. OUTCOMES

The intervention is expected to yield improved data literacy and health decision-making, as learners apply statistics, ratios, and percentages to their own biometric datasets and to game-related choices (Zhang & Ma, 2023). It should also increase motivation and participation through Project-Based Learning and cooperative structures, effects that align with moderate, positive impacts on achievement and socio-emotional variables reported in Physical Education (Boke et al., 2025).

Additionally, school well-being and belonging are expected to be strengthened by integrated STEAM + PE programming. From a performance standpoint, students should demonstrate more efficient technique and movement through the explicit use of biomechanical principles and structured feedback (Cui & Wang, 2024). Finally, the design anticipates greater digital literacy and self-regulation via the formative use of wearables and data analytics—recognising their motivational value while acknowledging that objectively measured physical-activity gains in school settings remain mixed without robust pedagogy (Au et al., 2024; Chen et al., 2025).

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FASTEAM - STRENGTHENING INCLUSIVE LEARNING THROUGH HANDS-ON FAMILY EXPERIENCES

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ABSTRACT

The FASTEAM project explores how family engagement can strengthen confidence, participation, and collaboration within STEAM education. The project focuses on improving cooperation between students, educators, and families by positioning family engagement as an integrated part of STEAM learning rather than an additional activity. FASTEAM responds to the challenge that many caregivers feel disconnected from STEAM subjects because of limited confidence, previous educational experiences, or the perception that STEAM is only for experts.

The project promotes accessible and practical STEAM experiences that connect schools, homes, and communities. Through hands-on activities, storytelling, experiments, and collaborative challenges, families are encouraged to actively participate in children's STEAM learning processes. A central methodological element of the project is the CARE framework, which focuses on building connections, encouraging active participation, supporting reflection, and empowering families within STEAM education.

The project also developed the Together Tool, a practical resource that helps schools strengthen family engagement strategies, communication, and collaboration. Through international cooperation, professional development, and practical piloting, FASTEAM aims to develop transferable approaches that help schools create more inclusive, welcoming, and family-oriented STEAM learning environments.

KEYWORDS

Family engagement; inclusion; experiential learning; STEAM education

1. MAIN TEXT

Family engagement is increasingly recognised as an important factor in children's educational development and long-term academic success. Research shows that when families are actively involved in learning processes, students often demonstrate stronger motivation, greater confidence, and improved academic outcomes (Epstein & Sheldon, 2023; Jeynes, 2005). Within STEAM education, family influence is especially important during childhood and early adolescence, when learners begin developing perceptions about their own abilities, interests, and future educational pathways.

The FASTEAM project addresses the role of family engagement within STEAM education by focusing on collaboration between students, educators, and families. The project responds to the challenge that many caregivers feel disconnected from STEAM subjects because of previous educational experiences, lack of confidence, or the perception that STEAM is only for experts. At the same time, research and project discussions highlighted that families strongly influence children's attitudes toward science, mathematics, creativity, and problem-solving.

Rather than positioning family engagement as an additional activity alongside education, FASTEAM approaches it as an integrated part of STEAM learning. The project builds on the idea that families are children’s first educators and important partners in developing curiosity, confidence, and interest in STEAM subjects. The project therefore focuses on creating accessible, practical, and collaborative STEAM experiences that connect schools, homes, and communities.

The FASTEAM approach is strongly centred around the relationship between students, educators, and families. Instead of viewing these groups separately, the project approaches STEAM learning as a shared process built on communication, collaboration, and mutual support.

This partnership-based approach aligns with research on family-school collaboration, which highlights the importance of shared responsibility and meaningful communication between schools and families (Epstein & Sheldon, 2023). Within FASTEAM, knowledge and support are not seen as moving only from schools toward families. Instead, the project promotes reciprocal relationships in which schools also learn from families and communities.

The project particularly emphasises two-way communication, accessibility, and inclusion. Training activities developed within FASTEAM encourage educators to communicate clearly, use inclusive language, and connect STEAM learning to everyday life situations familiar to families. Examples include cooking, gardening, building, music, digital tools, and sports-related activities, helping families recognise that STEAM already exists within their daily environments.

To operationalise family engagement within STEAM education, FASTEAM applies the CARE framework, introduced during the Learning, Teaching and Training Activities in Skopje. The CARE framework provides a practical structure for strengthening collaboration between schools, learners, and families.

The CARE framework consists of four interconnected dimensions: Connect, Act, Reflect, and Empower.

The Connect dimension focuses on building welcoming and positive relationships between schools and families. Particular attention is given to trust, accessibility, belonging, and inclusive communication. Activities include welcoming conversations, creating safe learning environments, and recognising the different backgrounds and experiences of families.

The Act dimension focuses on hands-on and collaborative STEAM experiences. Families participate together in experiments, storytelling activities, challenges, and practical exploration. Importantly, activities are intentionally designed to remain accessible and low-threshold, avoiding dependence on advanced STEAM knowledge or expensive materials.

Reflection is an important part of the FASTEAM methodology. Families, students, and educators are encouraged to discuss experiences, ask questions, and connect STEAM activities to everyday life. Reflection also helps educators adapt activities and communication approaches to the needs of different families and school contexts.

The Empower dimension focuses on voice, agency, and ownership. Families are encouraged to actively contribute ideas, shape activities, and participate in decision-making processes surrounding STEAM learning. This is particularly important for families and groups who may previously have experienced barriers or exclusion within educational settings.

Methodologically, the project combines professional development activities, collaborative international learning, practical experimentation, and reflective action planning. During the Learning, Teaching and Training Activities in Skopje, project partners explored family engagement strategies through workshops, empathy mapping, collaborative planning activities, and peer feedback sessions. This supported partners in translating the CARE framework into concrete school-based actions.

These actions are further supported by the project’s main results. The Together Tool helps educators plan and improve family engagement in STEAM. The STEAM Storytime with Experiments Guide offers simple story-based activities that families can carry out together. The Online Family

Challenges Platform will provide an accessible space where families can take part in STEAM challenges, share ideas, and engage in creative problem-solving.

In this way, FASTEAM focuses on making family engagement practical and usable for schools. The project does not expect families to become STEAM experts. Instead, it supports educators in creating activities and communication approaches that help families feel welcomed, confident, and involved. Through these tools and activities, the project aims to strengthen children's curiosity, confidence, and interest in STEAM, while also improving cooperation between schools and families.

The FASTEAM consortium combines expertise from schools, higher education, educational innovation organisations, and STEAM-focused initiatives across Europe. Through international cooperation, professional development, and practical piloting, the project develops approaches that can be adapted by different schools and family contexts.

More information about the project and its results can be found at: www.fasteam-project.eu

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MATHEMATICS AND SPORTS IN EUROPE: DATA, STRATEGY, AND MOTOR SKILLS

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ABSTRACT

This article aims to analyse the teaching unit developed in the Erasmus+ Steam & Sports project in which it is integrated Mathematics and Physical Education within a STEAM framework to foster data-informed health decisions aligned with SDG 3 (Good Health and Well-Being). It combines Project-Based Learning, Universal Design for Learning, and cooperative learning to ensure accessibility, engagement, and rigorous knowledge construction. The sequence (four 50-minute sessions, ages 10–15) progresses from measurement to modelling and application: students collect biometric and performance data (e.g., BMI, heart rate, short fitness tests), analyse distributions and trends in spreadsheets, and apply geometry and probability to precision tasks and game strategy. They then design a data-driven training plan that links technical refinement with foundational biomechanical principles.

Formative assessment is embedded through rubrics, self- and peer-evaluation, and reflective presentations. Basic sensors and optional wearables are used as formative tools to support feedback and self-regulation. Anticipated outcomes include improved data literacy, mathematical reasoning, and motivation; enhanced technical efficiency and injury-prevention awareness; gains in digital competence and collaborative skills; and a stronger sense of well-being and belonging. The design aligns with the EU Key Competences for Lifelong Learning (mathematical, digital, personal-social, and citizenship competences) and provides a transferable, evidence-informed model for integrating quantitative analysis with physical literacy and health promotion.

KEYWORDS

Biomechanics; cooperative learning; physical Education; probability; project-based learning; statistics; STEAM

1. THEORETICAL FRAMEWORK

The proposal is explicitly aligned with SDG 3 (Good Health and Well-Being), positioning sport as an authentic context for learning that promotes healthy lifestyles across the lifespan and situates health-related decision-making within meaningful school experiences. Guided by Universal Design for Learning (UDL) (CAST, 2018), the design anticipates learner variability by offering multiple means of engagement, representation, and action/expression, thereby ensuring both accessibility and appropriate cognitive challenge. The unit adopts an interdisciplinary stance grounded in Project-Based Learning and STE(A)M integration, drawing on evidence of positive effects on achievement, attitudes, and creativity to justify the coupling of mathematical and scientific inquiry with physical-education practice (Kwon & Lee, 2025). Within Physical Education specifically, the use of cooperative structures is warranted by research showing moderate gains across affective, cognitive, physical, and social domains; accordingly, the intervention organizes learners in four-student teams to optimise collaboration and peer feedback (Boke et al., 2025).

Digital tracking tools and wearables are incorporated to enhance motivation and to support the formative use of data (e.g., logging heart rate or steps and visualizing trends), yet their role is deliberately bounded: given heterogeneous findings on objectively increasing school-based physical activity, devices are framed as supports rather than ends in themselves (Koutromanos & Kazakou, 2021; Chen et al., 2025). From an applied biomechanics perspective, systematic qualitative and quantitative feedback on technique is used to improve movement efficiency and mitigate injury risk, which also strengthens explicit curricular links to geometry (angles, vectors) and kinematic reasoning (Cui & Wang, 2024). Finally, sports analytics provides a rigorous context for introducing probability and modelling with real performance data, reinforcing the statistical literacy that underpins informed decision-making in both academic and athletic settings (Yip, 2021).

2. OBJECTIVES

This project pursues three integrated aims in a single, coherent pathway: first, to connect core mathematical content—descriptive statistics, probability, proportions, and geometry—with the improvement of motor performance and decision-making in school sports contexts; second, to promote healthy habits and well-being in accordance with SDG 3: Good Health and Well-Being (United Nations; United Nations Development Programme); and third, to cultivate transversal competences—cooperative work, critical thinking, and digital literacy—through active methodologies and formative assessment, drawing on the Universal Design for Learning framework and meta-analytic evidence on project-based learning.

3. METHODOLOGY

The unit integrates Mathematics, Physical Education, and Social Sciences across four 50-minute sessions (ages 10–15). Session 1 (Exploration): brief fitness assessments (endurance—3-minute run; strength—30-second push-ups; speed—20 m sprint; flexibility—reach test; coordination—target throwing and balance) followed by data analysis using measures of central tendency/dispersion and graphical representations. Session 2 (Application): probability and strategy in precision tasks (effects of angle and distance) linked to performance patterns. Session 3 (Evaluation): team presentations with intra/inter-group comparisons, discussion of healthy habits, and data-informed injury prevention. Session 4 (Synthesis): design of a data-driven training plan linking technique and biomechanics. The approach uses teams of four, formative assessment (rubrics, self/peer assessment), and spreadsheets/GeoGebra with basic sensors.

Quality framework: alignment with the EU Key Competences for Lifelong Learning (mathematical, digital, personal-social, citizenship) strengthens the competence-based approach (Council of the European Union, 2018).

4. COMPETENCES

The unit purposefully develops four interrelated EU Key Competences. First, it strengthens mathematical, scientific, technological and engineering competence by engaging learners in real world data analysis, estimation/measurement, and basic modelling tasks that connect quantitative reasoning with authentic school contexts.

Second, it builds digital competence through the critical use of apps/sensors and spreadsheets to capture, visualise, and communicate information with clarity and integrity.

Third, it advances the personal, social, and learning-to-learn competence by cultivating self-regulation, cooperative work, and goal-oriented feedback practices grounded in Universal Design for Learning (UDL), thereby anticipating learner variability and ensuring multiple options for engagement, representation, and action/expression.

Finally, it nurtures citizenship and cultural awareness/expressive competence by framing sport as a space for inclusion and fair play while situating classroom inquiry within a European sociohistorical context that values participation, responsibility, and respect for diversity.

5. OUTCOMES

Anticipated outcomes include enhanced mathematical competence and critical thinking, as students apply statistics and probability to their own datasets and to tactical game decisions (Kwon & Lee, 2025). Achievement and motivation are expected to increase through cooperative work and authentic projects in Physical Education (Boke et al., 2025), while integrated STEAM + PE programming contributes to a stronger sense of school well-being and belonging (Tafuri et al., 2024). Technique and movement efficiency should improve via explicit biomechanical principles and systematic feedback, supporting safer and more effective motor performance. Finally, the unit aims to build digital literacy and self-regulation through the formative use of wearables and data analytics—recognizing their motivational value but also the mixed evidence for objective gains in school-based physical activity (Cui & Wang, 2024).

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THE HUMAN BODY IN MOTION: AN INTERDISCIPLINARY STEAM APPROACH TO ANATOMY AND PHYSICAL LITERACY

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ABSTRACT

The "Human Body in Motion" lesson plan presents a 90-minute interdisciplinary STEAM inquiry designed for students aged 11–13. Utilizing the 5E instructional model, the curriculum integrates Biology, Physical Education, and Language to explore the physiological synergy between the circulatory, respiratory, and muscular systems during physical exertion. Students engage in active learning through biometric data collection—utilizing health applications and manual pulse checks—to analyze fluctuations in heart and breathing rates. The pedagogical framework facilitates the translation of scientific observations into visual "Movement Maps" and technical descriptive writing. By bridging the gap between theoretical anatomy and practical body awareness, this lesson promotes scientific inquiry and empowers students to make data-informed decisions regarding personal well-being. This structured approach ensures a comprehensive understanding of how internal systems maintain homeostasis, fostering lifelong physical literacy and health-oriented self-regulation.

KEYWORDS

5E Model; Anatomy; Biology; Physical Education; STEAM; Well-being

1. THEORETICAL FRAMEWORK

The lesson is grounded in the 5E Instructional Model, a constructivist framework that promotes inquiry-based learning through the sequential phases of Engage, Explore, Explain, Elaborate, and Evaluate (Bybee et al., 2006). This model supports active knowledge construction by encouraging learners to connect prior experiences with newly acquired scientific concepts and apply them in authentic contexts.

The interdisciplinary design integrates Biology, Physical Education, and Language Education within a STEAM approach, fostering connections between scientific understanding, physical literacy, and communication skills. STEAM education has been shown to enhance student engagement, creativity, collaboration, and problem-solving abilities through the integration of multiple disciplines (Yakman & Lee, 2012).

The lesson is aligned with Sustainable Development Goal (SDG) 3, which promotes healthy lives and well-being, and SDG 4, which advocates for inclusive and quality education (United Nations, n.d.; United Nations Development Programme, n.d.). Through the development of personalized fitness plans and reflective learning activities, students are encouraged to adopt healthy lifestyles while developing scientific literacy and self-regulation skills.

Furthermore, research indicates that cooperative learning approaches positively influence students' academic achievement, motivation, and social interaction in physical education settings (Boke et al., 2025). Similarly, STEAM project-based learning has been associated with increased creativity and deeper conceptual understanding (Kwon & Lee, 2025). Consequently, the lesson combines inquiry, collaboration, and authentic assessment to support meaningful and transferable learning experiences.

2. OBJECTIVES

This curriculum is engineered to achieve three integrated pedagogical goals: connecting core anatomical content (circulatory, respiratory, and muscular systems) with physical performance; promoting sustainable healthy habits and well-being; and refining students' language and descriptive writing skills. By synthesizing Natural Sciences and Physical Education, the lesson promotes inquiry-based learning and meaningful knowledge construction (Bybee et al., 2006).

3. METHODOLOGY

This educational intervention consisted of a 90-minute interdisciplinary STEAM lesson entitled "Human Body in Motion", designed for students aged 11–13 years. The lesson integrated concepts from Biology, Physical Education, and Language Education and was structured according to the 5E Instructional Model (Bybee et al., 2006).

The intervention began with the Engage phase, during which students measured their resting heart rate through manual pulse checks or mobile health applications. Guided questioning was used to activate prior knowledge and encourage students to formulate predictions regarding physiological changes during physical activity.

During the Explore phase, students participated in three inquiry-based learning stations. At the first station, students performed jumping jacks and recorded changes in heart and breathing rates. At the second station, they observed respiratory responses through controlled deep-breathing exercises. At the third station, students investigated muscular responses through stretching activities. Data collected during these activities enabled students to observe the interactions among the circulatory, respiratory, and muscular systems.

In the Explain and Elaborate phases, students analyzed their observations collaboratively and constructed a "Movement Map" illustrating the relationships among body systems involved in movement. Working in pairs, they identified key anatomical structures and processes, including oxygen transport, blood circulation, muscular contraction, and energy production. Students also produced a short descriptive text using scientific terminology to explain how these systems function together during physical activity.

Assessment was conducted during the Evaluate phase through teacher observation, peer discussion, oral presentations, and written reflections. Evaluation criteria focused on students' understanding of physiological processes, their ability to interpret collected data, the accurate use of anatomical vocabulary, and the clarity of scientific communication.

Finally, in the Extend phase, students applied their learning by designing a personalized fitness plan incorporating cardiovascular, strength, and flexibility activities. This task encouraged the transfer of scientific knowledge to real-life contexts and promoted awareness of healthy lifestyle choices, supporting the development of physical literacy and lifelong well-being.

4. COMPETENCES

The competence framework is aligned with the European Key Competences for Lifelong Learning (Council of the European Union, 2018).

Scientific and Technological Competence: Students develop this through the empirical process of measuring resting and active heart rates using manual pulse checks or health applications. They gain a functional understanding of human anatomy by tracing the path of oxygenated blood from the lungs and heart to the muscular system, bridging the gap between theoretical biology and physical sensation

Linguistic Competence: This lesson emphasizes the mastery of a specialized anatomical vocabulary (e.g., diaphragm, blood vessels, energy). Students must demonstrate clarity and coherence in their writing by producing descriptive paragraphs that explain complex physiological interactions, while also developing their "creative voice" through the visual design of Movement Maps

Personal, Social, and Learning-to-Learn Competence: A primary focus is on self-regulation and healthy lifestyle choices. By designing a "Weekly Fitness Plan" tailored to their personal interests, students learn to set goals, incorporate rest days, and understand the mental and physical benefits of regular exercise. The cooperative nature of the activity stations also fosters social skills and collaborative inquiry

Digital Competence: Students utilize digital tools, such as stopwatches and health tracking sensors, to capture and analyze their own biometric data, fostering a critical and practical use of technology in a health context.

5. OUTCOMES

Integration of Body Systems: Students will be able to articulate exactly how the circulatory, respiratory, and muscular systems work together to sustain movement, specifically detailing how the heart and lungs respond to the increased oxygen demands of contracting muscles.

Data Analysis and Interpretation: A key outcome is the improved ability to measure, record, and interpret physiological markers. Students will be able to identify trends in their own data, such as how different types of exercise (e.g., jumping jacks vs. stretching) impact heart and breathing rates differently.

Scientific Communication: Achievement is demonstrated through the creation of a "Movement Map," where students must accurately label anatomical parts and use arrows to illustrate blood flow and system interactions. Success is also measured by their ability to use at least five new vocabulary terms correctly in a written reflection.

Behavioral Change and Health Awareness: Beyond academic knowledge, the lesson aims for the practical outcome of increased motivation toward physical activity. By creating sustainable fitness plans that include cardiovascular, strength, and flexibility goals, students leave the lesson with a concrete tool for self-improvement and long-term well-being.

Enhanced Inclusion: With multi-modal instructions and flexible group roles, the lesson ensures that students of all mobility levels can experience the outcome of understanding their body's potential for motion.

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NTC + STEAM&SPORTS

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ABSTRACT

Following STEAM concept this unit integrates knowledge and skills in Mathematics, Biology / Engineering, Art and Design, Sports, one session (5 lessons), approximately (45min.) is divided into five stages. Engagement (30min), Explore (60min) Elaboration (60 min), Evaluation (45 min) and Extension (15 min- optional). Going throw the unit procedure, students deal with map making (Engineering - visual program language) supporting by compass training method, design and painting animal masks implying all characteristics of the animal. (Art and design, Biology). Students move across the playground, do exercises based on variety of derived and innate human motions (walking, lifting, carrying, squatting), Sports, follow required cognitive and motor procedures, answer the questions (applying their theoretical and functional knowledge in, Biology)going throw the task procedure leaning on their own body and landmarks (body awareness and landmark recognition), structure correct spatial information they go forward to the objective, solve the puzzle, measure the time of action, compare and contrast the results and give some basic information about the (animals foot print) animal.

KEYWORDS

Spatial orientation; Spatial Cueing; Biology; Sport; Art; IT; Design; Project-Based learning; Mathematics

1. THEORETICAL FRAMEWORK

Spatial orienteering tasks imply cognitive and motor procedures to enable individual perception and navigation between our body (body awareness) and landmarks (landmark recognition) essentials for daily functioning – to maintain oriented during movement and for planning routs. Implying egocentric frame method suggests student how people use their own body (egocentric) to external landmarks (allocentric) to structure their spatial information. Spatial cueing (bird sounds) indicates where target might be and the prompts (input) take the students step-by-step throw the task, towards their objective.

2. OBJECTIVES

Improve spatial orientation, advance cognitive and motor procedures, perception, recognize the importance of external landmarks (landmark recognition) and our body structuring special information (body awareness) improvement of digital competence and creativity potential, revision and functional applying of merge knowledge. of different subject areas, decision - making tasks.

3. METHODOLOGY

One session approximately 5 lessons (45 min) is divided into five stages: Engagement (30min), Explore (60 min) Elaboration (60 min), Evaluation (45 min) Extension (15 min), optional. Engagement - students consider landmark recognition, body awareness, spatial orientation, Explore - students cross the polygon collect jigsaw puzzle, solve tasks, Elaboration - mask making, Evaluation - knowledge presentation and map making, Extension (optional).

4. COMPETENCES

Spatial orienteering skills, cognitive and motor skills improve their theoretical and functional knowledge, Environmental awareness, critical opinion, exploring, digital competence, team spirit, social inter relationship.

5. OUTCOMES

Using functional knowledge from different subject areas in appropriate way, recognize the importance of diversity of plant and animal life and set an example, cooperation , team spirit, improve cognitive and motor skills, creativity potential, digital competence, spatial orientation (using maps, compass for determine direction, spatial cueing) , problem task solving, environmental care, inclusion, body awareness (understanding your body's position in relation to the surrounding environment and navigation 3D space, effectively).

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NESSIE - NEW SKILLS & SPACES IMPULSE FOR THE EDUCATION OF ASPIRANT ENERGY TRANSITION INSTALLERS

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ABSTRACT

NESSIE (NEw Skills & Spaces Impulse for the Education of aspirant energy-transition installers) is an Interreg North Sea Region project that addresses the growing demand for skilled professionals within the energy transition sector. The project focuses on how vocational education and training (VET) can better connect learners to authentic professional environments within renewable energy and sustainable technologies, while also attracting and guiding new target groups towards sustainable technical studies and professions.

A central methodological principle within NESSIE is "learning by doing". Rather than separating theory from practice, the project develops educational approaches in which learners engage directly with real installations, companies, sustainability projects, and professionals working within the energy transition sector. Through Short Advanced Courses (SACs), traineeships, and E-Campuses in lighthouse regions, learners gain practical experience while developing a clearer understanding of technical professions and career opportunities.

The project also explores how authentic learning environments and direct interaction with industry can improve learner motivation, recruitment into technical education, and awareness of career pathways within the energy transition. Particular attention is given to groups traditionally underrepresented within technical professions, including women and career changers.

Through practical experimentation and regional collaboration, NESSIE contributes to more practice-oriented and responsive approaches within vocational education for the energy transition.

KEYWORDS

Energy transition; skills ecosystems; vocational education and training; workforce development

1. MAIN TEXT

NESSIE (NEw Skills & Spaces Impulse for the Education of aspirant energy-transition installers) is an Interreg North Sea Region project that addresses the growing demand for skilled professionals within the energy transition sector. As Europe accelerates the transition towards renewable energy systems and sustainable technologies, vocational education and training (VET) faces the challenge of preparing learners for rapidly changing technical professions while companies increasingly experience shortages of qualified installers and technicians.

Rather than focusing primarily on curriculum reform, NESSIE explores how vocational education can become more connected to authentic professional environments within the energy transition sector. Research and pilot activities within the project indicate that many learners have limited visibility of technical professions and little direct experience with real working environments related to renewable energy systems and sustainable technologies. Career pathways are often perceived as unclear, while technical professions are not always recognised for their societal relevance and future opportunities. NESSIE therefore specifically explores how vocational education can make sustainable technical careers more visible, accessible, and attractive for learners who would not traditionally consider technical education pathways.

A central methodological principle within NESSIE is “learning by doing”. The project is built around the idea that vocational learning becomes more meaningful when learners can directly connect education to professional practice and real-life applications. This aligns with research on authentic learning environments, which highlights the importance of learning within realistic professional contexts where learners engage with real tasks, problems, and stakeholders (Herrington & Oliver, 2000).

To support this approach, NESSIE develops educational interventions that place authentic learning environments at the centre of vocational education. Instead of separating theory from practice, learners work directly with installations, sustainability projects, companies, and professionals active within the energy transition sector. Practical experience is therefore not treated as an addition to learning, but as a core part of the educational process.

One of the main methodological elements within the project is the use of lighthouse regions as experimental learning environments. These regions function as frontrunner locations where educational institutions, companies, public authorities, and regional stakeholders collaborate around real sustainability challenges connected to renewable energy systems and energy infrastructure. In locations such as islands and coastal regions, learners engage directly with practical applications connected to local sustainability ambitions and regional energy projects.

Within these lighthouse regions, NESSIE develops E-Campuses as hybrid learning environments that combine physical training spaces, digital learning environments, and knowledge from real regional energy projects. The E-Campus model supports collaboration between students, educators, companies, and regional stakeholders while allowing learners to connect classroom learning directly to labour market developments and practical applications.

The project also develops Short Advanced Courses (SACs) as modular and practice-oriented learning units that can quickly respond to developments within the energy transition sector. These courses combine technical knowledge with practical assignments and can be integrated into existing vocational programmes or used for upskilling and reskilling purposes.

A further methodological element is the strong integration of workplace learning through traineeships and collaboration with companies and installers. By working alongside professionals within authentic working environments, learners gain practical experience while developing a clearer understanding of technical professions and career pathways within the energy transition sector. This approach also strengthens the relationship between vocational education and regional labour market needs.

In addition to technical skill development, NESSIE focuses strongly on learner motivation and recruitment into technical education. The project recognises that visibility and direct exposure to the professional field are important factors influencing career choices. Recruitment activities therefore focus on making technical professions more tangible and accessible through practical demonstrations, interaction with professionals, outreach activities, and real career stories from the sector. Particular attention is given to attracting and supporting groups traditionally underrepresented within technical professions, including women, career changers, and learners with limited prior exposure to technical education.

Methodologically, NESSIE combines co-creation, testing, and continuous refinement of educational approaches within real-world contexts. Educational institutions, companies, and regional stakeholders collaborate throughout the process to ensure that learning activities remain connected to labour market developments and regional sustainability ambitions. This iterative approach allows project partners to continuously adapt educational interventions based on practical experiences and feedback from learners, educators, and professionals.

Through international cooperation across the North Sea Region, NESSIE contributes to more practice-oriented and responsive approaches within vocational education. The project demonstrates how authentic learning environments, workplace learning, and closer collaboration between education and industry can strengthen both technical competences and learner engagement within the energy transition sector.

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CHAPTER 3

Conclusions of the Conference

EMERGING TRENDS

The contributions presented during the STEAM&Sports Final Conference reveal a number of emerging trends that are shaping contemporary educational innovation. Although the projects and experiences described in this volume vary in scope, methodology, and disciplinary focus, several common themes can be identified. Together, they suggest new directions for teaching and learning that respond to the challenges of the twenty-first century while remaining grounded in meaningful educational practice.

Interdisciplinary Learning as a Response to Educational Fragmentation

One of the most evident trends emerging from the conference is the growing recognition that complex real-world problems cannot be adequately addressed through isolated disciplinary approaches. Across the contributions, sports functioned as a unifying context through which students engaged simultaneously with concepts from science, technology, engineering, arts, mathematics, health, and environmental education. Rather than treating knowledge as a collection of disconnected subjects, the experiences presented demonstrate the potential of interdisciplinary learning to promote deeper understanding, transfer of knowledge, and greater student engagement.

Sports as a Meaningful Educational Context

The conference further highlighted the educational value of sports beyond their traditional role in physical education. Sports were consistently used as a vehicle for inquiry, experimentation, problem-solving, creativity, and collaboration. Whether investigating energy consumption, analysing posture through artificial intelligence, exploring spatial orientation, or understanding scientific principles through movement, sports provided authentic contexts that connected learning to students' interests and everyday experiences. This reinforces the growing view that physical activity can play a central role in broader educational processes rather than remaining confined to a single curricular area.

The Expansion of Artificial Intelligence in Education

Several contributions reflected the increasing presence of artificial intelligence within educational environments. Importantly, the examples presented moved beyond viewing AI as a purely technological innovation and instead explored its pedagogical potential. AI tools were employed to support personalized learning, facilitate teacher work, and create meaningful classroom experiences that encouraged critical thinking and digital literacy. The conference suggests that future educational innovation will increasingly depend not only on access to AI technologies but also on educators' ability to integrate them ethically, critically, and purposefully within learning processes.

Data Literacy and Inquiry-Based Learning

A recurring feature of many projects was the use of data collection, analysis, and interpretation as part of the learning process. Students measured environmental variables, analysed physical performance, interpreted technological outputs, and generated evidence-based conclusions. These experiences reflect a broader educational trend towards inquiry-based learning, where students actively investigate questions, evaluate evidence, and construct knowledge through exploration. In a society increasingly shaped by data and technology, these competencies are becoming essential components of educational practice.

Health, Well-Being, and Sustainable Development as Educational Priorities

The conference contributions also reveal a growing integration of health promotion and sustainability within educational innovation. Topics such as posture, physical activity, environmental responsibility, energy consumption, and healthy lifestyles were not treated as isolated concerns but as interconnected dimensions of student development. This reflects a broader movement within education towards holistic approaches that seek to prepare students not only for academic success but also for responsible participation in society and the adoption of sustainable lifestyles.

Educational Equity Through Engagement

Perhaps the most significant trend emerging from the STEAM&Sports project is the shift from viewing educational equity solely in terms of access towards understanding equity as meaningful participation and engagement. The experiences documented throughout this volume suggest that students are more likely to succeed when learning is relevant, active, and connected to their interests. By combining STEAM disciplines with sports, the project demonstrated how innovative pedagogical approaches can create opportunities for a wider range of learners to participate successfully in educational experiences that might otherwise appear inaccessible or disconnected from their lives.

Looking Ahead

Taken together, these trends point towards a future in which interdisciplinary learning, technological innovation, physical activity, sustainability, and inclusion become increasingly interconnected. The experiences presented in this conference do not offer a single educational model to be replicated universally. Rather, they illustrate a shared direction of travel: towards educational environments that are more participatory, connected, relevant, and responsive to the needs of contemporary learners. The challenge for educators, researchers, and policymakers will be to continue developing these approaches while ensuring that innovation remains guided by pedagogical purpose and a commitment to educational equity for all.

EDUCATIONAL IMPLICATIONS

The experiences presented throughout the STEAM&Sports project offer valuable insights for educators, schools, and educational systems seeking to respond to the demands of contemporary society. While the specific activities described in this volume were developed within particular contexts, the lessons learned extend far beyond the project itself and suggest broader implications for educational practice.

Moving Beyond Subject Boundaries

One of the principal implications of the project is the need to reconsider traditional disciplinary structures in education. The contributions included in these proceedings demonstrate that meaningful learning often occurs when students are encouraged to connect concepts, methods, and skills across subject areas. Rather than viewing science, mathematics, technology, arts, and physical education as separate domains, schools may benefit from creating opportunities for interdisciplinary collaboration that more closely reflect the complexity of real-world challenges.

This does not imply abandoning disciplinary knowledge. On the contrary, the project shows that strong disciplinary foundations can be enriched through meaningful integration, allowing students to understand not only what they learn, but also why it matters and how it can be applied in authentic situations.

Redefining the Role of Physical Education

The STEAM&Sports approach also highlights the potential of Physical Education to contribute to broader educational goals. Traditionally viewed as a subject primarily concerned with physical development, sport and movement can also serve as powerful contexts for scientific inquiry, technological exploration, mathematical reasoning, creativity, and social learning. This broader conception of Physical Education encourages greater collaboration among teachers and positions physical activity as an integral component of holistic education rather than an isolated curricular area.

Strengthening Student-Centred Learning

Many of the experiences developed during the project relied on active methodologies that placed students at the centre of the learning process. Inquiry-based learning, project-based learning, experimentation, collaborative problem-solving, and real-world applications encouraged students to take a more active role in constructing knowledge. The results suggest that such approaches can enhance motivation, participation, and understanding while supporting the development of autonomy and responsibility.

For educators, this implies a gradual shift from the transmission of information towards the design of learning environments in which students investigate, create, discuss, test ideas, and reflect on their own learning processes.

Developing Digital and AI Literacy

The increasing presence of digital technologies and artificial intelligence in society requires schools to prepare students not only as users of technology but also as critical and informed citizens. The conference contributions illustrate how digital tools, data collection technologies, and AI applications can be integrated into educational experiences in ways that are meaningful, accessible, and pedagogically grounded.

At the same time, these developments highlight the growing importance of teacher training. Effective implementation depends not merely on technological availability but on educators' capacity to select, adapt, and use technological tools in ways that support learning objectives while addressing ethical and social considerations.

Promoting Inclusion Through Diverse Learning Pathways

The project further suggests that educational inclusion can be strengthened by diversifying the ways in which students engage with knowledge. By combining physical activity, technology, creativity, experimentation, and collaboration, the STEAM&Sports approach creates multiple entry points into learning. Such diversity allows students with different interests, strengths, and learning preferences to participate meaningfully and demonstrate competence through a variety of pathways.

This perspective aligns with contemporary views of educational equity, which emphasise not only equal access to learning opportunities but also the creation of environments in which all learners have genuine opportunities to succeed.

Implications for Future Educational Practice

Taken together, the findings of the project support a vision of education that is more integrated, active, inclusive, and connected to students' lived experiences. Future educational initiatives may benefit from creating stronger links between curricular areas, expanding opportunities for experiential learning, incorporating emerging technologies responsibly, and recognising the educational value of contexts that students already find meaningful and motivating.

The experiences documented in this volume suggest that when learning becomes relevant, participatory, and interdisciplinary, students are more likely to develop not only academic knowledge but also the competencies, attitudes, and dispositions required to navigate an increasingly complex world.

FUTURE LINES OF RESEARCH

The STEAM&Sports project has demonstrated the potential of integrating STEAM education and sports to promote student engagement, interdisciplinary learning, and educational equity. However, the experiences presented in this volume also highlight a number of questions that deserve further investigation. As educational systems continue to evolve in response to technological, social, and environmental challenges, future research will play a crucial role in refining, validating, and expanding the approaches explored within this project.

Long-Term Impact on Learning and Motivation

While the project generated encouraging results regarding student engagement and short-term learning outcomes, future studies should examine the long-term effects of STEAM-integrated sports education. In particular, researchers may investigate whether participation in these experiences contributes to sustained interest in STEAM subjects, influences educational choices, or affects students' aspirations towards STEAM-related careers. Longitudinal studies would provide valuable insights into the lasting impact of interdisciplinary educational approaches.

Educational Equity and Diverse Learner Profiles

One of the central objectives of the project was to promote educational equity through engaging and accessible learning experiences. Future research should explore how STEAM and sports integration affects different learner populations, including students from disadvantaged socioeconomic backgrounds, students with disabilities, neurodivergent learners, and groups traditionally underrepresented in STEAM fields. Understanding how different learners experience and benefit from these approaches will help educators design more inclusive educational environments.

Artificial Intelligence and Emerging Technologies

The increasing incorporation of artificial intelligence into educational settings opens numerous avenues for future research. Beyond evaluating the effectiveness of specific tools, further studies should investigate how AI can support personalized learning, formative assessment, feedback processes, and teacher decision-making while preserving human relationships at the centre of education. Particular attention should be given to ethical considerations, digital citizenship, data privacy, and the development of critical AI literacy among both students and educators.

Assessment of Interdisciplinary Competencies

Traditional assessment systems often focus on subject-specific knowledge, making it difficult to evaluate the broader competencies fostered by interdisciplinary learning. Future research should therefore contribute to the development of assessment frameworks capable of capturing skills such as problem-solving, creativity, collaboration, critical thinking, systems thinking, and the ability to transfer knowledge across contexts. Reliable assessment tools would support both research and classroom implementation of integrated educational models.

Teacher Professional Development

The successful implementation of interdisciplinary approaches depends heavily on teacher preparation and confidence. Future studies should examine the competencies, training models, and support structures required to help educators design and facilitate STEAM-integrated learning experiences. Research exploring collaborative teaching practices, interdisciplinary planning processes, and the role of professional learning communities may provide valuable guidance for educational institutions seeking to adopt similar approaches.

Scaling and Transferability Across Educational Contexts

The project demonstrated that the STEAM&Sports approach can be implemented successfully across different countries and educational systems. Nevertheless, additional research is needed to understand how such initiatives can be scaled while maintaining quality and contextual relevance. Comparative studies involving different educational levels, cultural contexts, and institutional settings would contribute to a deeper understanding of the factors that facilitate or hinder successful implementation.

Towards Holistic Models of Education

Perhaps the most promising avenue for future research lies in the continued exploration of holistic educational models that connect academic learning with health, well-being, sustainability, citizenship, creativity, and technological innovation. The experiences documented in this volume suggest that meaningful learning often emerges when students engage with authentic challenges that cut across disciplinary boundaries. Future research should continue to investigate how such integrative approaches can contribute not only to academic achievement but also to human flourishing, social participation, and lifelong learning.

In conclusion, the STEAM&Sports project should be understood not as a final destination but as a starting point. The outcomes presented in these proceedings provide evidence of what is possible when educators, researchers, and institutions collaborate to rethink traditional educational boundaries. Future research will be essential in building upon these foundations and further advancing educational practices that are innovative, inclusive, and responsive to the needs of contemporary learners.

RECOMMENDATIONS

Drawing upon the experiences, outcomes, and reflections generated throughout the STEAM&Sports project, several recommendations can be proposed for educators, school leaders, researchers, and policymakers interested in promoting innovative, inclusive, and interdisciplinary educational practices.

For Teachers

Teachers are encouraged to explore meaningful connections between disciplines and to use authentic contexts that resonate with students' interests and experiences. Sports represent one such context, but the broader principle extends to any learning environment capable of linking academic knowledge with real-world applications. Small-scale interdisciplinary projects can serve as effective starting points, allowing educators to gradually develop confidence and experience in integrated teaching approaches.

Teachers should also embrace active learning methodologies that encourage inquiry, experimentation, collaboration, and reflection. Rather than positioning students as passive recipients of information, learning environments should provide opportunities for investigation, problem-solving, creativity, and decision-making.

For Schools and Educational Leaders

Educational institutions should create conditions that facilitate interdisciplinary collaboration among teachers. Flexible planning structures, shared projects, and opportunities for professional dialogue can help overcome traditional subject boundaries and support the development of integrated learning experiences.

Schools should also recognise the educational value of physical activity beyond its contribution to health and well-being. Sport and movement can become powerful vehicles for learning across multiple disciplines while simultaneously fostering motivation, participation, and social development.

For Teacher Education and Professional Development

Universities and training providers should strengthen opportunities for future and practising teachers to develop competencies related to interdisciplinary teaching, digital literacy, project-based learning, and the pedagogically sound use of emerging technologies. Professional development initiatives should emphasise both technical knowledge and pedagogical design, enabling educators to adapt innovative approaches to their own contexts.

Special attention should be devoted to supporting teachers in the responsible integration of artificial intelligence and digital technologies, ensuring that these tools enhance rather than replace meaningful human interactions in education.

For Researchers

Future research should continue investigating the effectiveness of interdisciplinary educational models across diverse contexts and learner populations. Particular attention should be given to long-term outcomes, educational equity, inclusion, student motivation, and the development of transversal competencies. Collaboration between researchers and practitioners can help ensure that future innovations remain grounded in educational realities while contributing to evidence-based practice.

For Policymakers

Educational policies should encourage innovation while providing schools with the flexibility necessary to implement interdisciplinary and experiential learning approaches. Assessment frameworks, curriculum structures, and funding mechanisms should recognise the value of competencies that extend beyond traditional disciplinary knowledge, including collaboration, creativity, problem-solving, digital literacy, and active citizenship.

Policymakers should also continue supporting international cooperation projects that enable educational institutions to exchange experiences, develop shared resources, and address common challenges through collaborative innovation.

A Final Reflection

Perhaps the most important recommendation emerging from the STEAM&Sports project is that educational innovation should always remain centred on learners. Technology, methodologies, and educational resources are valuable only insofar as they contribute to meaningful learning experiences that help students understand themselves, others, and the world around them. The experiences documented in this volume demonstrate that when learning becomes active, relevant, interdisciplinary, and inclusive, students are more likely to engage deeply with knowledge and to develop the competencies needed to thrive in an increasingly complex society.

The future of education will undoubtedly continue to evolve. Yet the lessons learned through this project suggest a clear direction: educational systems should strive to create learning environments that connect disciplines, embrace diversity, encourage participation, and inspire curiosity. In doing so, they will be better equipped to prepare future generations not only for employment, but also for lifelong learning, responsible citizenship, and human flourishing.

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