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VR Workouts

A Guide to Needs Assessment

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VR workouts

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About VR Workouts

VR Workouts is an Erasmus+ Project that aims to improve the learning experiences of children with special needsthrough immersive and engaging VR scenarios and empower educators with innovative pedagogical frameworks. WP2 focuses on conducting a comprehensive needs assessment to understand how virtual reality (VR) can effectively enhance physical education (PE) in schools. This involves researching the needs, preferences, and challenges of students, teachers, and educational institutions regarding physical activity and VR use in education. It also includes analysing current PE practices, evaluating technological infrastructure within partner schools, and benchmarking best practices in VR for education and physical activity globally. The findings will be compiled into a detailed report that will guide the development of VR workouts and educational materials, ensuring they are user-centred, accessible, and aligned with proven best practices for integrating VR into PE and the wider curriculum.

The partners

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CHAPTER 1: A Systematic Literature Review on Virtual Reality and Physical Activity for Special Needs Education

1.1 Introduction

The rapid advancement of Virtual Reality (VR) technologies has opened new possibilities for transforming educational practices, particularly in the development of physical and motor skills among children with special educational needs (SEN). VR's immersive, interactive, and adaptive features provide unique opportunities to overcome some of the limitations of traditional methods, which are often perceived as repetitive, resource-intensive, or insufficiently engaging. As a result, VR is increasingly being investigated and applied in both educational and therapeutic contexts to foster motor skill development, enhance physical activity, and promote inclusive learning experiences.

This review seeks to establish a comprehensive understanding of how academic research and industry innovations are shaping the application of VR in education and rehabilitation. Drawing upon a wide range of sources—including peer-reviewed studies, systematic reviews, industry reports, and product evaluations—the analysis identifies current trends, evaluates evidence-based strategies, and highlights key challenges and gaps in the field. The review is guided by a dual focus: first, to assess the effectiveness of VR interventions for promoting motor skill development and physical engagement in children with SEN; and second, to examine how emerging VR technologies are being designed, implemented, and refined to support these educational and therapeutic goals in both research and real-world applications.

By synthesizing insights from both academic literature and industry-driven initiatives, this review aims to inform the design and development of a VR educational framework that is grounded in evidence while also leveraging the latest technological innovations. The overarching goal is to create engaging, accessible, and effective learning experiences that bridge the gap between research, technology, and inclusive education. Ultimately, this work seeks to contribute to the development of VR solutions that foster motor skill growth, physical activity, and broader participation for learners of all abilities.

1.2 Key findings

Motor Skills Development and Rehabilitation

One of the most consistent findings across the literature is VR's effectiveness in supporting motor skill development. Several studies emphasize improvements in both fine and gross motor skills, including gripping, writing, walking, running, and jumping (Karadag et al., 2025). For children with cerebral palsy (CP), VR interventions have demonstrated significant improvements in balance, coordination, and fine motor control (Ren & Wu, 2019; Oznur & Arzu, 2023). Similarly, systematic reviews confirm that VR-based therapy enhances gross motor function, muscle strength, aerobic capacity, and postural control in children with CP and Down syndrome (Chen et al., 2022; Pinar-Lara et al., 2024; Velasco Aguado et al., 2025).

Balance is another key area of improvement. Multiple reviews and meta-analyses highlight that VR interventions produce measurable gains in balance for children with CP and developmental coordination disorder (DCD) (Wei et al., 2022; Piñar-Lara et al., 2025). Customized VR-based physiotherapy, particularly when combined with traditional methods, has been shown to enhance gross motor function and movement quality in children with CP (Kolezoi et al., 2025).

The evidence regarding upper limb function is mixed. While some randomized controlled trials suggest that VR can improve grip strength and functional skills (Alrashidi et al., 2023), other studies found no significant differences when compared to conventional therapies. These inconsistencies may stem from variations in session frequency, intervention intensity, and the predominance of non-immersive, commercially available gaming systems rather than customized therapeutic VR platforms.

Engagement and Motivation

Engagement and motivation are central to VR's appeal. Unlike traditional rehabilitation methods that may feel repetitive or monotonous, VR offers gamified, playful environments that encourage sustained participation. Studies confirm that children enjoy VR sessions more than conventional therapy, leading to improved adherence and consistency (Komaini et al., 2024). For children with autism spectrum disorder (ASD), VR's interactive settings also provide opportunities to practice social interaction and motor mimicry in controlled yet engaging contexts (Minissi et al., 2023; Carvalho et al., 2023).

Artificial intelligence (AI)-enhanced VR systems further personalize learning and therapy by adjusting content in real time, thereby supporting individual needs and boosting outcomes in attention, motor coordination, and emotional regulation (Taneska & Bogdanova, 2023). Importantly, these motivational benefits extend beyond therapy into educational contexts, where VR has been reported to enhance cognitive engagement, self-esteem, and overall enjoyment (Analyti et al., 2024; Chitu et al., 2023).

Educational Applications

Beyond clinical rehabilitation, VR plays a growing role in inclusive education. Studies suggest that VR supports skill acquisition by simulating real-life activities, such as navigating streets, interacting with peers, or practicing safety routines, within safe and controlled environments (Chitu et al., 2023). These simulations not only promote independence but also enhance emotional involvement and social learning, which are often difficult to achieve through conventional instruction.

In physical education (PE), VR and augmented reality (AR) interventions have been found to increase motivation, participation, and motor coordination compared to traditional classes (Kuleva, 2024; Kim et al., 2023). Inclusive VR learning environments can be particularly beneficial for students with specific learning disabilities (SLDs), providing safe, personalized contexts that encourage repeated practice and confidence-building (Mokmin & Rassy, 2024). Teachers, however, emphasize barriers such as limited resources, lack of training, and insufficient

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curriculum integration, all of which constrain VR's broader adoption (Mokmin et al., 2025).

Challenges and Limitations

Despite its benefits, several challenges hinder VR's widespread implementation. The high cost of hardware and software remains a significant barrier, particularly in under-resourced educational and therapeutic settings (Karadag et al., 2025). Furthermore, many VR systems are not specifically designed for children with SEN, limiting their adaptability to diverse needs (Alrashidi et al., 2023).

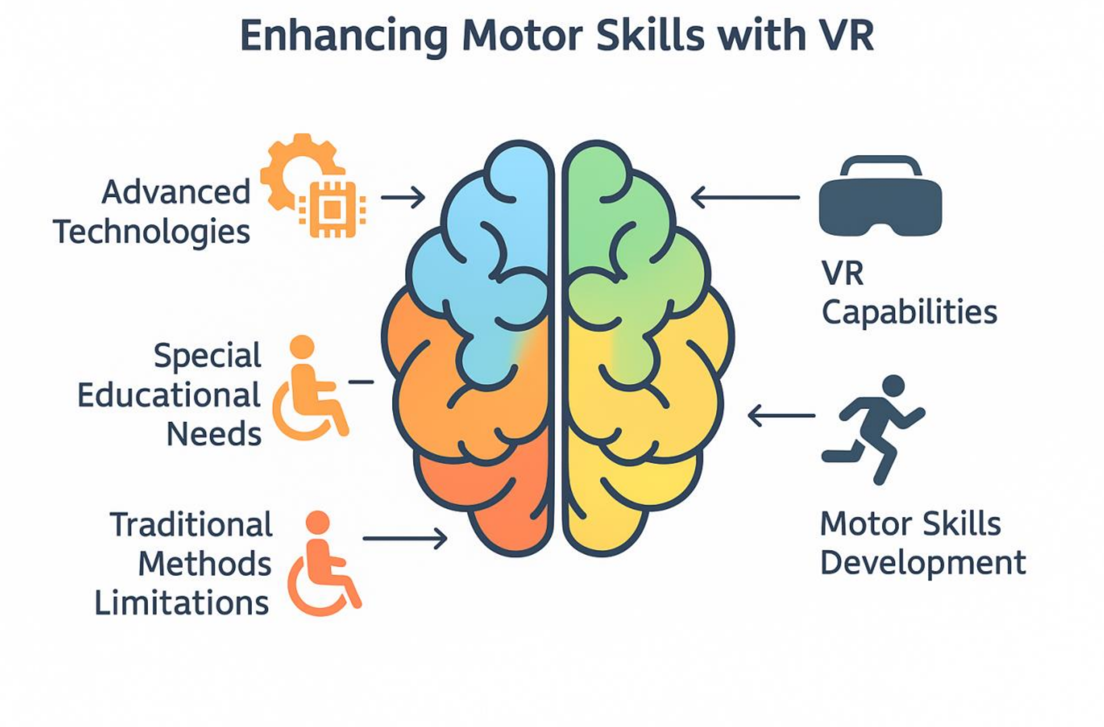
User experience concerns also persist. Extended use can lead to fatigue, eye strain, or motion sickness, and some applications lack sufficient interactivity to sustain children's attention (Karadag et al., 2025). The transferability of skills learned in VR to real-life contexts remains uncertain, with researchers calling for more standardized outcome measures and long-term studies (Hocking et al., 2022).

Another critical issue is the lack of teacher and therapist training. Without adequate professional development and technical support, VR interventions risk being underutilized or misapplied (Pérez-Muñoz et al., 2024). Finally, safety concerns such as overexposure, overstimulation, and the potential for addiction underscore the need for careful monitoring and structured implementation (Karadag et al., 2025).

Overall, the reviewed literature demonstrates that VR has strong potential to enhance motor skills, engagement, and educational inclusion for children with SEN. It offers unique advantages over traditional therapies by combining immersive environments, gamification, and adaptability. Evidence consistently supports VR's effectiveness in improving gross motor function, balance, and coordination, while also highlighting motivational and emotional benefits. However, challenges such as cost, limited accessibility, inconsistent evidence, and insufficient professional training must be addressed for VR to achieve widespread adoption. Future research should prioritize large-scale, long-term studies with standardized protocols to establish VR as a reliable, evidence-based practice in both rehabilitation and education.

1.3 Virtual Reality and Motor Skill Development in Children with Special Educational Needs

Motor skills are foundational for children's physical, cognitive, and social development, enabling them to participate in daily activities, academic tasks, and recreational opportunities. Children with special educational needs (SEN)—such as cerebral palsy (CP), developmental coordination disorder (DCD), autism spectrum disorder (ASD), or Down syndrome—often experience significant challenges in acquiring these skills at the same rate as their peers, which can hinder independence and inclusion (Karadag et al., 2025). In recent years, Virtual Reality (VR) has gained attention as an innovative intervention for motor skill training, offering immersive, safe, and engaging environments that can replicate real-world tasks while providing real-time feedback and opportunities for repetitive practice. This review synthesizes academic evidence to evaluate the role of VR in enhancing motor skills in children with SEN.



VR for Fine and Gross Motor Skills

Fine and gross motor skills form the foundation for children's autonomy in daily living activities such as dressing, feeding, and mobility. VR interventions have shown significant potential in supporting these domains. For example, children with CP demonstrated improvements in both fine motor skills (e.g., grasping, hand dexterity) and gross motor abilities (e.g., balance, walking, and coordination) following VR therapy (Ren & Wu, 2019; Oznur & Arzu, 2023). Similarly, research involving children with hemiplegic CP and developmental disabilities found that VR programs enhanced hand function, balance, and daily functional activities (Komaini et al., 2024).

Commercially available systems such as Xbox Kinect and Nintendo Wii have been effectively used to train whole-body movements, demonstrating benefits for children with burns, motor disorders, and developmental disabilities (Komaini et al., 2024). These findings reinforce VR's value as both a clinical rehabilitation tool and an accessible, engaging platform for skill development in home or school settings.

Balance and Coordination

Balance and coordination are essential for both daily functioning and participation in sports and play. Evidence from systematic reviews and randomized controlled trials confirms that VR-based interventions can significantly improve balance in children with CP, DCD, and Down syndrome (Wei et al., 2022; Pinar-Lara et al., 2024; Piñar-Lara et al., 2025). For instance, VR balance training for children with DCD resulted in notable improvements in proprioception, trunk control, and core stability, skills that are often impaired in this population (Tsang et al., 2022).

Experimental studies combining traditional physiotherapy with VR-based training—such as those using the Nintendo Wii Balance Board—have also reported sustained improvements in gross motor function and postural control in children with CP (Kolezoi et al., 2025). These results underscore VR's ability to provide repetitive, feedback-rich environments that support neuroplasticity and motor learning.

Motor Planning, Dexterity, and Spatial Perception

Motor planning and spatial perception are critical for children's ability to navigate environments and perform coordinated tasks. VR allows for the practice of these skills through goal-directed tasks, such as reaching, grasping, or navigating obstacle courses. Research with children with ASD showed that immersive VR activities supported whole-body coordination, anticipatory control, and spatial planning, even though their motor performance often displayed greater variability compared to typically developing peers (Minissi et al., 2023).

Similarly, VR interventions targeting manual dexterity and object manipulation have proven valuable for children with SEN, enhancing fine motor control and cognitive engagement through gamified and interactive exercises (Karadag et al., 2025). By integrating visual, auditory, and kinesthetic feedback, VR supports multisensory learning, a crucial factor for children with motor impairments (Cavalcante Neto et al., 2018).

Physical Activity and Endurance

Beyond motor rehabilitation, VR also plays a role in promoting physical activity and general fitness in children with disabilities. For example, school-based VR programs have been shown to successfully deliver moderate-intensity exercise for adolescents with mobility impairments, improving overall engagement in physical activity (Lai et al., 2025). Meta-analyses also suggest that VR-based training enhances muscular endurance and cardiorespiratory fitness, particularly for children with Down syndrome and CP (Pinar-Lara et al., 2024; Velasco Aguado et al., 2025).

Commercial VR fitness platforms such as Beat Saber and FitXR have demonstrated similar benefits for youth populations by increasing weekly activity levels, improving aerobic endurance, and enhancing gross motor coordination (Johnson & Lee, 2022). While these platforms are not specifically designed for SEN populations, their accessible design and gamified elements indicate promising applications in inclusive education and rehabilitation contexts.

Engagement and Motivation in Motor Learning

Motivation and engagement are vital to the success of any motor skills intervention. Traditional physiotherapy is often perceived as repetitive or monotonous, leading to reduced adherence. By contrast, VR's interactive and playful nature has been consistently highlighted as a driver of engagement, with children more willing to participate in therapy and practice skills for extended periods (Karadag et al., 2025; Hocking et al., 2022).

Gamified feedback systems, reward structures, and personalization of tasks make VR particularly effective in maintaining interest and enthusiasm among children with SEN (Komaini et al., 2024). Studies on AI-enhanced educational games further demonstrate how adaptive feedback mechanisms can promote attention, motor coordination, and sensory integration in children with disabilities (Taneska & Bogdanova, 2023).

Challenges and Limitations

Despite its clear potential, the implementation of VR for motor skill development faces notable challenges. Cost and accessibility remain significant barriers, especially in under-resourced educational or clinical environments (Karadag et al., 2025). Additionally, many commercially available VR platforms were not designed for SEN populations, limiting customization and adaptability (Alrashidi et al., 2023).

User experience issues such as fatigue, dizziness, and motion sickness also raise concerns about prolonged VR use (Karadag et al., 2025). Moreover, inconsistencies in study design, sample size, and outcome measures reduce the generalizability of findings across different populations (Chen et al., 2022). These limitations highlight the need for standardized protocols, larger trials, and long-term evaluations of skill transfer from virtual to real-world contexts.

All in all, the reviewed literature provides compelling evidence that VR can significantly enhance motor skill development in children with SEN. Improvements in fine and gross motor skills, balance, coordination, motor planning, and endurance have been widely documented across diverse populations and conditions. Importantly, VR's engaging and gamified nature fosters motivation and sustained participation, addressing key limitations of traditional therapies. Nonetheless, barriers related to accessibility, customization, and methodological inconsistencies must be addressed to fully realize VR's potential. Future research should prioritize inclusive design, long-term outcome studies, and scalable models of implementation to integrate VR as a standard component of motor rehabilitation and education.

1.4 VR Interventions, Tools or Strategies for Motor Skill Development in Children with Special Educational Needs

Virtual Reality (VR) is increasingly recognized as a promising intervention for promoting motor skills and physical activity among children with special educational needs (SEN). Its immersive, interactive, and adaptable features make it particularly suitable for populations where conventional therapies may lack engagement, scalability, or personalization. Recent studies and systematic reviews highlight a growing spectrum of VR interventions—from commercial gaming platforms to custom-designed therapeutic systems—that target fine and gross motor function, balance, coordination, and broader physical engagement. This section provides a critical analysis of the VR interventions, tools, and strategies explored in the literature, with an emphasis on their effectiveness, accessibility, and challenges in implementation.

VR Interventions: Task-Oriented and Gamified Training

VR interventions for motor skills are primarily designed around task-oriented and gamified activities, simulating real-world physical movements in safe, controlled environments. Studies consistently show that children benefit from repetitive, feedback-rich VR training that enhances balance, strength, and coordination (Ren & Wu, 2019; Wei et al., 2022). For example, weight-shifting exercises delivered through VR balance games improved postural control and walking ability in children with cerebral palsy (Kolezoi et al., 2025; Oznur & Arzu, 2023).

Gamification plays a pivotal role in sustaining engagement. Children with autism spectrum disorder (ASD) and developmental coordination disorder (DCD) demonstrated enhanced motivation and compliance when motor learning tasks were embedded in game-like VR scenarios compared to conventional physiotherapy (Minissi et al., 2023; Cavalcante Neto et al., 2018). Furthermore, VR supports both motor and social learning by incorporating collaborative problem-solving and goal-oriented physical activities (Karadag et al., 2025).

Tools and Technologies for VR-Based Motor Training

The literature identifies a diverse range of VR tools, ranging from commercial systems to specialized therapeutic platforms:

Commercial Consoles (Nintendo Wii, Xbox Kinect, PlayStation Move): Widely used due to affordability and accessibility, these platforms promote interactive, whole-body movements and have demonstrated benefits for coordination, hand function, and aerobic fitness in children with burns, CP, or developmental disabilities (Komaini et al., 2024; Cavalcante Neto et al., 2018).

Immersive VR Headsets (Oculus Rift, HTC Vive, Meta Quest): Increasingly used in rehabilitation to deliver highly engaging, immersive tasks with real-time feedback. These systems facilitate motor sequencing, gait simulation, and balance training, often outperforming traditional therapy in motivation and adherence (Zhao et al., 2023; Lai et al., 2025).

Custom-Built VR Systems: Tailored environments allow researchers to design condition-specific tasks, such as gait correction, upper limb rehabilitation, or coordination games. For example, Minissi et al. (2023) employed immersive VR with motion capture to assess and train whole-body motor control in children with ASD.

Assistive and Adaptive Technologies: Tools such as Leap Motion controllers, haptic feedback devices, robotic exoskeletons, and AI-driven adaptive systems extend VR's applicability by accommodating severe motor impairments and personalizing training intensity (Alrashidi et al., 2023; Taneska & Bogdanova, 2023).

Augmented and Mixed Reality (AR/MR): AR overlays instructions or game elements onto real-world activities, enabling posture correction and movement guidance in physical education (Kim et al., 2023; Mokmin et al., 2025). MR systems further integrate real and virtual elements for interactive, hybrid motor training (Pérez-Muñoz et al., 2024).

Collectively, these technologies highlight VR's versatility in adapting to different functional needs, from basic coordination to complex motor planning.

Strategies for Effective Implementation

Across the literature, several strategies are emphasized to optimize the success of VR interventions:

Personalization and Customization: Adaptive difficulty settings and individualized task design ensure that VR interventions meet diverse cognitive, physical, and sensory needs (Karadag et al., 2025). AI-enhanced systems exemplify this approach by analyzing performance data and tailoring feedback in real time (Taneska & Bogdanova, 2023).

Gamification and Motivation: Reward systems, progress tracking, and playful environments are critical for sustaining long-term participation (Komaini et al., 2024). For students with specific learning disabilities (SLDs), VR coaching provided an autonomy-supportive learning space that fostered intrinsic motivation and skill acquisition (Mokmin & Rassy, 2024).

Feedback and Biofeedback: Real-time visual, auditory, or haptic feedback facilitates motor learning by reinforcing correct movements and enabling self-correction (Hocking et al., 2022; Tsang et al., 2022). Biofeedback integration also holds promise for regulating stress and improving emotional regulation during therapy (Karadag et al., 2025).

Integration with Traditional Methods: Evidence suggests that VR is most effective when combined with physiotherapy or physical education programs, offering complementary benefits rather than replacing conventional methods (Velasco Aguado et al., 2025; Oznur & Arzu, 2023).

Safety and Monitoring: Strategies such as limiting session duration, incorporating breaks, and adjusting sensory settings (brightness, volume) are essential to prevent overstimulation, eye strain, or motion sickness (Karadag et al., 2025). Careful assessment of children's physical and psychological conditions ensures that interventions remain safe and appropriate.

Accessibility and Continuity: To address financial and logistical barriers, portable and cost-effective VR devices are recommended, alongside home-based VR interventions that extend therapy beyond clinical or school settings (Komaini et al., 2024; Lai et al., 2025).

Critical Challenges and Limitations

Despite promising outcomes, VR interventions face notable challenges. Cost and resource constraints remain the most commonly cited barriers, limiting widespread adoption in schools and rehabilitation centers (Karadag et al., 2025). Additionally, the majority of interventions rely on commercially available systems not specifically designed for children with SEN, raising concerns about adaptability and clinical rigor (Alrashidi et al., 2023).

Another issue lies in inconsistent evidence across studies. While many report significant improvements in balance, coordination, and strength, others find outcomes comparable to conventional therapy (Chen et al., 2022). These inconsistencies reflect variations in intervention duration, task design, and the novelty effect, which may artificially inflate engagement and motivation in short-term trials (Mokmin & Rassy, 2024).

Finally, technical and training limitations—such as space requirements, motion sickness, insufficient teacher/therapist preparation, and poor curriculum integration—pose barriers to sustainable implementation (Pérez-Muñoz et al., 2024; Mokmin et al., 2025).

To sum up, VR interventions demonstrate strong potential for enhancing motor skills, engagement, and motivation in children with SEN. Tools ranging from commercial gaming consoles to AI-enhanced immersive environments have shown benefits for fine and gross motor development, balance, and coordination. Effective strategies such as personalization, gamification, biofeedback, and integration with traditional therapy strengthen outcomes while addressing motivational and adherence challenges. However, accessibility, cost, and evidence gaps remain critical barriers to mainstream adoption. Future research should focus on developing affordable, child-centered VR platforms, conducting long-term controlled studies, and fostering cross-disciplinary collaboration among educators, therapists, and technology developers.

1.5 Content of the VR Workouts Curriculum

The reviewed literature provides compelling evidence that Virtual Reality (VR) offers significant potential to enhance motor skill development and physical coordination among children with special educational needs (SEN). Across a range of interventions, VR has demonstrated effectiveness in improving fine and gross motor skills, balance, coordination, and postural control, while also fostering higher levels of motivation and engagement compared to traditional therapeutic methods (Ren & Wu, 2019; Wei et al., 2022; Karadag et al., 2025). The immersive, gamified qualities of VR are particularly valuable in sustaining children's participation, encouraging repeated practice, and reinforcing neuroplasticity—factors essential for meaningful motor learning and long-term functional gains (Komaini et al., 2024; Minissi et al., 2023). Furthermore, the integration of adaptive technologies, such as artificial intelligence, haptic interfaces, and biofeedback systems, underscores VR's capacity for delivering highly personalized interventions tailored to children's diverse physical and cognitive needs (Taneska & Bogdanova, 2023; Alrashidi et al., 2023).

Despite these promising outcomes, several obstacles continue to limit the scalability and long-term impact of VR interventions. Cost and accessibility remain pressing concerns, particularly in under-resourced educational and therapeutic contexts. Technical issues such as motion sickness, limited usability for children with severe impairments, and variability in hardware quality further complicate implementation (Chen et al., 2022; Pérez-Muñoz et al., 2024). Moreover, the majority of existing VR systems were not originally designed with SEN populations in mind, raising important questions around inclusivity, age appropriateness, and pedagogical alignment (Mokmin et al., 2025). These limitations point to the urgent need for VR solutions that are not only engaging and clinically effective but also affordable, adaptable, and integrated into educational curricula in ways that can be sustained over time.

Within this context, the Erasmus+ project *"Improving Physical Coordination in Children with Special Needs Through Virtual Reality Workouts"* is positioned to make a timely and valuable contribution. Drawing on evidence-based strategies such as personalization, gamification, and integration with traditional motor training, the project seeks to design structured VR workouts that target key domains of physical coordination. The envisioned curriculum will extend beyond isolated motor drills to encompass comprehensive workout modules organized around the following dimensions:

Foundational Gross Motor Skills: Activities focusing on posture, gait, weight-shifting, and bilateral coordination, with progressive difficulty levels that allow children to build stability and core strength. VR games simulating walking across stepping stones, climbing, or jumping tasks can provide safe, repeatable practice in engaging environments.

Balance and Proprioception Training: Modules using dynamic VR environments (e.g., balance boards, obstacle navigation, virtual tightrope walking) to enhance equilibrium and trunk control. Integration of real-time visual and auditory feedback will help children self-correct movements, improving proprioceptive awareness.

Fine Motor and Hand-Eye Coordination: Targeted exercises such as grasp-and-release activities, virtual object manipulation, or VR drawing tasks to strengthen dexterity, spatial accuracy, and hand–eye coordination. These will be particularly beneficial for daily living skills like writing or feeding.

Rhythm, Timing, and Sequencing: Interactive VR workouts incorporating rhythmic movement (e.g., drumming, dance, or choreographed sequences) to develop motor planning, timing, and sequencing—skills often impaired in children with DCD or ASD.

Cognitive-Motor Integration: Combined tasks requiring children to respond to cues, solve problems, or make decisions while moving (e.g., catching objects of a specific color, navigating mazes). These modules bridge physical and cognitive development, supporting attention, memory, and executive function.

Motivation and Engagement Layers: Each module will embed gamification elements, such as progress tracking, reward systems, and customizable avatars, to sustain motivation and promote intrinsic enjoyment. Adaptive difficulty algorithms, informed by real-time performance data, will ensure that each workout is neither too easy nor too difficult, aligning with individual ability levels.

Social and Cooperative Elements: Where feasible, the curriculum will incorporate collaborative VR activities that encourage peer interaction, teamwork, and social communication—supporting not only physical coordination but also inclusive participation and social integration.

By combining these elements into a coherent curriculum, the project aims to create VR workouts that are developmentally appropriate, pedagogically sound, and responsive to the heterogeneity of SEN populations. Importantly, these workouts will be designed for integration within educational settings, allowing teachers and therapists to align them with existing physical education or rehabilitation goals. Structured lesson plans, monitoring tools, and teacher training will ensure that the curriculum is both implementable and sustainable.

Ultimately, this project does not simply replicate what has been demonstrated in the literature but actively seeks to advance it by bridging research, practice, and technology. Through its applied and inclusive focus, the Erasmus+ initiative will provide critical insights into the long-term feasibility of VR-based motor coordination training and contribute to the evidence base on how immersive technologies can transform special education and rehabilitation practices across Europe.

1.6 Conclusion

In summary, the literature highlights Virtual Reality (VR) as a promising tool for enhancing motor skill development and physical coordination in children with special educational needs. Evidence demonstrates consistent benefits for fine and gross motor skills, balance, and engagement, while also pointing to challenges around accessibility, inclusivity, and long-term effectiveness. These insights underscore the importance of developing structured, evidence-based VR interventions—such as the proposed Erasmus+ project—that can translate research findings into sustainable, inclusive, and practical solutions for education and rehabilitation.

CHAPTER 2: A Comprehensive Report on Best Practices and Case Studies for VR Workouts

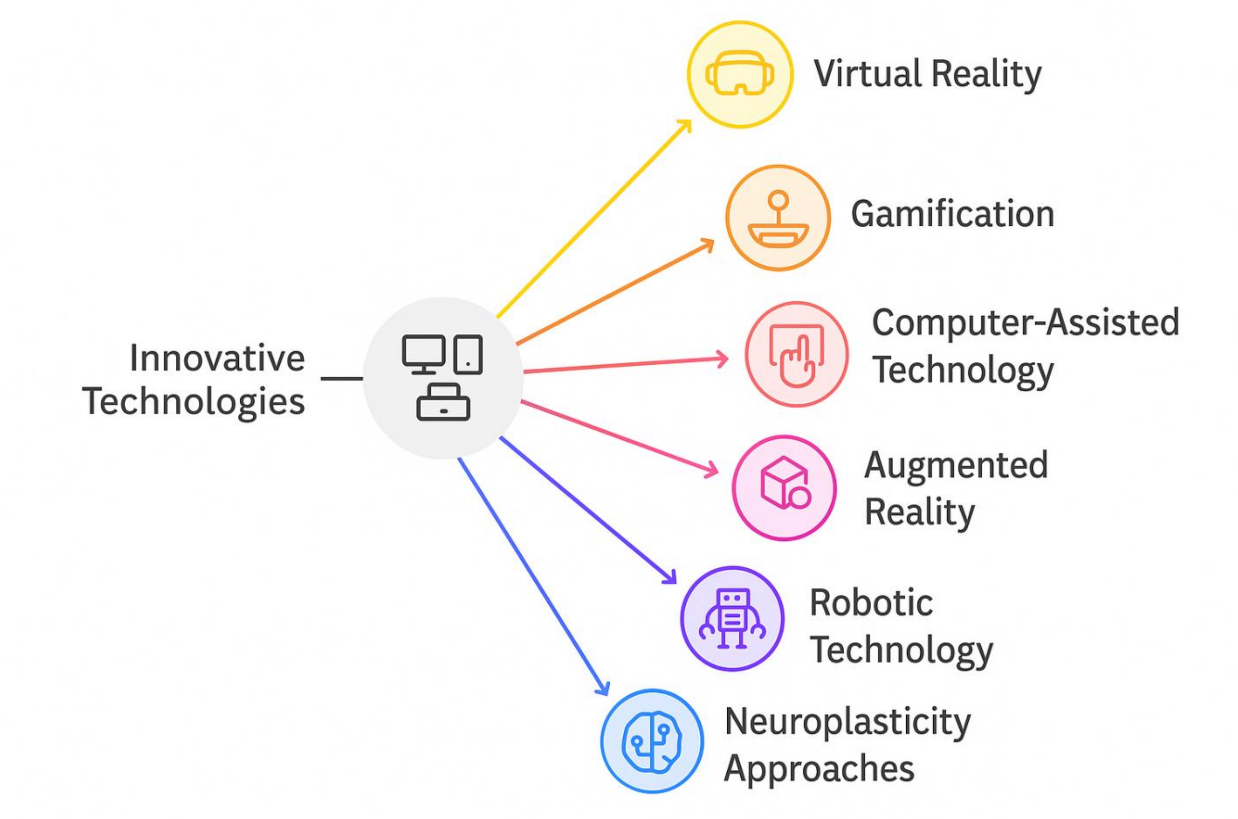
2.1 Introduction

The integration of Virtual Reality (VR) into educational and therapeutic practices has gained increasing attention in recent years, particularly within the field of special educational needs (SEN). VR provides immersive and interactive experiences that can enrich traditional learning and rehabilitation approaches, offering students with cognitive, motor, or social-emotional challenges new opportunities for development. By simulating real-life situations and creating safe, adaptable environments, VR enables learners to practice motor skills, strengthen cognitive abilities, and build confidence in ways that conventional methods may not always achieve.

This report synthesizes insights, best practices and case studies as they were collected from eight Erasmus+ partners from Greece, Cyprus, Turkiye, Romania, Italy, Croatia and Latvia that made a research on VR-based interventions for SEN learners. The collective findings demonstrate how VR has been applied to enhance motor coordination, support cognitive rehabilitation, and promote social-emotional growth. By drawing on these experiences, the Erasmus+ VR-SEN project seeks to identify transferable strategies and frameworks that can inform the design of inclusive, evidence-based interventions across diverse educational contexts.

For students with SEN, individualized and adaptable learning opportunities are essential. While traditional methods of teaching and therapy often face challenges in sustaining motivation and engagement, VR offers dynamic alternatives that are both personalized and engaging. Examples from partner countries illustrate VR's impact across a spectrum of needs, from motor training in children with cerebral palsy (CP) to cognitive support for students with autism spectrum disorder (ASD), and physical activity programs for learners with developmental disabilities (DD).

Crucially, the adaptability of VR technology allows interventions to be tailored to the abilities of each learner, while also fostering inclusion by enabling students with varying disabilities to participate in shared educational experiences. As technological advances continue to expand the capabilities of VR, its potential to strengthen equity, accessibility, and innovation in SEN education is becoming increasingly evident.



2.2 Best practices/ Case studies from Greece

Partners: Diefthinsi Protobathmias Ekpaidefsis Fthiotidas and Special Education Needs School of Lamia

Structure of VR Workouts

Across the reviewed best practices, VR workouts were generally organized into task-specific modules lasting between 20 and 40 minutes per session, repeated over several weeks to reinforce motor learning. These modules combined skill-focused drills, such as hand–eye coordination exercises in table tennis (Hu, 2023), locomotor training via stationary cycling (Lee & Jin, 2023), and upper-limb reaching movements for children with cerebral palsy (Chen et al., 2007). Functional tasks embedded within virtual environments, such as obstacle navigation for wheelchair maneuvering (John et al., 2017) or shopping-based role-play for children with ASD (Herrera et al., 2008), further supported skill acquisition and transfer. In educational contexts, VR also provided immersive simulations of historical events, demonstrating its potential to structure learning around realistic, memorable scenarios (Yildirim et al., 2018). Importantly, progressive practice—where complexity and task demands increased gradually—was a common feature, ensuring that skills could develop in step with each learner's ability.

Engagement Techniques

Engagement strategies played a central role in sustaining motivation and participation across all interventions. Gamification elements such as points, challenges, and rewards were frequently employed to make repetitive practice enjoyable and goal-oriented (Hu, 2023; Lee & Jin, 2023). Cooperative learning and team-based activities significantly boosted social interaction and intrinsic motivation, particularly in physical education contexts (Hu, 2023). Immersive environments delivered through head-mounted displays heightened presence and reduced external distractions, supporting deeper engagement (Lee & Jin, 2023; Yildirim et al., 2018). Variety was also crucial: novel fantasy scenarios such as cycling through imaginative landscapes or enacting shopping activities helped prevent monotony and encouraged sustained participation (Lee & Jin, 2023; Herrera et al., 2008). Together, these strategies highlight how VR's interactive and adaptive features can transform repetitive exercises into compelling, motivating experiences.

Methods to Suit Diverse Abilities

The case studies emphasized the importance of tailoring VR workouts to suit learners with diverse physical and cognitive needs. Individualization was a consistent approach, with tasks adjusted to each participant's abilities—for example, offering both seated and standing options or simplifying movement patterns (Chen et al., 2007; Lee & Jin, 2023). Accessibility was enhanced through naturalistic body interactions, as in the ASD shopping simulation where functional object use was reinforced (Herrera et al., 2008). Progressive difficulty was another key method, allowing children with developmental disabilities or limited coordination to engage at an appropriate level before advancing to more complex challenges (Lee & Jin, 2023). At the same time, interventions worked best when participants demonstrated adequate cognitive capacity and cooperation, underscoring the need for structured support and supervision (Chen et al., 2007). Educational studies also highlighted inclusivity, with VR providing equitable access for learners with different needs and learning styles (Yildirim et al., 2018).

Tools, Platforms, and Equipment

The interventions employed a range of VR platforms and devices tailored to specific objectives. The Holofit VR platform was applied in sports education to facilitate cooperative learning and sport-specific drills (Hu, 2023). Stationary bikes integrated with HMDs created immersive locomotor training environments for children with developmental disabilities (Lee & Jin, 2023). Custom VR systems with motion-tracking supported fine-motor rehabilitation in children with cerebral palsy, particularly for reaching and grasping tasks (Chen et al., 2007). For powered wheelchair training, researchers designed consumer-grade VR applications that could be deployed cost-effectively at home or in assessment centers (John et al., 2017). In ASD interventions, VR environments were coupled with specialized tools such as *"I am going to act as if…"* to support symbolic and functional play (Herrera et al., 2008). Finally, history education case studies utilized immersive HMDs to increase presence and realism (Yildirim et al., 2018). Collectively, these examples demonstrate the flexibility of VR to incorporate commercial platforms, custom applications, and simple controllers in ways that match diverse training needs.

Outcomes Reported

Outcomes across the studies revealed a broad spectrum of benefits. Motivation and participation consistently improved, with cooperative VR workouts producing gains across intrinsic and extrinsic motivation scales (Hu, 2023). Significant improvements were also observed in locomotor and gross motor coordination, including a 3.2-point increase in scaled locomotor scores and an 11.3-point rise in the Gross Motor Index (Lee & Jin, 2023). Upper-limb coordination improved through VR reaching tasks, with measurable changes in movement time, path length, and velocity as well as improvements on the PDMS-2 scale (Chen et al., 2007). Wheelchair training demonstrated measurable skill retention, including reduced collisions and faster navigation times (John et al., 2017). Symbolic play interventions showed progress in functional and imaginative play, with evidence of skill generalization from virtual to real-world environments (Herrera et al., 2008). In educational contexts, VR enhanced students' sense of presence, engagement, and perceived retention of information (Yildirim et al., 2018). Balance and reaction time were also indirectly improved through locomotor and coordination-based activities, though not always surpassing traditional training outcomes (Hu, 2023).

Implications for practice

Taken together, these best practices illustrate that VR workouts are most effective when designed as progressive, task-specific modules**,** enriched with gamification, cooperative learning, and immersive environments to sustain motivation. By incorporating adaptive methods such as individualized difficulty, simplified controls, and inclusive design, VR can support learners with diverse abilities and needs. Tools ranging from commercial platforms like Holofit to custom-built VR systems show that effective interventions can be both scalable and context-specific. The outcomes consistently demonstrate improvements in motivation, locomotor skills, fine motor coordination, reaction time, and user satisfaction, with additional benefits in symbolic play, spatial awareness, and educational engagement. While VR may not always outperform traditional approaches in every physical domain, its capacity to enhance engagement and accessibility makes it a powerful complement to conventional methods.

2.3 Best practices/ Case studies from Cyprus

Partner: University of Cyprus

Structure of VR Workouts

Across studies, VR interventions were structured with clear goals and progressive challenges. Mirelman et al. (2016) used treadmill-based VR tasks for older adults, focusing on dynamic balance and gait adaptability over six weeks with three sessions per week. Laver et al. (2021) applied a four-week design with 45-minute VR interventions targeting upper-limb recovery post-stroke. Beeli and Koeneke (2022) extended this approach to adolescents, implementing twice-weekly VR physical education classes for eight weeks. In each case, the programs balanced frequency, duration, and progressive task demands to encourage steady skill acquisition.

Engagement Techniques

A consistent theme across all three case studies was the emphasis on engagement to sustain adherence. Mirelman et al. (2016) introduced adaptive challenges such as navigating virtual obstacles, which provided immediate visual feedback and a sense of accomplishment. Laver et al. (2021) noted that gesture-based systems like Armeo® and Kinect improved motivation through interactive play compared to conventional rehabilitation. Similarly, Beeli and Koeneke (2022) reported high enjoyment in adolescents when VR was gamified through sports like tennis and boxing. These findings highlight the importance of embedding fun, feedback, and variety into VR workouts.

Methods to Suit Diverse Abilities

VR interventions were designed to address the unique needs of different populations. For older adults at risk of falling, Mirelman et al. (2016) emphasized safe yet challenging gait tasks that mirrored real-world scenarios. Stroke survivors in Laver et al.'s (2021) trial benefited from repetitive, task-specific training that could be adjusted to each participant's recovery level. For adolescents, Beeli and Koeneke (2022) tailored exercises to developmental needs, alternating game genres to balance cognitive, motor, and physical demands. These adaptations show how VR can be personalized across age groups and physical capabilities.

Tools, Platforms, and Equipment

The technology used in each study varied but shared a focus on immersive and interactive platforms. Mirelman et al. (2016) combined treadmills with VR projections to simulate obstacles and corridors. Laver et al. (2021) utilized commercial systems like Armeo® and Kinect for motion capture and gesture-based rehabilitation. Beeli and Koeneke (2022) applied Oculus Quest headsets to create immersive sports environments in school settings. Together, these cases illustrate that VR platforms can range from high-end rehabilitation systems to consumer-grade equipment, depending on context and goals.

Outcomes Reported

All three studies demonstrated meaningful improvements in physical function and engagement. Mirelman et al. (2016) reported a 42% reduction in fall rates among older adults, alongside better balance and gait adaptability. Laver et al. (2021) found superior motor recovery outcomes for stroke patients in the VR group, with some exceeding expected recovery milestones. Beeli and Koeneke (2022) measured improved reaction times (by 0.4 seconds on average) and enhanced coordination in adolescents. In addition to measurable physical benefits, high levels of user satisfaction and motivation were consistent outcomes.

Implications for practice

Together, these best practices suggest that VR workouts should combine structured, progressive sessions with engaging game-like elements tailored to the ability levels of users. Platforms can be chosen based on target populations, ranging from medical-grade rehabilitation systems to accessible consumer headsets. The consistent improvements in functional outcomes and user motivation across older adults, stroke survivors, and adolescents point to VR as a flexible and effective approach for physical training and rehabilitation (Mirelman et al., 2016; Laver et al., 2021; Beeli & Koeneke, 2022).

2.4 Best practices/ Case studies from Turkiye

Partner: ISTANBUL UNIVERSITY-CERRAHPASA

Structure of VR Workouts

The reviewed VR interventions from Istanbul University-Cerrahpasa and collaborators used structured, therapeutic programs combining VR tasks with conventional physiotherapy. For example, the Nintendo Wii Balance Board therapy (NWT) was delivered twice weekly for six weeks, with each 45-minute session divided between standard physiotherapy and VR exercises targeting balance and gross motor function (Istanbul University-Cerrahpasa, 2025). Similarly, Pourazar et al. (2019) applied a six-week Kinect-based program with a tapering session frequency (5→3→2 sessions/week) to balance training intensity and fatigue. Birrer et al. (2011) structured short but immersive Lokomat®-based sessions (7 minutes per VR task condition),emphasizing active participation during gait cycles. These designs show how session length, frequency, and integration with existing therapies can be adapted to population needs.

Engagement Techniques

Engagement was consistently prioritized through gamified and interactive tasks. The Wii Balance Board therapy incorporated playful games like ski slalom, soccer heading, and yoga to motivate children with cerebral palsy while encouraging repeated practice (Istanbul University-Cerrahpasa, 2025). The Kinect "Just Dance 3" program leveraged rhythm and music to sustain children's interest and enhance dynamic balance (Pourazar et al., 2019). In robot-assisted gait training, children played VR soccer or navigation games, which increased active effort compared to passive conditions like watching a DVD (Birrer et al., 2011). Across cases, VR's fun, competitive, and feedback-rich activities were key in fostering motivation and adherence.

Methods to Suit Diverse Abilities

The VR programs demonstrated flexibility in tailoring to children with varying physical abilities. NWT provided multiple game options with adjustable challenge levels, ensuring accessibility for different coordination and strength levels (Istanbul University-Cerrahpasa, 2025). Kinect-based dance training used progressive intensity and therapist support to help children maintain safety while expanding their movement repertoire (Pourazar et al., 2019). Lokomat® training allowed individualized control of body weight support and walking velocity while using biofeedback values to adjust difficulty (Birrer et al., 2011). These examples illustrate how VR can be adapted to children with cerebral palsy or gait disorders through scalable challenges and therapist-guided supervision.

Tools, Platforms, and Equipment

The technologies used ranged from accessible consumer systems to advanced medical devices. The Wii Balance Board system offered a cost-effective, non-immersive VR tool with multisensory feedback via force sensors, visuals, and sound (Istanbul University-Cerrahpasa, 2025). Kinect-based interventions used motion tracking cameras and dance games to provide full-body feedback (Pourazar et al., 2019). In contrast, the Lokomat® orthosis integrated robotics and immersive VR, with motion sensors translating real-time effort into on-screen soccer or navigation tasks (Birrer et al., 2011). This range of equipment highlights that both affordable and high-tech platforms can be effective when properly integrated into therapy.

Outcomes Reported

All three best practices reported significant improvements in physical outcomes. The Wii Balance Board therapy produced measurable gains in gross motor function, pediatric balance scores, and movement quality, with effects sustained at follow-up (Istanbul University-Cerrahpasa, 2025). The Kinect dance program improved dynamic balance across anterior, posterolateral, and posteromedial directions, supported by statistical significance (Pourazar et al., 2019). The Lokomat® VR intervention enhanced active participation, a prerequisite for motor learning, with higher biofeedback values and effect sizes in VR conditions compared to conventional therapy (Birrer et al., 2011). These findings confirm VR's impact on motor performance, engagement, and rehabilitation outcomes.

Implications for Practice

Together, these best practices suggest that VR workouts should combine structured therapy schedules with gamified, multisensory tasks tailored to the abilities of children with cerebral palsy or gait impairments. Accessible platforms like Wii and Kinect can provide effective, scalable solutions, while advanced systems like Lokomat® can deepen clinical precision. Key design principles include progressive task difficulty, real-time feedback, and therapist supervision. Reported outcomes across studies demonstrate improvements in balance, motor control, and motivation, positioning VR as a promising tool for pediatric rehabilitation (Istanbul University-Cerrahpasa, 2025; Pourazar et al., 2019; Birrer et al., 2011).

2.5 Best practices/ Case studies from Romania

Partner: INSPECTORATUL SCOLAR JUDETEAN HUNEDOARA, ROMANIA

Structure of VR Workouts

The five case studies highlight different ways VR workouts and interventions are structured, from single-session exposure therapy to multi-week rehabilitation programs. Coja et al. (2023) reviewed interventions lasting between one session and eight weeks for reducing kinesiophobia. Komariah et al. (2024) synthesized pediatric cerebral palsy (CP) interventions that used Nintendo Wii, RAPAEL Smart Kids, and Xbox Kinect across structured therapy cycles. Lavoie et al. (2024) focused on controlled object manipulation tasks to measure eye–hand coordination. McComas et al. (1998) emphasized the long-term design of VR experiences for children with disabilities, tailored to individual learning styles. Hsu et al. (2024) structured a three-phase program—prototype development, expert validation, and pilot testing—for de-escalation training. These varying designs illustrate VR’s adaptability across short-term therapeutic exposure, pediatric rehabilitation, skill testing, and professional training.

Engagement Techniques

Maintaining engagement emerged as a key design principle. VR interventions for kinesiophobia used graded exposure to reduce fear of movement while reinforcing positive experiences (Coja et al., 2023). Pediatric CP studies embedded therapy within playful, gamified contexts like Wii Fit and Kinect dance games, increasing children's motivation (Komariah et al., 2024). Eye–hand coordination tasks demonstrated how VR environments, even when slower than real-world tasks, could sustain focus by demanding accuracy and calibration (Lavoie et al., 2024). McComas et al. (1998) showed how multisensory cues and simplified environments promoted concentration for children with sensory or learning disabilities. Hsu et al. (2024) added realism and empathy-driven engagement through interactive de-escalation scenarios, validated by both experts and users.

Methods to Suit Diverse Abilities

Each study adapted VR interventions to suit diverse physical, cognitive, and emotional needs. Coja et al. (2023) emphasized customizable exposure levels for individuals with chronic pain or movement anxiety. Komariah et al. (2024) highlighted CP-specific adaptations such as semi-immersive or fully immersive formats tailored to functional abilities. Lavoie et al. (2024) demonstrated how VR tasks can replicate real-world actions while safely scaling difficulty for motor learning. McComas et al. (1998) described how VR can support children with sensory impairments by translating visual stimuli into auditory or tactile feedback, or by reducing distractions for autistic learners. Hsu et al. (2024) developed scenarios to suit professional staff needs, offering scalable role-play environments for different de-escalation contexts.

Tools, Platforms, and Equipment

The technologies used spanned both consumer and specialized systems. Kinesiophobia interventions employed VR exposure platforms that simulated real-life movement in safe environments (Coja et al., 2023). CP-focused therapies utilized Nintendo Wii, Kinect, and RAPAEL Smart Kids devices (Komariah et al., 2024). Eye–hand coordination research relied on VR headsets with motion controllers compared against real-world tasks with motion capture (Lavoie et al., 2024). McComas et al. (1998) leveraged custom VR environments adaptable for children with disabilities, integrating auditory and tactile modalities. Hsu et al. (2024) used an interactive VR prototype on standard headsets, supported by expert feedback to refine the realism of de-escalation training.

Outcomes Reported

All five best practices reported positive functional and psychological outcomes. Coja et al. (2023) found that VR interventions consistently reduced kinesiophobia across chronic pain populations. Komariah et al. (2024) reported significant improvements in balance, gross motor function, and activities of daily living for children with CP. Lavoie et al. (2024) showed that while VR tasks took longer, they provided diagnostic power for eye–hand coordination, reinforcing VR's use for motor calibration. McComas et al. (1998) demonstrated improved accessibility, motor learning, and quality of life for children with disabilities, including those with sensory impairments. Hsu et al. (2024) validated their de-escalation VR prototype, achieving good usability and showing correlations between VR performance and empathy.

Implications for Practice

These best practices underscore VR's versatility across therapeutic, diagnostic, and training domains. Programs should incorporate structured, progressive tasks while embedding gamification and feedback mechanisms to sustain engagement (Coja et al., 2023; Komariah et al., 2024). VR's adaptability allows tailoring for children with CP, sensory impairments, or autism, as well as for adult professionals in disability support contexts (McComas et al., 1998; Hsu et al., 2024). While consumer platforms like Wii and Kinect demonstrate broad accessibility, specialized tools and prototypes can enhance precision and realism (Lavoie et al., 2024). Reported outcomes confirm VR's role in reducing fear, improving motor skills, and enhancing empathy, suggesting that diverse applications of VR can improve both physical and social aspects of care.

2.6 Best practices/ Case studies from Latvia

Partner: Latvia, Private school "Gaismas tilts 97"

Structure of VR Workouts

The three VR interventions reviewed differed in structure but all prioritized short, repeated sessions in supportive contexts. *My Lovely Granny's Farm* immersed autistic children in a structured farm scenario with sequential tasks such as greeting a farmer, recognizing animal sounds, and exploring environments, with teacher facilitation (Soltiyeva et al., 2023). The expert-informed study by Karadag et al. (2024) emphasized structured repetition and progression across varied VR systems to strengthen motor coordination. Lai et al. (2025) implemented a school-based program of 10-minute VR exercise sessions, three times per week for six weeks, designed to provide moderate-intensity activity for youth with mobility disabilities. These designs illustrate how VR sessions can be flexible in length and frequency while maintaining consistency and progression.

Engagement Techniques

Engagement was fostered through personalization, immersive environments, and supervision. In *My Lovely Granny's Farm*, adaptive virtual characters responded to children's actions and emotions, encouraging social communication (Soltiyeva et al., 2023). Experts in the Karadag et al. (2024) study highlighted the motivational power of VR when games incorporated audiovisual cues and tactile feedback. Lai et al. (2025) reported that supervised classroom sessions promoted high engagement and enjoyment, whereas unsupervised home use led to reduced motivation. Collectively, these cases show that engagement in VR training thrives when immersive feedback, adaptive difficulty, and structured support are combined.

Methods to Suit Diverse Abilities

VR interventions were designed to accommodate children with different needs and abilities. For children with autism, farm-based environments provided safety, familiarity, and reduced anxiety while still supporting social interaction goals (Soltiyeva et al., 2023). Karadag et al. (2024) emphasized the adaptability of VR systems, noting their use for both children with special educational needs (SEN) and typically developing peers, with adjustable difficulty and task variety to match motor abilities. Lai et al. (2025) tailored exercises to youth with mobility limitations by focusing on upper-body movements like reaching and punching. These approaches demonstrate VR's flexibility in providing inclusive, ability-matched training.

Tools, Platforms, and Equipment

The technologies used ranged from consumer-grade to purpose-built systems. *My Lovely Granny's Farm* employed Oculus Quest 2 headsets and handheld controllers, supported by laptops or smartphones for monitoring (Soltiyeva et al., 2023). Karadag et al. (2024) discussed platforms spanning motion-tracking devices, sensory feedback systems, and VR games adaptable to therapy, without relying on a single device. Lai et al. (2025) used Meta Quest VR headsets in classroom settings, chosen for accessibility and immersive exercise experiences. Together, these studies illustrate that both off-the-shelf and customized VR tools can be effective if they integrate real-time feedback and supervision.

Outcomes Reported

Each study reported meaningful improvements in targeted outcomes. In the farm-based VR, autistic children demonstrated greater social interaction, focus, and reduced anxiety in novel environments, with most participants actively engaging with virtual characters (Soltiyeva et al., 2023). Karadag et al. (2024) synthesized expert consensus that VR enhances motor coordination, postural control, and participation compared to traditional approaches. Lai et al. (2025) found that students with mobility disabilities achieved moderate physical activity levels during supervised VR sessions, though engagement decreased in unsupervised contexts. These findings underscore VR's ability to promote communication, coordination, and physical activity across diverse groups.

Implications for Practice

Together, these best practices suggest that VR workouts should be short, structured, and supported by teachers or therapists, while maintaining immersive and adaptive features that sustain motivation. Familiar environments and responsive characters can ease anxiety for autistic children (Soltiyeva et al., 2023), while flexible, expert-informed designs can generalize across diverse disabilities (Karadag et al., 2024). For children with mobility limitations, supervised, school-based VR sessions can deliver meaningful physical activity, whereas unsupervised home-based use may fall short

(Lai et al., 2025). These insights confirm VR's potential as an inclusive, engaging, and context-sensitive tool for supporting social, motor, and physical development.

2.7 Best practices/ Case studies from Italy

Partner: cises srl

Structure of VR Workouts

The reviewed interventions vary in structure but share a common focus on repeated, task-oriented engagement. Sobota et al. (2012) designed a university program where students engaged in step-by-step tasks with VR technologies, from 3D modeling to scanning and printing, strengthening sensorimotor interaction. Chen et al. (2015) developed *Super Pop VR*, an eight-week home-based program using bubble-popping tasks to promote repetitive reaching and upper-limb control in children with cerebral palsy (CP). Liu et al. (2025) introduced a projection-based AR exergame for children aged 4–8, structured in one-minute activity rounds with immediate feedback, making sessions short and developmentally appropriate. Together, these examples illustrate how VR workouts can be sequenced from introductory to advanced, balancing repetition and progression with achievable goals.

Engagement Techniques

Each program used unique strategies to maintain motivation. Sobota et al. (2012) emphasized hands-on creation, where students saw their designs realized through 3D visualization and printing, driving engagement through purposeful outcomes. In *Super Pop VR*, Chen et al. (2015) embedded playful bubble-popping mechanics, complemented by real-time visual feedback and adaptive difficulty to sustain interest in repetitive motor tasks. Liu et al. (2025) relied on colorful, limb-specific targets, point scoring, music, and sound effects to keep young children immersed and motivated. Across cases, gamification, feedback loops, and task relevance proved essential for sustaining engagement.

Methods to Suit Diverse Abilities

The interventions showed adaptability to different ability levels and user needs.

Sobota et al. (2012) combined digital modeling with hardware manipulation, requiring both fine and gross motor skills, but allowed flexibility in task selection and pacing. Chen et al. (2015) designed *Super Pop VR* for home use, with Kinect tracking and adaptive challenge levels, making it feasible for children with CP and varying motor abilities. Liu et al. (2025) tailored difficulty by automatically adjusting object height based on child size and providing simple tutorials to guide younger users, while older children requested more advanced levels. These cases highlight the importance of adaptive systems that can accommodate a wide range of physical and cognitive abilities.

Tools, Platforms, and Equipment

The technologies used ranged from advanced lab setups to consumer-grade hardware. Sobota et al. (2012) employed stereoscopic and autostereoscopic displays, motion-tracking systems like InterSence IS-900, and 3D printers, providing a comprehensive technical environment. Chen et al. (2015) used affordable equipment—a Microsoft Kinect paired with a laptop—demonstrating that effective therapy can be delivered with minimal cost. Liu et al. (2025) implemented an Intel RealSense depth-tracking camera with projection-based AR, using Unity for game development. These varied tools underline the flexibility of VR and AR platforms, from high-end labs to accessible, low-cost setups, depending on context.

Outcomes Reported

Each study reported functional and experiential gains. Sobota et al. (2012) observed improvements in technical fluency, confidence, and spatial reasoning, with qualitative evidence of enhanced hand–eye coordination and fine motor skills. Chen et al. (2015) documented measurable improvements in upper-limb motor function, including smoother trajectories, better range of motion, and reduced asymmetry, supported by kinematic and functional assessments. Liu et al. (2025) reported children's improvements in reaction time, limb coordination, balance, and left–right orientation, alongside high enjoyment and willingness to replay. These outcomes confirm VR and AR as effective tools for enhancing both technical and physical coordination skills.

Implications for Practice

Together, these best practices show that effective VR workouts combine structured, step-by-step progressions with engaging feedback mechanisms. Familiar, playful, and task-oriented challenges—whether bubble-popping, object manipulation, or reaching for projected targets—can improve motor coordination while sustaining interest (Sobota et al., 2012; Chen et al., 2015; Liu et al., 2025). Adaptive systems that adjust difficulty based on user ability are critical for inclusivity. Equipment choices can be scalable, from consumer-grade cameras and headsets to advanced motion-tracking systems. Reported outcomes suggest that VR and AR are not only educational and therapeutic but also motivational, making them strong candidates for integration into coordinated workout programs.

2.8 Best practices/ Case studies from Croatia

Partner: OŠ Podmurvice, Rijeka, Croatia

Structure of VR Workouts

The reviewed interventions demonstrate structured yet adaptable formats tailored to specific developmental needs. Purpura et al. (2024) designed an 11-week rehabilitation program for children with developmental coordination disorder (DCD), using the VITAMIN platform with Kinect and Wii Balance Board sensors to deliver individualized exergames. Yu et al. (2023) created a hide-and-seek VR system to train gaze fixation in autistic children, structured as short, repeatable gameplay sessions. Rodriguez (2015) implemented a wheelchair simulator enabling children with multiple disabilities to practice navigation safely and progressively. Chen et al. (2024) built a role-playing VR game for children with intellectual disabilities, embedding daily tasks within immersive sessions. Smith et al. (2021) applied the VOISS project in schools, offering repeated social scenario practices over long periods. Finally, Hocking et al. (2022) tested GaitWayXR in six 20-minute sessions across two weeks to support motor skill development in autistic youth. Collectively, these structures illustrate the value of balancing repetition, gradual complexity, and context-specific tasks.

Engagement Techniques

Gamification and personalization were central to sustaining motivation. Purpura et al. (2024) matched exergames to each child's functional profile, boosting focus and engagement. Yu et al. (2023) introduced personalized avatars resembling family members to enhance attention and emotional connection during gaze fixation training. Rodriguez (2015) emphasized motivation through safe, risk-free exploration of wheelchair navigation. Chen et al. (2024) used role-playing with real-life scenarios, promoting adaptive behavior through immersive storytelling. Smith et al. (2021) provided social skill simulations with VOISS and teacher resources for transfer to real-life settings. Hocking et al. (2022) used short, interactive gameplay with body-tracking, encouraging participation while minimizing fatigue. Across cases, engaging content, emotional resonance, and immediate feedback were key drivers of adherence.

Methods to Suit Diverse Abilities

All six programs demonstrated careful tailoring to participants' abilities. Purpura et al. (2024) individualized difficulty based on children's executive and motor function profiles. Yu et al. (2023) personalized avatars and adjusted hide-and-seek difficulty for children with autism spectrum disorder (ASD). Rodriguez (2015) customized wheelchair training environments to match each user's capacity for navigation. Chen et al. (2024) allowed role-playing complexity to be scaled according to intellectual ability. Smith et al. (2021) made VOISS flexible enough for use across multiple schools and devices. Hocking et al. (2022) highlighted the importance of affordable systems and parental involvement, ensuring interventions could adapt to space, cost, and ability constraints.

Tools, Platforms, and Equipment

The technological range reflects both specialized and low-cost systems. Purpura et al. (2024) integrated Kinect V2 and Wii Balance Board sensors into the VITAMIN platform for exergames. Yu et al. (2023) employed VR headsets with face and voice manipulation technologies for avatar personalization. Rodriguez (2015) developed a VR wheelchair simulator with customizable scenarios. Chen et al. (2024) used immersive VR role-playing environments built for therapeutic applications. Smith et al. (2021) designed VOISS to run across multiple devices, supported by an educator platform. Hocking et al. (2022) employed GaitWayXR with a low-cost motion capture system, demonstrating scalability for home and school contexts. Together, these highlight that effective VR interventions can rely on consumer hardware or specialized systems, depending on context.

Outcomes Reported

Positive functional and behavioral outcomes were consistently observed. Purpura et al. (2024) reported improvements in visual attention and visual-motor coordination for children with DCD. Yu et al. (2023) found enhanced gaze fixation in autistic children, with personalized avatars boosting effectiveness. Rodriguez (2015) emphasized the simulator's value in developing safe navigation confidence among children with multiple disabilities. Chen et al. (2024) demonstrated skill transfer to real-world contexts in 70–80% of participants with intellectual disabilities. Smith et al. (2021) reported that VOISS enabled repeated social practice across 17 schools, supporting social skill generalization. Hocking et al. (2022) found correlations between motor assessments and VR-based tracking data, showing feasibility and parental support for home use.

Implications for Practice

Taken together, these best practices suggest that VR programs should combine individualized progression, adaptive technology, and motivational gamification. Familiar or role-play scenarios enhance relevance, while safe and customizable environments support children with varied disabilities (Purpura et al., 2024; Yu et al., 2023; Rodriguez, 2015). Flexibility in hardware—whether Kinect sensors, wheelchairs, or low-cost motion tracking—enables scalability and accessibility (Hocking et al., 2022). Educational integration, as demonstrated by VOISS, shows how teacher-supported programs can bridge VR skills into real-world contexts (Smith et al., 2021). Overall, these cases confirm VR's potential to address physical, cognitive, and social challenges, offering inclusive and effective rehabilitation and learning opportunities.

2.9 Conclusion

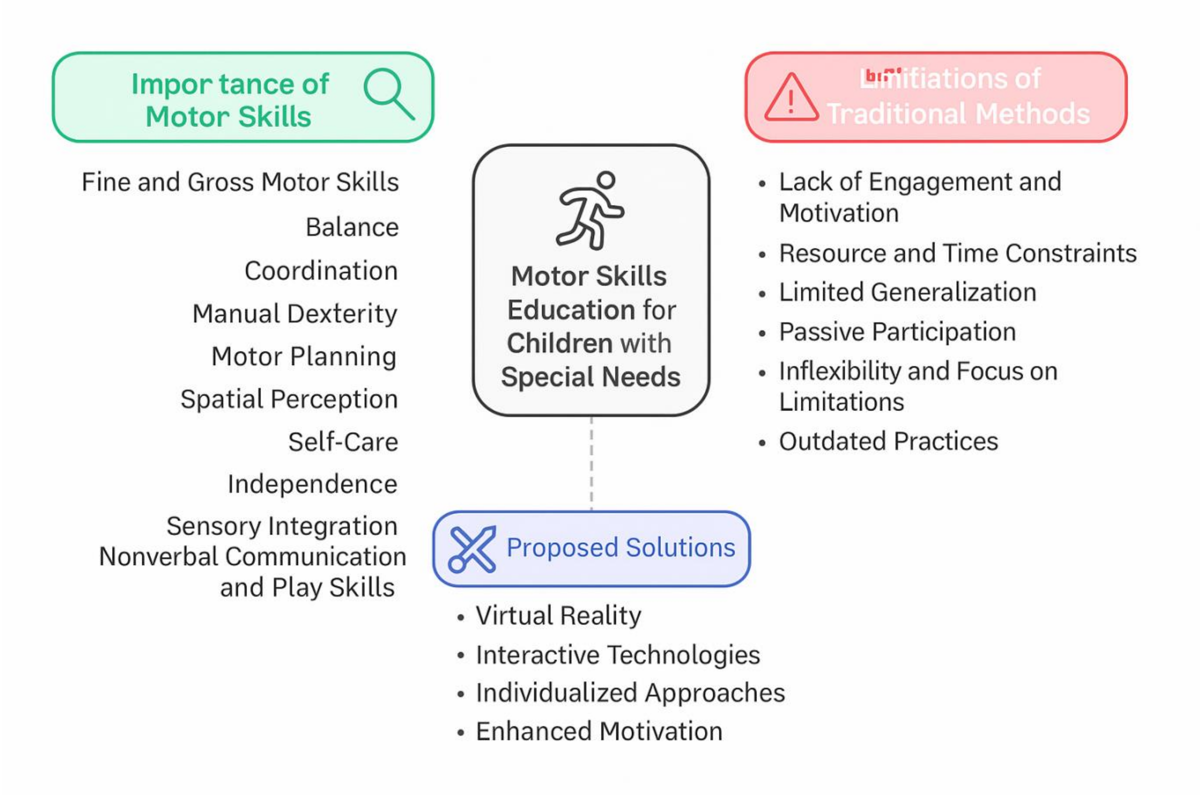
The reviewed best practices and case studies collectively demonstrate the transformative potential of Virtual Reality (VR) in education, rehabilitation, and skill development for diverse populations, including children with developmental, physical, and cognitive challenges. Across contexts—from clinical rehabilitation labs and school classrooms to home-based and low-cost setups—VR consistently emerged as an adaptable, engaging, and effective tool for fostering motor coordination, balance, social communication, and cognitive skills.

A unifying feature across interventions was their structured design: short, task-specific modules delivered over multiple sessions with progressive complexity ensured that learners could build skills gradually and sustainably. Engagement was enhanced through gamification, immersive environments, cooperative play, and adaptive feedback systems, which together made repetitive practice both motivating and enjoyable. Importantly, personalization—through individualized difficulty, familiar avatars, or role-play scenarios—proved essential for meeting the diverse needs of learners with different abilities and conditions.

The technological range extended from consumer-grade devices like Kinect, Wii, and Oculus Quest to specialized platforms such as Lokomat® and custom-built rehabilitation systems. This flexibility underscores that effective VR training does not depend on high-cost equipment alone; rather, it relies on thoughtful program design, accessibility, and integration into supportive learning or therapeutic environments.

Reported outcomes confirm significant improvements across domains, including gross and fine motor coordination, visual–motor integration, balance, gaze fixation, reaction time, social skills, motivation, and symbolic play. Beyond physical gains, VR also fostered psychological benefits, such as reduced anxiety, increased confidence, and greater willingness to engage in real-world activities. These findings highlight VR's dual role as both a therapeutic and educational tool.

Taken together, these insights establish VR not merely as a technological novelty but as a powerful complement to traditional methods. When designed with inclusivity, progression, and user engagement in mind, VR can bridge gaps in rehabilitation, education, and accessibility, offering learners immersive and meaningful opportunities to practice, improve, and thrive.



Chapter 3: Exploring the Potential of Virtual Reality for Motor Skills Training in Children with Special Educational Needs: Perspectives from SEN teachers

3.1 Introduction

The use of advanced technologies in education has opened the door to innovative approaches that better accommodate diverse learning needs. Among these, virtual reality (VR) stands out for its immersive and interactive qualities, offering unique opportunities to enrich learning experiences. VR has become especially relevant in special education, where it shows strong potential as a tool for supporting the development of motor skills in children who require individualized and engaging methods of instruction.

Motor skills play a vital role in children's overall growth, underpinning their ability to carry out daily tasks, take part in recreational activities, and succeed in academic settings. For children with special educational needs (SEN), including those with physical, cognitive, or developmental challenges, acquiring these skills can be more difficult. Traditional training methods often fall short, as they may not provide the adaptability, variety, or motivation necessary to meet the wide range of needs within this group. In many cases, repetitive task-based practice—essential for motor learning—can become tedious or discouraging when not paired with engaging strategies. This creates a demand for innovative solutions like VR, which can adapt to different ability levels, maintain motivation, and deliver learning experiences that are both functional and enjoyable.

3.2 Methodology

3.2.1 Research Design

This study adopted a mixed-methods research design, combining both qualitative and quantitative approaches, to investigate expert perspectives and experiences regarding the integration of virtual reality (VR) technology into motor skill training for children with special educational needs (SEN).

The qualitative component employed a case study strategy, which allowed for an in-depth exploration of the subjective insights, perceptions, and practical experiences of professionals directly engaged with VR technology in educational and therapeutic contexts. This design facilitated the collection of rich, context-sensitive data and supported a nuanced understanding of the challenges and opportunities associated with VR integration in SEN motor skills training (Creswell & Poth, 2018).

Complementing this, the quantitative component utilized a structured questionnaire to systematically capture measurable data on participants' views and practices. This allowed for the identification of broader patterns and trends, enhancing the generalizability of the findings.

By integrating qualitative and quantitative methods, the study achieved a more comprehensive perspective, combining the depth of expert testimonies with the breadth of systematically gathered data.

3.2.2 Participants

The study sample consisted of 87 experts from seven countries: Türkiye, Romania, Latvia, Italy, Greece, Cyprus, and Croatia. Participants were selected based on their professional expertise in fields such as special education, motor skills rehabilitation, VR technology development, or the intersection of these domains.

A purposive sampling strategy (Patton, 2015) was employed to ensure that only individuals with substantial experience and relevant knowledge regarding the integration of VR technology into motor skills training for children with special educational needs (SEN) were included. This approach allowed the research to target participants who could provide both practical insights and expert evaluations of VR applications in educational and therapeutic contexts.

By including experts from multiple European countries, the study further aimed to capture a diverse range of perspectives and to explore howcultural and contextual differences may shape the implementation and perceived effectiveness of VR-based interventions in SEN motor skills training.

3.2.3 Data Collection

Data were collected using a mixed-methods approach, combiningsemi-structured interviews with a Google Forms questionnaire.

The semi-structured interviews provided a flexible yet focused framework for obtaining in-depth information. This format allowed the exploration of pre-defined topics while giving participants the opportunity to elaborate on their experiences, share nuanced insights, and introduce unanticipated perspectives. The interview protocol was designed to address central themes such as the perceived benefits and challenges of integrating virtual reality into motor skills training, participants' practical experiences with VR implementation, and their recommendations for future applications. Each interview lasted approximately 45–60 minutes and was conducted either in the participant's native language or in English, depending on individual preference. All interviews were audio-recorded and transcribed verbatim to ensure accuracy and reliability in the subsequent analysis.

Complementing this, a structured questionnaire distributed via Google Forms captured quantitative data regarding participants' perceptions, experiences, and attitudes. This instrument facilitated the collection of broader, standardized responses, allowing the identification of patterns and trends across the larger sample.

By integrating interviews and questionnaire data, the study combined depth and richness of qualitative accounts with the breadth and generalizability afforded by quantitative measures, thereby strengthening the validity and comprehensiveness of the findings.

3.2.4 Data Analysis

The data were analyzed using a mixed-methods approach, incorporating both qualitative and quantitative techniques to align with the study's overall research design.

For the qualitative component, interview transcripts were subjected to a descriptive thematic analysis(Elo & Kyngäs, 2008; Braun & Clarke, 2006). The process began with careful transcription and thorough familiarization with the content, followed by the identification of initial categories. These categories were refined into codes and subsequently organized into broader themes that directly addressed the research questions. The descriptive approach emphasized capturing the complexity of participants' experiences without imposing external theoretical frameworks, thereby ensuring that the findings remained grounded in the empirical data. The analysis was iterative, involving continuous refinement of codes and themes as new insights emerged. To enhance the trustworthiness of the results, member checking was employed, allowing participants to review and validate the interpretations of their contributions (Lincoln & Guba, 1985). In addition, peer debriefing was conducted to ensure that the coding and interpretation processes were consistent, transparent, and free from individual bias.

For the quantitative component, data from the Google Forms questionnaire were analyzed using descriptive statistics. Frequencies, percentages, and measures of central tendency were calculated to summarize participant demographics, perceptions, and reported practices. This statistical overview provided a broader perspective on patterns and trends across the large, multinational sample, complementing the depth of the qualitative findings.

By combining thematic and statistical analyses, the study ensured a rigorous and comprehensive examination of the data. This integration provided both the depth necessary to capture nuanced expert perspectives and the breadth required to identify generalizable trends, thereby strengthening the overall validity and reliability of the findings.

3.2.5 Ethical Considerations

"The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein."

This study was conducted in strict adherence to established ethical standards to ensure the protection, dignity, and rights of all participants. Before participating, experts were fully informed about the aims of the research, the methodologies employed, and the potential risks and benefits of their involvement. Written informed consent was obtained from all participants, who were also reminded of their right to withdraw from the study at any stage without any adverse consequences.

To safeguard privacy, anonymity and confidentiality were rigorously maintained. Interview recordings, transcripts, and questionnaire data were securely stored in password-protected files accessible only to the research team. During the transcription process, all identifying information was removed to ensure that participants could not be personally identified.

These measures ensured that the study respected both the ethical principles of beneficence, autonomy, and justice and the professional responsibilities of conducting research with human participants.

3.3 Findings

3.3.1 Findings from Greece

Partners: Diefthinsi Protobathmias Ekpaidefsis Fthiotidas and Special Education Needs School of Lamia

Country Overview

In Greece, the surveys and interviews involved between eleven and thirteen professionals, along with additional groups of teachers who contributed through structured interviews. The participants represented a wide range of specialties, including special education teachers, speech therapists, psychologists, physical education instructors, and occupational therapists. The majority had more than ten years of experience in special education, adding considerable credibility to their insights. Almost all of them worked primarily with children aged six to twelve years, which shaped the age-specific focus of the findings.

Key Findings

Educators identified a consistent set of motor coordination challenges among children with special needs. Fine motor difficulties were especially prevalent, such as problems with holding a pencil, cutting with scissors, or fastening buttons and zippers. Gross motor issues were also reported, including challenges with walking, jumping, balancing, or climbing stairs. Hand-eye and visual-motor coordination emerged as major concerns, particularly in tasks such as catching a ball, copying from the board, or aligning text. Balance, posture, and spatial orientation were noted as ongoing struggles, and some children also had difficulties with self-care skills such as feeding and dressing, as well as postural control during seated activities.

In terms of assessment practices, most educators relied heavily on observational methods, supported in some cases by therapy-based evaluations, standardized tests, or teacher and parent reports. Some mentioned that games and daily life activities were useful in assessing progress. When reflecting on traditional approaches, teachers agreed that physical education and exercise routines helped strengthen basic motor skills, maintain structure, and encourage social interaction. However, they also emphasized that such approaches often lacked adaptability, could overstimulate certain students, and rarely provided individualized feedback or measurable progress.

The use of technology in motor coordination development was found to be limited. While some teachers had experience with interactive games and applications such as Wii, GoNoodle, Kinems, or Dexteria, many faced barriers related to equipment shortages, outdated tools, limited access, and insufficient training. Few Greek-language applications were available, which further restricted use. Notably, most educators had little or no direct experience with VR, yet they expressed strong optimism about its potential.

Teachers believed VR could provide safe, controlled environments where children could practice movements without fear of injury, while also offering high levels of engagement and motivation. They saw potential benefits in improving hand-eye coordination, balance, body awareness, and overall confidence. At the same time, they voiced important concerns, including the high costs of VR technology, the need for significant training, risks of dizziness or sensory overload, technical malfunctions, and the challenge of helping children transfer VR-acquired skills into real-life contexts.

When asked about desirable features, educators consistently recommended safe, well-structured environments with clear boundaries, simple interfaces, and clear step-by-step instructions. They highlighted the importance of being able to adjust sensory settings such as brightness, pace, or sound, and suggested that visuals should be engaging but not overwhelming. Many saw value in music and rhythmic cues. They recommended short, varied VR sessions that incorporated positive reinforcement, and activities focused on balance, imitation, rhythm, functional movement, and even daily living skills. Importantly, they suggested VR should be flexible enough for both group and individual use.

Direct Insights

Interview data reinforced these findings. Teachers described their reliance on multisensory teaching strategies such as music, dance, tactile objects, and kinesthetic games to support motor development. They highlighted that VR could be particularly effective because it allows children to acquire coordination skills almost unconsciously while playing in a motivating and secure environment. At the same time, some teachers warned that excessive VR use could lead to reduced physical activity in real-world settings. Many recommended piloting VR programs in schools and emphasized the importance of gathering student feedback to refine the design of exercises.

Implications for Greece

Overall, the findings from Greece suggest strong professional interest and optimism toward VR as a complementary tool for supporting motor skill development in children with special needs. However, significant systemic barriers remain, particularly related to funding, training, and equipment. For VR to be effective in

Greek classrooms, interventions must be carefully designed to be customizable, simple, and safe, with special attention to children's sensory needs. Pilot programs co-designed with teachers and therapists appear to be the most appropriate way forward, allowing for gradual adoption, iterative improvement, and greater confidence among educators.

3.3.2 Findings from Cyprus

Partner: University of Cyprus

Country Overview

In Cyprus, the feedback process engaged seven educators alongside four SEN students. All of the teachers were professionals in the field of special education, primarily working with children aged six to twelve. They brought a wide range of professional experience, from five years to well over a decade, and combined teaching with therapeutic support. Their contributions were complemented by student voices, which provided first-hand perspectives on preferences, challenges, and motivations in relation to movement, play, and potential VR use.

Key Findings

Teachers consistently identified hand-eye coordination and body awareness as the most critical skills for development, describing them as essential for participation in both learning and social contexts. Although bilateral coordination and movement timing were also recognized as important, they were seen as less frequently targeted in current programs. Assessment of motor skills relied almost exclusively on observational methods, which were valuable but lacked the objectivity and precision that more advanced tools could provide.

Technology was already present in classrooms to a limited degree, through interactive software, tablets, and whiteboards, but none of the respondents had direct experience using VR. Nevertheless, all expressed openness and curiosity, with enthusiasm about VR's potential to provide immersive, movement-rich environments. Educators believed that VR could make motor exercises feel like play, thereby boosting engagement, motivation, and participation. They saw particular benefits in VR's ability to deliver immediate feedback, visual prompts, individualized pacing, and safe spaces for practice.

At the same time, concerns were raised about the cost of equipment, technical support requirements, and the need for comprehensive teacher training. Educators also noted that VR environments could potentially overwhelm or confuse some children, underlining the importance of supervision, careful design, and adaptability to diverse ability levels.

The students' voices confirmed this potential but also highlighted specific needs. Most had never experienced VR directly, yet they were enthusiastic about the idea. They were especially drawn to bright visuals, cheerful music, friendly characters, and simple instructions. They wanted games that encouraged dancing, imaginative play (e.g., animals, adventures), and exploration of engaging environments. Conversely, they disliked loud noises, fast pacing, and games with unclear instructions, which could cause anxiety and frustration. They also stressed the importance of feeling safe, with the presence of a teacher or adult nearby and the ability to pause or stop the game when needed.

Direct Insights

Educators recommended that VR workouts should feature adjustable difficulty levels, calm and friendly visuals, clear step-by-step guidance, and positive reinforcement through rewards. They suggested activities such as walking along virtual beams, rhythm-based dancing, throwing or catching objects, and exploring obstacle courses. Students echoed many of these ideas, requesting short, fun, and flexible games with rewards like stars or applause, and the chance to personalize aspects such as music or colors. Both groups highlighted the importance of balancing stimulation with clarity, safety, and comfort.

Implications for Cyprus

The findings from Cyprus reflect both enthusiasm and caution**.** Teachers see strong potential for VR to enhance motivation, personalize interventions, and target crucial coordination skills, but systemic barriers—particularly cost, training, and infrastructure—pose challenges. Student perspectives reinforce the importance of fun, imagination, personalization, and emotional safety in VR design. Together, these insights suggest that the most effective path forward is the development of pilot programs that combine technical investment with teacher training, student feedback, and careful evaluation. This would allow VR to be introduced not as a novelty but as a meaningful, inclusive tool to support motor development in children with special needs.

3.3.3 Findings from Turkiye

Partner: ISTANBUL UNIVERSITY-CERRAHPASA

Country Overview

In Turkey, four academicians from Istanbul University-Cerrahpaşa participated in in-depth interviews. Their backgrounds spanned pediatric neurorehabilitation, educational technology, special education, and adaptive physical education. Collectively, they brought extensive experience in research and practice with children who have special educational needs (SEN), including those with cerebral palsy, autism spectrum disorders, ADHD, and developmental coordination disorders. Their expertise allowed for a reflective and research-informed perspective on how VR could be integrated into educational and therapeutic settings to support motor skill development.

Key Findings

The academicians identified several recurring motor challenges among children with special needs. These included difficulties with balance, postural control, bilateral coordination, and motor planning**,** which affected both physical activities and everyday classroom routines. Additional concerns included trunk stability**,** sequencing of movements, and spatial orientation, all of which limit participation in structured and social activities.

Current strategies relied on task-specific training, sensory-integrated routines, structured repetition, and peer-modeled games. These methods were effective in supporting gross motor skills, engagement, and social interaction, but were limited by their lack of individualization, poor tracking of progress, and occasional failure to sustain student motivation.

Technology was already being applied in targeted ways. Examples included balance-board systems that provided real-time visual feedback, Kinect-based movement games, tablet apps for fine motor tracing, and motion-sensing dance activities. These tools boosted engagement and gave students intuitive feedback. However, challenges were noted in access to equipment, inequities across schools, risk of overstimulation, low teacher training levels, and issues with device durability and maintenance.

Regarding VR specifically, all participants expressed measured enthusiasm. They saw VR as a tool capable of creating immersive, controlled, and repeatable experiences where students could practice safely while staying motivated. The gamified nature of VR was seen as particularly valuable for sustaining engagement, while features like visual-motor feedback loops could strengthen children's awareness of their bodies in space. At the same time, the academicians highlighted important caveats: VR must be sensory-sensitive, physically safe, customizable, and always complementary to—not a replacement for—human-led interventions.

Direct Insights

The experts envisioned VR activities that were simple, structured, and playful, including dance and rhythm games, imitation tasks involving animal movements, obstacle navigation, and story-driven adventures that required full-body gestures. They stressed that these games should be designed with cognitive load in mind, ensuring that children are not overwhelmed.

They also outlined key features for VR design: customizable difficulty levels, calming visuals, modular tasks, ergonomic headsets, easy calibration, one-touch exits, and virtual safety boundaries. Crucially, they emphasized the need for adult supervision, clear audiovisual cues, and compatibility with mobility aids.

Concerns were also raised about potential risks such as motion sickness, disorientation, balance-related accidents, passive use of VR as screen time, and frustration when feedback is delayed or inconsistent. To mitigate these issues, they recommended ongoing professional development, technical support systems, and embedding VR into therapy and classroom routines rather than treating it as an isolated activity.

Implications for Turkiye

The findings from Turkey highlight a forward-looking yet cautious stance. Experts see strong potential for VR to address limitations of traditional and even current technology-based methods by making learning more individualized, engaging, and motivating. However, they stress that success will depend on training educators, providing adequate infrastructure, securing sustainable funding, and designing VR with inclusivity and developmental science in mind.

A recurring theme is that VR should scaffold progress rather than aim for perfection, helping children make meaningful steps toward improved coordination and independence. Ultimately, Turkey's academic experts believe VR can become a valuable adjunct to existing strategies if developed thoughtfully, ethically, and in close collaboration with SEN educators, therapists, and families.

3.3.4 Findings from Romania

Partner: INSPECTORATUL SCOLAR JUDETEAN HUNEDOARA,

ROMANIA

Country Overview

In Romania, two complementary data sources were collected: a survey of 19 support teachers working in mainstream schools in Hunedoara county and interviews with 32 teachers during a regional conference on support for children with autism and art therapy. The respondents represented a broad range of experience, from 1 to 30 years, and worked primarily with children aged 6–12 years and 13–18 years. This large and diverse sample provided rich insights into both current practices and expectations regarding VR for motor coordination.

Key Findings

Teachers identified a variety of motor coordination challenges in children with special needs. The most common were hand-eye coordination difficulties, gross motor deficits, balance and laterality disorders, poor synchronization of movements, and weak fine motor control. Everyday difficulties included grasping objects, tying shoelaces, buttoning, drawing straight lines, or using tools such as scissors. Delayed reaction speed and oculo-motor coordination problems were also noted. Beyond physical issues, some respondents mentioned challenges with pronunciation, perception, and socialization.

To address these, teachers currently rely on methods such as motor skill exercises, didactic games, coordination activities, multi-sensory interventions, rhythmic and sports games, and role play. A few also use educational robots (e.g., Ozoboot) or digital games, though these remain the exception. Traditional physical activities like outdoor play, social and motor/balance games, and movement-based group tasks were seen as effective for promoting participation, but less so for students with severe disabilities. Teachers agreed that while such activities encourage social interaction and provide structure, they often lack adaptability and measurable feedback.

In terms of technology use, about two-thirds of the teachers reported incorporating tools like music, dance, tablets, laptops, and interactive boards. Others relied more on natural materials or simple objects for motor tasks. Barriers included lack of knowledge, limited access to adapted devices, reluctance or frustration among students, and risks of overuse or computer addiction.

Regarding VR specifically**,** the majority of teachers were open and optimistic. In the interviews, 18 of 32 respondents considered VR workouts useful, while the remaining 14 saw them as partially useful when used in moderation. In the survey, just over half reported being familiar with VR in some form, while others were not. Teachers agreed that VR could offer safe, engaging, and motivating environments that improve motor coordination, balance, autonomy, and confidence. They also highlighted VR's ability to provide repetition, predictability, immediate feedback, and sensory stimulatio**n**—all of which are valuable for SEN students.

At the same time, several concerns were raised. Risks mentioned included addiction, disorientation, physical discomfort, isolation, distortion of reality, sedentary behavior, and emotional stress**.** High costs, lack of financial support, and limited teacher training were also recurring themes. Teachers emphasized that VR must be designed to avoid sudden movements or overstimulation and should always be implemented under teacher supervision.

Direct Insights

Educators offered concrete suggestions for VR design. They stressed the importance of simplicity, adaptability to student needs, friendly environments, and clear instructions**.** Features such as positive reinforcement, personalization of themes, adjustable difficulty and pace, calming sound and color schemes, and low-light intensity were recommended. Teachers and students should be able to track progress, and games should encourage safe exploration rather than overstimulation.

Preferred VR activities included movement and coordination games, attention tasks, motor and posture exercises, bilateral laterality tasks, and sports-based games. Respondents also suggested sensory games, educational and exploration activities, and interactive puzzles. Creative proposals included catching falling objects, sorting or assembling tasks, bubble-popping games, breathing control exercises, and bilateral coordination challenges. Teachers noted that these should not only train motor skills but also foster autonomy, problem-solving, and social interaction.

Implications for Romania

The Romanian findings reflect both enthusiasm and realism**.** Teachers recognize VR's potential to enhance motivation, engagement, and coordination skills, while also voicing caution about risks such as cost, overstimulation, and addiction. The insights strongly support the need for pilot projects that integrate VR into classrooms gradually, with adequate teacher training, adapted equipment, dedicated spaces, and supervision**.** Importantly, the suggestions emphasize VR design that is inclusive, calming, and child-centered**,** balancing fun and safety with developmental goals. If implemented thoughtfully, VR could become a valuable tool to complement traditional methods, particularly in mainstream school integration contexts.

3.3.5 Findings from Latvia

Partner: Latvia, Private school "Gaismas tilts 97"

Country Overview

In Latvia, feedback was collected from a focus group of four professionals (including a speech therapist, developmental therapist, school principal, and STEAM teacher) as well as a survey of 10 teachers working in inclusive education. Participants had substantial experience supporting children with special needs across educational and therapeutic contexts, particularly with children requiring help in developing motor skills, balance, and fine motor coordination.

Key Findings

Educators consistently identified cross-lateral movements, balance, hand-eye coordination, fine motor skills, movement planning, and spatial awareness as the most challenging areas for children with special needs. These difficulties affected participation in physical education, completion of classroom tasks such as writing or cutting, and everyday self-care skills like tying shoelaces or buttoning clothing.

Current strategies to address these needs included fine motor activities (e.g., bead threading, coloring, tracing), structured routines, perceptual coordination exercises, and sensory methods such as the Crispiani method or warm grain therapy (providing tactile stimulation to activate brain centers). Traditional physical activities like relay races, ball games, or endurance workouts were seen as effective for general gross motor development and rhythm, but insufficient for addressing precise coordination needs without specialist adaptation and repetition.

Technology was used in various forms, including computer games, puzzles, balance boards, magnet-based games, interactive whiteboards, and textured equipment**.** These tools helped increase engagement and provided sensory feedback. Challenges included sustaining attention, balancing screen-based interaction with real physical activity, and managing students' difficulties in grasping devices (e.g., computer mouse).

Regarding VR, participants expressed measured optimism**.** While few had direct experience, they considered VR a valuable complement to traditional methods. VR was seen as capable of offering safe simulations of tasks children might otherwise avoid due to fear or difficulty, as well as opportunities for individualized, engaging, and creative training. Teachers emphasized, however, that VR is not a miracle solution and must be carefully adapted to children's developmental and emotional needs.

Benefits identified included VR's ability to capture attention, motivate through novelty, adapt tasks to individual needs, and promote skills such as balance, coordination, spatial orientation, hand-eye coordination, reaction speed, and self-confidence**.** It also offered opportunities for safe exploration and social interaction. Concerns centered on high costs, visual strain, overstimulation, dependency, and accessibility issues**,** alongside the risk that VR could lack real-world transfer if not designed carefully.

Direct Insights

Educators highlighted specific features that would make VR effective: customizable difficulty, calm and friendly visuals, clear instructions, emotional safety mechanisms (e.g., a visible “exit” button), and options for students to stop play independently. They suggested including avatars of teachers in the VR environment for reassurance, and emphasized the need for rest breaks and equivalent real-life tasks to reinforce transfer.

Preferred activities included dance and rhythm-based games, animal-movement imitation, exploration tasks, narrow path walking, climbing, catching objects, sports simulations, threading or maze-based fine motor activities, and role-play linked to real-life scenarios**.** Engaging visuals, storytelling, familiar cartoon characters, and customizable elements (colors, music, symbols) were recommended to enhance motivation.

Implications for Latvia

The Latvian findings highlight both cautious optimism and practical realism**.** Teachers and therapists see VR as a supportive tool rather than a replacement for hands-on or specialist-guided activities. Its potential lies in making practice more engaging, motivating, and individualized, especially for students struggling with balance, cross-lateral movements, and fine motor tasks. However, successful implementation will require training, technical support, adapted equipment, and thoughtful design that avoids overstimulation and ensures real-life applicability. Pilot programs co-designed with educators and rehabilitation specialists, and reinforced by equivalent physical activities, would offer the most promising pathway for VR adoption in Latvia.

3.3.6 Findings from Italy

Partner:cises srl

Country Overview

In Italy, a survey was conducted with 12 educators and specialists working with children with special educational needs. The participants represented a diverse mix of professional backgrounds, including primary school teachers, psychologists, educators with psycho-social and pedagogical training, and specialists in multiple disabilities. Their experience ranged from just one year to over thirty years, with 10 years being the most frequently reported. The group primarily worked with children aged 6–12 **(58.3%)** and adolescents aged 13–18 (41.7**%)**, providing insights relevant to both primary and secondary education contexts.

Key Findings

Educators highlighted a variety of motor and coordination challenges. Fine motor skills were a major concern, particularly tasks such as writing in cursive, cutting with scissors, folding paper, or using rulers and compasses. Difficulties with hand-eye coordination (oculo-manual integration) were also frequently noted, affecting both academic and recreational activities. Issues related to body awareness, spatial orientation, and movement planning were emphasized, with some teachers observing that children struggled to understand and control their body in relation to others, which could lead to social difficulties. Emotional and behavioral issues, such as lack of trust, low self-confidence, or even self-harming behaviors, were also mentioned as complicating factors in motor development.

Across all five key domains—balance and stability, hand-eye coordination, body awareness, bilateral coordination, and reaction time—respondents overwhelmingly rated them as important or very important. Balance, stability, and body awareness received the highest prioritization, reflecting a shared understanding that these are foundational to broader participation and learning.

When it came to assessment, half of the teachers relied primarily on direct observational assessments**,** while a quarter used a combination of observation, parental feedback, and therapeutic evaluations. Only a small number employed standardized physical tests or structured assessment tools, suggesting that assessment remains largely informal and context-driven.

In terms of technology use, most educators reported limited or no integration of technological tools for supporting motor development. While a few used smartphones, interactive whiteboards, or internet-based apps, many still relied on traditional methods such as manipulative play, sports equipment, or coordination games. Notably, no participants reported using advanced technologies such as motion sensors or VR, highlighting a significant gap between awareness of technological possibilities and their actual use in classrooms.

Direct Insights

Familiarity with VR among Italian teachers was low. Three-quarters (75%) had no experience with VR**,** while the remaining quarter had only limited familiarity. Despite this, some respondents recognized VR's potential, noting its structured, engaging, and pre-tested activities as advantages. Others expressed uncertainty, responding with "I don't know" or "Not sure." This suggests a cautious openness but a clear need for professional development and hands-on exposure before teachers can confidently adopt VR in practice.

The benefits of VR, as understood by participants, included potential improvements in coordination, engagement, and motivation. At the same time, respondents identified multiple challenges**:** high costs, lack of training, difficulty adapting tools to diverse student profiles, sensory overload, and uncertainty about whether skills learned in VR would transfer to real life**.** A few also mentioned institutional barriers, such as lack of administrative support or absence of suitable equipment in schools.

When asked about design features, most respondents admitted they did not know enough to provide detailed recommendations. However, some suggested visually engaging environments, strong visual impact to capture attention, and attractive, stimulating activities to maintain motivation. A few mentioned the integration of video-based elements or gym equipment, showing a tendency to draw on familiar teaching strategies when imagining VR possibilities.

Implications for Italy

The Italian findings reveal both potential and hesitation. Teachers recognize the importance of motor coordination for children with special needs and are open to exploring innovative solutions, but their limited exposure to VR constrains their ability to envision its applications in detail. For VR to succeed in Italy, investments in teacher training, institutional awareness, and accessible resources will be critical. Pilot programs that introduce educators to VR in structured, supportive ways could bridge the knowledge gap and encourage wider adoption.

Overall, the Italian context suggests that while interest exists, meaningful integration of VR into special education will require not only technology but also systemic support, professional preparation, and careful alignment with educational goals. Without these foundations, VR risks being seen as a novelty rather than a transformative tool.

3.3.7 Findings from Croatia

Country Overview

In Croatia, feedback was collected from both a focus group of three teachers at Podmurvice Elementary School and a survey of 11 teachers. Participants included primary school teachers, social pedagogues, and specialists in inclusive education. They worked with children with a range of special needs and had experience supporting motor development in daily classroom tasks as well as in physical education and play contexts.

Key Findings

Teachers consistently noted difficulties with both fine and gross motor skills. Fine motor challenges included writing, cutting, erasing, sharpening pencils, turning pages, and handling small objects. Gross motor issues were observed in movement coordination, dexterity, direction and speed of movement, balance, and participation in sports. Additional challenges included eye-hand coordination, lateral movements, and tracking moving objects, which affected tasks such as catching or throwing a ball.

Current strategies relied on individualized exercises, often structured around games and playful activities. Gamification was frequently used, allowing children to develop coordination while remaining engaged and unaware that they were “learning.” Visual aids, pictorial material, and templates (such as books and films) also supported understanding and task execution. Teachers emphasized that daily practice and collaboration among staff were crucial for helping students improve.

Traditional physical activities like outdoor play, sports, and ball games were considered beneficial for building endurance and gross motor skills, but they often fell short in addressing the precise needs of children with disabilities. Respondents felt that combining these methods with new tools like VR could provide better results.

Technology was used occasionally, with tools such as the Play Attention device to support focus and engagement, or outdoor physical activities to promote coordination and balance. However, limitations were noted, including that many technological solutions use standardized exercises not tailored to individual needs**,** and some could cause frustration or sensory overload for students with disabilities.

Teachers expressed optimism about VR, viewing it as a powerful tool for motivation, focus, and individualized pacing. They emphasized that VR could provide stimulating environments, enhance learning, and support both fine and gross motor skill development. VR was also seen as useful for promoting social skills, speech development, attention, and emotional regulation**. A**t the same time, caution was advised to avoid overuse, ensure safety, and provide adequate teacher training.

Direct Insights

Teachers stressed that VR should be adapted to students’ needs through visual, motor, and auditory customization. Safety was a priority, with the need for secure spaces, comfortable equipment, and options for children to remove VR glasses if they felt uncomfortable. They highlighted VR’s potential in simulating daily life skills (e.g., shopping, crossing the road), enhancing focus, supporting sensory integration, and offering calming experiences for children with autism or ADHD.

Preferred activities included movement-based games, puzzle-solving, pantomime, imitation of animals or natural sounds, sports simulations, and creative activities such as painting, playing instruments, or designing 3D objects. Teachers also envisioned VR as a complement to reading and history lessons, helping students engage with texts, explore new places, or participate in collaborative experiences like team sports and board games.

Implications for Croatia

The Croatian findings highlight both promise and pragmatism. Teachers see VR as a valuable complement to traditional activities, capable of enhancing motivation, coordination, and social participation. However, successful implementation will require training, adapted content, financial investment, and ongoing support. Importantly, VR must be carefully tailored to the individual abilities and sensory profiles of students to ensure accessibility and comfort.

Overall, educators in Croatia envision VR not only as a tool for improving coordination but also as a means of fostering inclusion, creativity, and emotional well-being. Pilot programs co-developed with teachers and specialists could help determine best practices while ensuring safe, balanced, and effective integration into classrooms.

3.4 Cross-Country Summary of Key Findings

Across Greece, Cyprus, Turkey, Romania, Latvia, Italy, and Croatia, the findings show a clear consensus: children with special educational needs face significant challenges in both fine and gross motor coordination, and educators see strong potential for Virtual Reality (VR) as a supportive tool, though adoption faces barriers.

Motor Coordination Challenges

Teachers across all countries reported frequent difficulties in:

- Fine motor skills (writing, cutting, buttoning, manipulating small objects).
- Gross motor skills (balance, jumping, running, posture, climbing stairs).

- Hand-eye coordination, bilateral coordination, and spatial orientation.

  These issues affected not only academic and recreational tasks but also self-care and social participation.

Current Practices and Limitations

Most educators rely on observational assessments and use traditional physical activities (games, sports, role play) to build coordination. While these methods support socialization and general motor skills, they are often insufficient for individual needs and lack precision, feedback, and measurable progress. Some innovative practices (multisensory methods, balance boards, interactive games) are in use, but access and training are inconsistent.

Use of Technology

Technology use varied but was generally limited**.** Some countries (Turkey, Latvia, Romania) reported modest use of devices like tablets, balance boards, Wii, or specialized apps. Others (Italy, Croatia) reported minimal integration of advanced tools. Across all contexts, barriers included costs, lack of equipment, insufficient training, outdated tools, and accessibility issues.

Perceptions of VR

Familiarity with VR was low everywhere, but educators and students expressed cautious optimism. Commonly perceived benefits included:

- High engagement and motivation (making exercises feel like play).
- Safe, controlled environments for practice.
- Customizable difficulty and pacing for individual needs.
- Support for improving balance, hand-eye coordination, body awareness, and confidence.

Concerns echoed across countries:

- High costs and lack of school funding.
- Training needs for educators.
- Risks of overstimulation, dizziness, dependency, or isolation.
- Uncertainty about the transfer of VR skills to real life.

Desired VR Features

Teachers and students suggested VR should include:

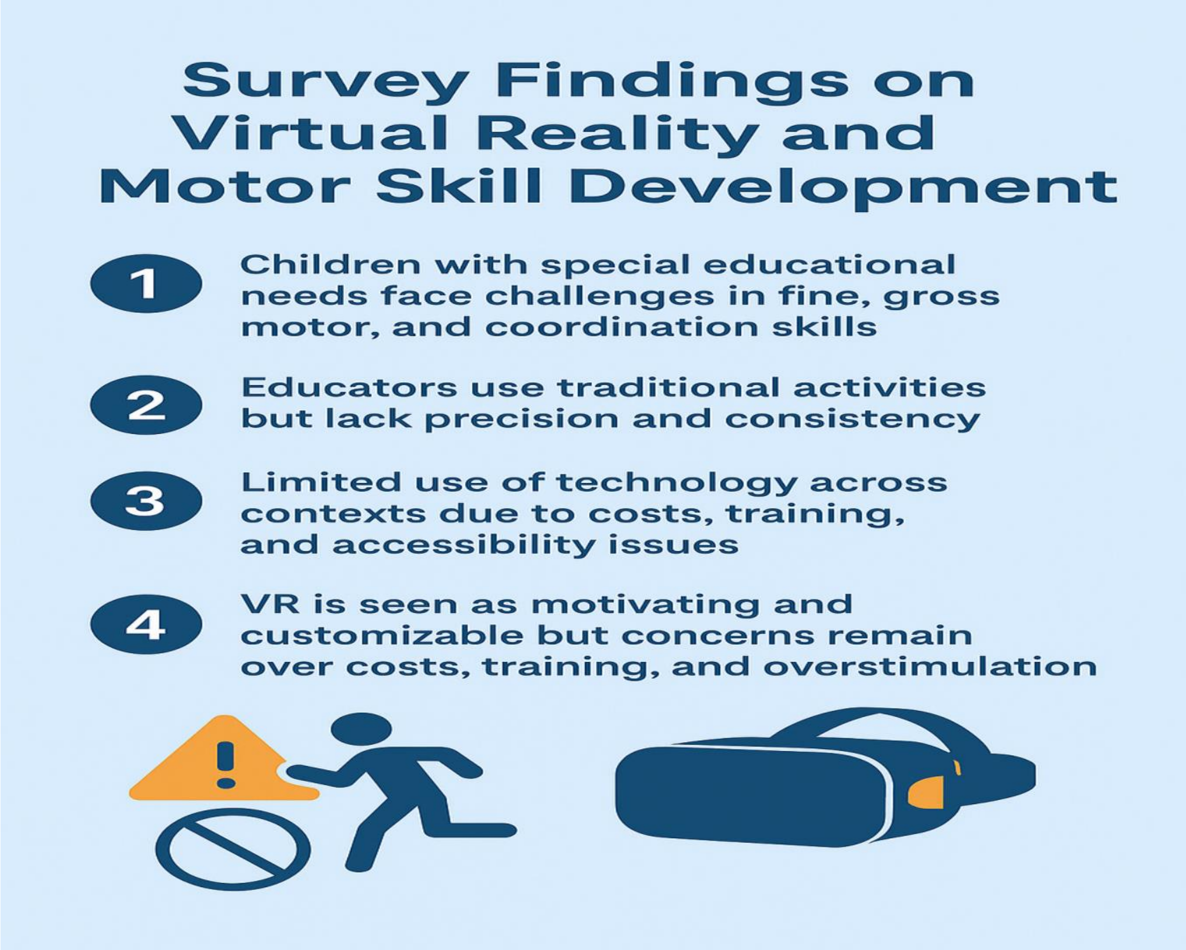
- Simple, clear interfaces with calming visuals and sound.
- Adjustable difficulty, pacing, and sensory settings.
- Positive reinforcement through rewards.
- Short, varied sessions with options for pausing or exiting safely.
- Activities such as balance games, dance, imitation, obstacle navigation, puzzles, sports simulations, and role play of daily life skills.

Implications Across Countries

The findings reflect broad interest and optimism in using VR to support motor development, but also practical caution**.** For successful adoption, countries will need:

- Pilot programs co-designed with teachers and therapists.
- Investment in equipment, training, and infrastructure**.**
- Designs that are inclusive, sensory-sensitive, and flexible.
- Strong links between VR activities and real-world application.

All seven countries see VR as a motivating, customizable, and promising tool for motor skill development in children with special needs — but its potential can only be realized if challenges around cost, training, accessibility, and safe design are addressed.


Survey Findings on Virtual Reality and Motor Skill Development
1
Children with special educational needs face challenges in fine, gross motor, and coordination skills
2
Educators use traditional activities but lack precision and consistency
3
Limited use of technology across contexts due to costs, training, and accessibility issues
4
VR is seen as motivating and customizable but concerns remain over costs, training, and overstimulation

Chapter 4: Exploring the Potential of Virtual Reality for Motor Skills Training in Children with Special Educational Needs: Perspectives from students

4.1 Introduction

While the views of educators provide a professional and structured assessment of the challenges and opportunities surrounding motor coordination and the potential of virtual reality (VR), it is equally important to consider the voices of the students themselves. Children and young people with special educational needs are not only the primary beneficiaries of these interventions but also active participants whose motivation, preferences, and comfort significantly shape the success of any educational or therapeutic program.

The data collected from students across the partner countries offers valuable insights into how they perceive physical coordination activities, their attitudes toward technology, and their expectations of VR as a learning tool. Through surveys, focus groups, and informal interviews, students shared their experiences of daily physical challenges, their likes and dislikes in play and movement-based activities, and their feelings about immersive technologies.

This chapter presents the perspectives gathered from students, highlighting common themes such as their enthusiasm for engaging, playful experiences; their sensitivity to sensory overload; and their desire for supportive environments that balance fun with safety. By integrating student voices alongside those of teachers, the findings provide a more holistic understanding of the role VR could play in enhancing motor skill development for children with special needs.

4.2 Methodology

The student component of this research formed part of a broader European project exploring the use of Virtual Reality (VR) to support motor skill development in children with special educational needs (SEN). A mixed-method survey design was used to gather data across six partner countries. The surveys were carefully adapted for accessibility, with simple language, visual aids, and in some cases bilingual introductions, ensuring inclusivity for children of different ages and abilities.

The primary aim was to capture students' perspectives on physical coordination challenges, their preferences for play and movement-based activities, their prior exposure to VR, and their expectations for VR game design. By focusing on the voices of children themselves, the methodology sought to complement educator perspectives with authentic insights from the end users of VR interventions.

4.2.1 Research Design

The research adopted a descriptive, exploratory design that relied on structured questionnaires administered in both digital (Google Forms) and paper formats. To ensure child-friendly engagement, the surveys used multiple-choice questions, tick-box options, and spaces for open responses. The questions were grouped into five main domains: background information (such as age, gender, and prior VR exposure), enjoyment of sports and movement games, perceptions of physical abilities (distinguishing between tasks considered easy or difficult), interest in improving skills through play, and expectations, likes, and dislikes regarding VR games. This design allowed for the collection of both quantitative data—such as percentages reflecting preferences, interests, and difficulties—and qualitative insights drawn from students' own words about fun, safety, and game ideas.

4.2.2 Participants

In total, more than ninety students from six European countries participated in the surveys. The sample was diverse in age and background, including both boys and girls, with a slight male majority in several contexts. The participants included sixteen children aged seven to fourteen in Greece, four children aged eight to eleven in Cyprus, seventeen students with intellectual disabilities aged nine to fifteen in Romania, eight students from inclusive education settings in Latvia, seventeen adolescents aged ten to nineteen in Italy, and twenty students aged thirteen in Croatia. While heterogeneous in profile, all participants represented learners with special educational needs, providing valuable cross-national perspectives on physical coordination and the role of VR.

4.2.3 Data Collection

Data were collected during the second phase of the project's needs assessment through surveys administered in school or community settings. Depending on local contexts, teachers and project partners distributed the questionnaires either digitally or in paper form. In countries such as Greece and Italy, digital surveys using Google Forms were employed, while in Romania, Cyprus, Latvia, and Croatia, paper-based surveys were more common. In some cases, facilitators supported students by reading questions aloud or clarifying terminology to ensure comprehension. The surveys were translated into local languages where necessary and adapted to be age-appropriate, with examples and simplified phrasing to ensure accessibility for children with special educational needs.

4.2.4 Data Analysis

A mixed-methods approach guided the analysis of the survey data. Quantitative responses were compiled into descriptive statistics to capture patterns in preferences, experiences, and challenges. Percentages were calculated to illustrate levels of enjoyment of sports, interest in VR, or identification of difficult physical tasks. At the same time, open-ended responses were analyzed qualitatively through thematic coding, which allowed for the identification of recurring themes such as desired VR features, concerns about safety, and creative game ideas. By combining these two strands of analysis, the study generated both measurable patterns and richer insights into students' perspectives.

4.2.5 Ethical Considerations

The study placed strong emphasis on ethical engagement with minors and students with special educational needs. Informed consent was obtained from schools, parents, and, where appropriate, the children themselves. Participation was entirely voluntary, with students free to skip questions or withdraw at any point. All surveys were anonymous, ensuring confidentiality and compliance with GDPR regulations. To safeguard emotional well-being, the questionnaires were phrased positively and designed to avoid stress or discomfort. Facilitators reassured students that there were no right or wrong answers, and their contributions would be valued equally. Special care was taken to ensure accessibility and emotional safety, including the use of age-appropriate language and opportunities for students to express themselves freely.

4.3 Findings

4.3.1 Findings from Greece

Country Overview

In Greece, sixteen students between the ages of 6 and 12 took part in the survey, with the majority being eight and ten years old. Boys represented about 62.5% of the sample, while girls made up 37.5%. This group reflected a typical primary school age range, where children are developing both fine and gross motor coordination skills alongside their interests in play and movement.

Key Findings

Most students expressed a strong enjoyment of movement games and sports (87.5%), with none reporting disinterest. A large proportion (75%) had already tried VR, indicating relatively high exposure compared with other countries. Students identified running, walking, jumping, throwing/catching balls, dancing, and balancing as activities they found easy, showing confidence in common motor tasks. However, they also reported challenges, particularly in balance, synchronizing arm and leg movements, dancing to rhythm, and spatial awareness (e.g., bumping into things). Some mentioned struggles with football, yoga positions, or managing fear of heights.

Students showed strong motivation to improve their physical skills, with 75% saying they wanted to get better at moving, playing, or balancing, and nearly all (93.8%) stating they would like to play VR games that help them move their bodies. Their enthusiasm for VR was reinforced by their preferences for reward systems (points, stars, prizes), fun music and sounds, friendly characters, bright colors, and games that were easy to understand**.**

When asked what they disliked in games, students were clear about avoiding violence, weapons, shooting, war themes, blood, scary characters, and loud frightening sounds. Some also disliked difficult games, frequent losses, or poor-quality graphics. Game ideas suggested included football, basketball, dancing, obstacle courses, treasure hunts, exploration, racing, and Minecraft-style creative play**.** Importantly, students emphasized feeling safe and happy in VR through calming environments, soft music, clear instructions, and adult presence. A majority (93.8%) also wanted to track their progress and see improvements over time, reinforcing the motivational value of feedback.

Implications for Greece

The Greek findings demonstrate that children are not only enthusiastic about movement-based VR but also articulate about what makes experiences enjoyable or stressful. Their emphasis on safety, rewards, friendly design, and clear instructions provides important guidance for VR development. Given their relatively high familiarity with VR, students in Greece appear particularly ready to embrace pilot programs, provided games remain non-violent, accessible, and supportive of skill-building in balance, rhythm, and coordination.

4.3.2 Findings from Cyprus

Country Overview

In Cyprus, four primary school students, equally split between boys and girls, participated in the survey. They were between eight and eleven years old and represented a small but insightful sample of children with special educational needs. Their feedback reflected both curiosity and enthusiasm toward movement-based play and VR.

Key Findings

When asked about their feelings toward movement and sports, the children gave varied responses: some expressed a strong love of physical activity, while others enjoyed it only sometimes. All four participants said they would like to improve their skills in moving, playing, and keeping balance, showing motivation to grow in these areas.

Only one child had prior experience with VR, which they described as exciting. The others had never tried VR but were eager to do so, unanimously responding that they would love to play VR games that involve body movement. The children identified running, walking, dancing, moving to music, and catching balls as activities they found easy, while balancing, jumping, and managing quick movements were described as difficult.

Their preferences for VR game design included bright colors, simple instructions, friendly or funny characters, cheerful graphics, and music. They highlighted the importance of playful, silly, or exciting movements and disliked loud noises, dark scenes, scary characters, and games that felt too tiring or stressful. The children also asked for pause buttons, clear guidance, and supportive voices to help them feel safe and in control. Game ideas ranged from racing and obstacle jumping to exploration in forests or spaceships, dance missions, and puzzle-solving adventures. Importantly, all four valued progress tracking, rewards, and achievements as motivating features.

Implications for Cyprus

Despite their small number, the Cypriot students provided rich insights into how VR could be designed for inclusivity and fun. They showed openness to VR even without prior experience, emphasizing safety, emotional comfort, and guidance as key factors. Their imaginative ideas—racing, exploration, dancing—underline the need for varied, colorful, and story-like VR activities that balance challenge with playfulness. For

Cyprus, VR holds promise as a tool to engage students, provided games are designed to be non-threatening, supportive, and motivating.

4.3.3 Findings from Romania

Country Overview

In Romania, 17 students with intellectual disabilities, integrated into mainstream schools in Hunedoara County, participated in the survey. The group ranged in age from nine to fifteen, with a clear male majority (70.5% boys, 23.5% girls). This sample provided valuable insights into the perspectives of students who face both academic and motor coordination challenges within inclusive educational settings.

Key Findings

Over 70% of students said they enjoyed movement-based games and sports, reflecting enthusiasm for active play. More than half (58%) had prior experience with VR, suggesting relatively strong exposure. When asked about easy tasks, students identified running, walking, catching or throwing balls, dancing, and jumping, though at lower percentages than in other countries.

Difficulties included balance, dancing, strength in legs or arms, and playing basketball, while one recurring barrier was the busy school program, which some felt limited their ability to engage in physical activities. Importantly, 82.4% expressed a desire to improve their motor skills, showing motivation to grow.

Interest in VR was also strong: 70.6% said they would like to play VR games that help them move, 17.6% responded “maybe,” and only 11.8% were uninterested. Preferred features included playing at their own pace, fun music and sounds, dancing or jumping, easy-to-understand instructions, bright colors, prizes, and friendly characters. Students were unanimous in rejecting violence, scary situations, loud noises, and horror themes in games. Suggested VR game types included treasure hunts, jumping challenges, and obstacle courses, emphasizing playful exploration over competition.

For emotional safety, students valued clear voices giving instructions, pleasant music, and the absence of scary noises**.** A large majority (82.4%) wanted to track progress, reinforcing the appeal of feedback and achievements. Many also commented that VR games seemed useful and interesting for learning.

Implications for Romania

The Romanian findings underline the strong appeal of VR among students with disabilities**,** particularly for enhancing motivation and making physical activity fun. Their responses highlight the need for accessible, non-violent, supportive VR environments that avoid overstimulation and respect different paces of learning. Treasure hunts, dancing, and jumping games could be strong entry points. Importantly, Romanian students' emphasis on safety, rewards, and progress tracking suggests that VR could serve not only as an engaging tool but also as a means of building confidence and autonomy when integrated into inclusive classrooms.

4.3.4 Findings from Latvia

Country Overview

In Latvia, eight students participated in the survey, representing inclusive education settings. The group was small but diverse in terms of responses, with a mix of ages and backgrounds. Their feedback offered insights into both enthusiasm and skepticism toward movement-based play and VR, reflecting the variety of perspectives often found in SEN populations.

Key Findings

When asked about easy activities, students gave mixed and sometimes unusual answers such as "nothing," "run," "write letters," or "pumping." This indicates a wide range of abilities and self-perceptions. Similarly,when asked about difficulties, responses varied from "nothing" to "a lot of movement and loud music," showing that challenges were highly individualized.

Despite this variety, there was overall openness to VR. Several students expressed strong interest in playing VR games that involve movement, while others responded with ambivalence. Preferences for fun game features included bright colors, fun music, friendly characters, rewards, playing at one's own pace, and dancing or jumping, consistent with patterns seen in other countries.

In contrast, dislikes revealed important sensitivities. Students specifically mentioned avoiding bloody games, loud sounds, forests or caves, and trauma-related content. Some said "I like everything," while others expressed fear of dark or frightening environments. Game suggestions were highly imaginative, ranging from basketball, horse jumping, Minecraft, Roblox, and boxing to more unusual ideas such as "I am a cat" or being chased by "bloody policemen." These creative but sometimes dark themes highlight both curiosity and vulnerability in student perspectives.

When asked what would help them feel safe, responses again varied widely—from "everything" and "nobody" to "no scary things" and "clear guidance." Some students expressed interest in boxing or action-style games, but without frightening elements. Most said VR games are "cool" or "very interesting," with some wishing they could order VR glasses themselves.

Implications for Latvia

The Latvian findings reflect a broad spectrum of attitudes toward VR, from unreserved enthusiasm to clear concerns about safety and content. For these students, VR holds potential as a fun, imaginative, and physically engaging tool, but design must carefully avoid violence, frightening settings, or overstimulation. The variety of answers also underscores the importance of customization and choice, allowing each child to select games that match their comfort and interests. With thoughtful design and sensitive facilitation, VR could provide Latvian students with opportunities for safe exploration, creativity, and motor skill development.

4.3.5 Findings from Italy

Country Overview

In Italy, 17 students between the ages of 10 and 19 participated in the survey, with the largest group clustered around ages 15–16. The gender balance was relatively even, with 52.9% boys, 41.2% girls, and one respondent who preferred not to state gender. This group reflected the perspectives of middle and late adolescents, many of whom are already familiar with digital technologies and curious about innovative learning tools such as VR.

Key Findings

Students expressed generally positive attitudes toward physical activity: nearly half (47.1%) said they love movement-based games and sports, while another 41.2% reported enjoying them sometimes. Only a small minority (11.8%) showed low enthusiasm. Exposure to VR was mixed: 41.2% had tried VR before, while 58.8% had never experienced it.

When asked about easy activities, all students (100%) reported confidence in running or walking, with high levels of comfort also noted in balancing (88.2%), catching or throwing balls (82.4%), and coordinating arms and legs (82.4%). Dancing or moving to music was seen as easy for 70.6%. At the same time, some students identified challenges in complex coordination, dancing, precision tasks, balance, or body awareness, although several answered "none," suggesting that difficulties are individualized rather than widespread.

A majority (64.7%) said they would like to improve their motor skills, particularly in movement, games, and balance, while another 23.5% responded "maybe," showing openness. Interest in VR was strong, with 82.4% stating they would like to play VR games that help them move their bodies.

Preferences for fun features centered on music and fun sounds (82.4%), bright colors (76.5%), rewards like stars or prizes (58.8%), friendly characters (52.9%), flexibility to play at their own pace (52.9%), and active elements like dancing or jumping (47.1%). Clear instructions were valued by 41.2%. Students disliked games that were too childish, boring, overly difficult, physically demanding, competitive, or frightening. Some asked for calm, non-stressful environments.

Game ideas included dancing, treasure hunts, ball games, construction games, multiplayer play, parkour, and imaginative activities. Students also stressed emotional safety, requesting clear guidance, no scary sounds, friendly characters, and reassuring structures. Progress tracking was welcomed by 64.7% of respondents, while the rest were neutral, showing that feedback systems could be motivating without being intrusive.

Implications for Italy

The Italian findings reveal a population of adolescents who are largely confident in physical activities but eager to explore new tools that make movement fun and engaging. They value VR games that are visually appealing, musically stimulating, and rewarding, while rejecting experiences that are boring, childish, or stressful. Importantly, they showed openness to imaginative, social, and cooperative play, suggesting that VR could support not only motor coordination but also creativity and peer interaction. For Italy, careful attention to age-appropriate design, emotional safety, and variety will be crucial to ensuring VR becomes an attractive and effective educational tool for teenagers.

4.3.6 Findings from Croatia

Country Overview

In Croatia, 20 students, all aged 13, took part in the survey. This group represented a full class of adolescents at the same developmental stage, providing a focused perspective on how teenagers in early secondary school perceive VR and movement-based games.

Key Findings

The students generally showed a strong interest in movement games and sports, with many expressing enjoyment of active play. While some felt confident in basic skills such as running, walking, and catching balls, others highlighted challenges in balance, coordination, and endurance, particularly during more complex or sustained activities.

Only a minority had prior exposure to VR, but the majority indicated they would like to try VR games that encourage movement and coordination. Their enthusiasm was evident in their descriptions of what would make games fun: bright visuals, lively music, prizes, and opportunities for dancing, jumping, or active exploration. They emphasized the importance of simplicity and clear guidance, preferring games that are easy to follow and not overly complex.

Students were also vocal about what they disliked. They rejected violence, horror, dark settings, and loud or frightening sounds, echoing patterns seen in other countries. They also disliked games that were “boring,” “too hard,” or “pointless.” Many expressed a desire for VR games to be fun, energetic, and rewarding, with clear goals and feedback.

When suggesting game ideas, students mentioned sports simulations (football, basketball), obstacle courses, dancing, treasure hunts, racing, and creative adventures. Some also suggested imaginative or role-play scenarios, such as exploring new worlds or solving mysteries. To feel safe and happy while playing, they asked for no scary elements, calm music, clear instructions, and the presence of an adult or teacher nearby.

Implications for Croatia

The Croatian findings highlight the readiness of adolescents to embrace VR as both an entertaining and educational tool. Students expressed enthusiasm for active, colorful, and rewarding games, while making it clear that violent or frightening content should be avoided. Their focus on sports, dancing, and exploration suggests that VR could be particularly effective in supporting both coordination and teamwork skills in this age group. For successful implementation, VR in Croatia should be designed with safety, simplicity, and clear objectives in mind, while offering variety to sustain motivation.

4.4 Cross-Country Summary of Student Perspectives

Enjoyment of Movement and Sports

Across all six participating countries—Greece, Cyprus, Romania, Latvia, Italy, and Croatia—students expressed a consistently strong interest in movement-based activities. The majority reported enjoying sports and active play, with particularly high levels of enthusiasm in Greece and Romania. Even in Italy and Croatia, where some students were more reserved, most respondents expressed at least some enjoyment of physical activity. This widespread enthusiasm provides a strong foundation for integrating VR as a playful and engaging way to support motor skill development.

Familiarity with VR

Exposure to VR varied across countries. In Greece and Romania, many students had already tried VR, while in Cyprus, Latvia, Italy, and Croatia prior experience was limited. Nevertheless, interest in VR was consistently high in every country, with large majorities stating that they would like to play VR games that help them move their bodies. This highlights both the novelty of VR and its broad appeal among children and adolescents.

Motor Skills: Easy vs. Difficult

When asked about physical skills, students across contexts identified running, walking, catching balls, jumping, and dancing as activities they found easy. Challenges were most commonly reported in balance, rhythm, complex coordination, and body awareness. In Greece and Romania, balance and dancing were emphasized as areas of difficulty, while Italian respondents showed more individual differences, with some indicating no particular challenges at all. These findings suggest that VR interventions should focus on improving balance, rhythm, and fine coordination, while reinforcing gross motor skills that students already feel confident about.

Features That Make Games Fun

Students also provided detailed insights into what makes VR games enjoyable. Bright colors, cheerful visuals, fun music and sounds, and rewards such as stars or points were consistently valued. Friendly characters, simple instructions, and opportunities for creative movement—such as dancing, jumping, or imaginative play—were also highlighted as key features. These preferences underline the importance of designing VR experiences that are visually engaging, musically stimulating, and rewarding, while remaining accessible and easy to follow.

Dislikes and Concerns

Equally important were the things students did not want in VR games. Across all countries, children rejected violence, frightening or dark themes, loud noises, and horror-style content. Many disliked games that felt boring, childish, too simple, or conversely too physically demanding or competitive. This demonstrates the need for balance: VR games must be challenging and engaging, but not overwhelming or infantilizing.

Game Ideas

The game ideas shared by students reflected a rich variety of interests. Sports simulations such as football and basketball were popular, alongside dancing, treasure hunts, obstacle courses, and racing games. Many also requested imaginative and creative experiences, including Minecraft or Roblox-inspired environments, parkour challenges, and exploration of forests, treasure maps, or space adventures. These suggestions reflect a clear desire for variety, imagination, and playful exploration in VR environments.

Safety and Comfort

Safety and comfort were recurring themes throughout the surveys. Students emphasized the importance of non-threatening environments, calm music, and clear instructions. They wanted options to pause or exit the game easily, and many said they felt safer knowing an adult was present. These responses underline the need for VR systems to prioritize emotional and sensory safety, especially for children with special educational needs.

Progress Tracking

Finally, progress tracking emerged as a valued feature. In Greece, Romania, and Italy in particular, large majorities of students said they wanted to see their progress and improvements after playing VR games. Even in countries where this was less of a priority, no students rejected the idea outright. This indicates that progress tracking—whether through stars, badges, or progress bars—can serve as a motivating and rewarding element in VR game design.

Overall Insights

Overall, the findings from across the six countries reveal a high level of enthusiasm for VR as both an exciting and useful tool for motor skill development. Children consistently emphasized the importance of colorful, musical, rewarding, and safe experiences, while clearly rejecting violent or frightening content. They expressed motivation to improve their balance, rhythm, and coordination, and saw VR as a fun way to achieve this. For VR to be effective, it must be customizable to different abilities, provide positive reinforcement, and offer variety in game design, while always ensuring emotional and sensory safety.

4. 5 Teachers' and Students' Perspectives

Shared Enthusiasm for Movement

Both teachers and students across all partner countries emphasized the importance of movement and physical activity. Teachers described motor coordination as a fundamental challenge for children with special educational needs, noting difficulties in fine motor skills, balance, and hand–eye coordination. Students, meanwhile, expressed strong enjoyment of sports and games that involve movement, with the majority saying they liked or loved active play. This shared appreciation suggests that VR-based movement activities would be welcomed by both educators and learners as a motivating way to address motor challenges.

Familiarity with Technology and VR

Teachers and students alike reported limited prior experience with VR. Among educators, most had never used VR in practice, although some had experimented with related technologies like Wii or Kinect. Students showed slightly higher exposure, particularly in Greece and Romania, where more than half had tried VR at least once. Despite these differences in familiarity, both groups were optimistic about VR's potential. Teachers saw it as a promising complement to traditional methods, while students described it as fun, exciting, and appealing for learning new skills.

Motor Skills: Needs and Priorities

Teachers consistently identified balance, body awareness, bilateral coordination, and fine motor control as priority areas for development. Students confirmed these difficulties from their own perspective, frequently mentioning balance, rhythm, and coordination as tricky or frustrating. At the same time, students expressed confidence in simpler tasks such as running, walking, and catching balls, aligning with teachers' observations that gross motor activities are more accessible than fine or complex skills. This overlap highlights that both groups agree on where VR could have the greatest impact: supporting balance, rhythm, and coordination.

Game Design: What Works

Teachers and students shared similar views on what makes learning and play engaging. Both groups emphasized the importance of bright visuals, music, rewards, simple instructions, and friendly characters in sustaining motivation. Teachers saw these features as tools for personalization and positive reinforcement, while students described them as essential elements of fun. Both groups also recommended short, varied sessions to avoid fatigue, as well as adjustable difficulty levels to match individual abilities.

Concerns and Cautions

Caution was another area of overlap. Teachers and students were united in rejecting violence, frightening content, and loud or overwhelming sounds in VR games. Teachers added concerns about cost, lack of training, and technical reliability, while students focused more on emotional safety and comfort, asking for pause buttons, adult presence, and calm environments. Together, these perspectives underline the dual need to ensure both practical feasibility for educators and emotional security for learners.

Desired Outcomes

Teachers envisioned VR as a way to support skill development, inclusion, confidence, and autonomy. Students echoed these goals indirectly, by expressing their desire to get better at moving, playing, and balancing, and by asking for progress tracking to visualize their improvement. Both groups valued feedback and reinforcement, though students emphasized rewards and achievements, while teachers stressed measurable progress and educational outcomes.

Overall Alignment

Overall, the perspectives of teachers and students converged on several key points: VR should be engaging, supportive, safe, customizable, and motivating. Both groups recognized its potential to address challenges in motor coordination and enhance learning, provided that barriers such as cost, training, and design are overcome. Where they diverged was in emphasis: teachers highlighted structural challenges and the need for training and infrastructure, while students focused more on fun, creativity, and safety.Taken together, these insights point to the importance of designing VR tools that meet educational goals while also honoring the voices of children as end-users.

4.6 Conclusion and Recommendations

The cross-country surveys and interviews with teachers and students provide a comprehensive understanding of the potential role of Virtual Reality (VR) in supporting motor skill development for children with special educational needs. Despite differences in educational systems, cultural contexts, and prior exposure to technology, a remarkable level of consensus emerged across the seven participating countries.

Teachers consistently emphasized the importance of addressing motor coordination challenges such as balance, body awareness, bilateral coordination, and fine motor control. They saw VR as a promising tool for making learning engaging, adaptable, and safe, while also acknowledging systemic barriers, including high costs, lack of training, and technical limitations. Their insights highlight both the opportunities and the structural challenges associated with introducing VR into schools and therapy settings.

Students echoed many of these points from their own perspectives. They expressed strong enthusiasm for movement and sports, coupled with clear motivation to improve their skills through play. Across all six student surveys, children emphasized the appeal of colorful visuals, music, rewards, and friendly game environments, while consistently rejecting frightening or violent content. Importantly, they stressed the need for safety, comfort, and emotional reassurance, underlining that VR must balance stimulation with security.

Taken together, the perspectives of educators and learners reveal a shared vision: VR should be a motivating, inclusive, safe, and customizable tool that complements existing practices while addressing specific motor challenges. The findings suggest that if thoughtfully designed and responsibly implemented, VR could play a transformative role in enhancing both the educational and therapeutic experiences of children with special needs.

Based on the findings, several recommendations can guide the future development and implementation of VR in this field:

Start with Pilot Programs

Small-scale pilot projects in schools and therapy centers should be developed to test VR applications in real-life contexts. These pilots should include both teacher training and student feedback to refine the design and ensure practical feasibility.

Invest in Training and Support

Teachers and therapists require comprehensive training in how to use VR effectively. Ongoing technical support should also be available to ensure confidence and prevent disruptions.

Prioritize Safety and Accessibility

VR environments must be designed to avoid overstimulation, frightening content, or complex navigation. Safety features such as pause buttons, clear instructions, adjustable sensory settings, and adult supervision should be standard.

Emphasize Customization and Flexibility

Games should offer adjustable difficulty levels, pacing options, and sensory controls to accommodate diverse needs. Flexibility is essential to ensure that VR is inclusive of different abilities and preferences.

Integrate Feedback and Progress Tracking

Both teachers and students value feedback. VR systems should include simple but motivating progress-tracking features—such as stars, badges, or progress bars—while also allowing educators to monitor outcomes in a structured way.

Design for Engagement and Fun

To maximize motivation, VR applications should incorporate features identified by students as enjoyable: bright visuals, lively music, rewards, friendly characters, and imaginative game scenarios. The design should balance fun with educational goals, ensuring that activities remain purposeful while sustaining student interest.

Ensure Affordability and Equity

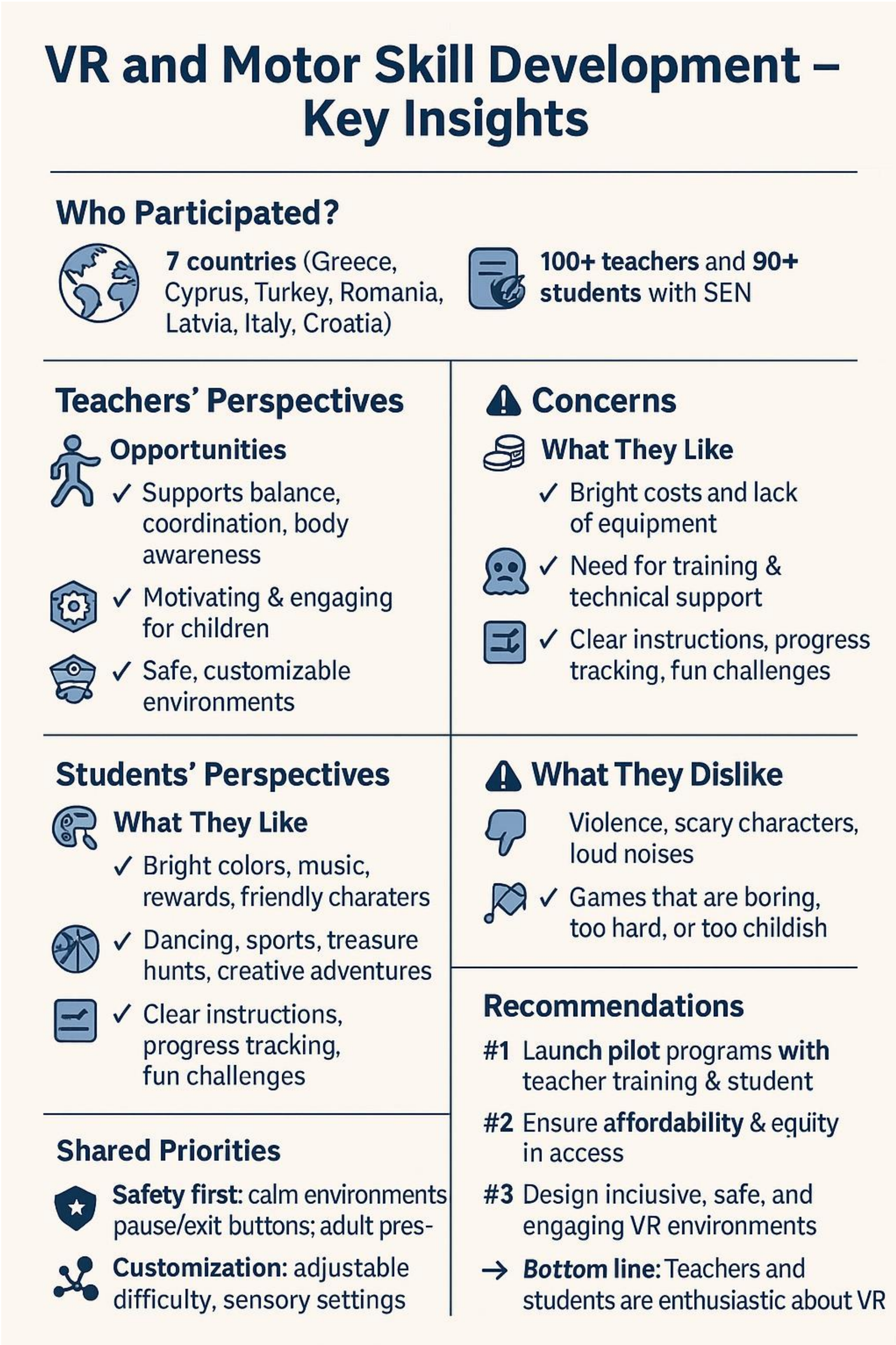
Policymakers and institutions should work to address cost barriers, ensuring that VR tools are not restricted to well-funded schools or therapy centers. Collaborative projects, shared resources, and public–private partnerships could support wider access.

Bridge VR and Real-World Application

To ensure transferability, VR tasks should be designed to link directly with real-life activities—such as balance exercises, sports, or self-care routines. Blending virtual and physical practice will increase the likelihood of meaningful skill development.

Final Reflection

The perspectives gathered in this study underscore both the promise and the responsibility that comes with integrating VR into special education. Teachers bring expertise on structural needs and long-term outcomes, while students bring authentic insights into what makes learning fun, safe, and motivating. By valuing both voices equally, VR can evolve into a tool that not only strengthens motor skills but also fosters confidence, inclusion, and joy in learning.


VR and Motor Skill Development – Key Insights
Who Participated?
7 countries (Greece, Cyprus, Turkey, Romania, Latvia, Italy, Croatia)
100+ teachers and 90+ students with SEN
Teachers' Perspectives
Opportunities
✓ Supports balance, coordination, body awareness
✓ Motivating & engaging for children
✓ Safe, customizable environments
Concerns
What They Like
✓ Bright costs and lack of equipment
✓ Need for training & technical support
✓ Clear instructions, progress tracking, fun challenges
Students' Perspectives
What They Like
✓ Bright colors, music, rewards, friendly charaters
✓ Dancing, sports, treasure hunts, creative adventures
✓ Clear instructions, progress tracking, fun challenges
What They Dislike
Violence, scary characters, loud noises
✓ Games that are boring, too hard, or too childish
Shared Priorities
Safety first: calm environments pause/exit buttons; adult pres-
Customization: adjustable difficulty, sensory settings
Recommendations
#1 Launch pilot programs with teacher training & student
#2 Ensure affordability & equity in access
#3 Design inciusive, safe, and engaging VR environments
→ Bottom line: Teachers and students are enthusiastic about VR

Chapter 5: Curriculum Analysis of VR-based Workouts across partner countries

5.1 Introduction

The integration of Virtual Reality (VR) into education has opened new possibilities for enhancing learning experiences, particularly for children with special educational needs (SEN). As an immersive technology, VR allows learners to interact with realistic, simulated environments that can be adapted to their individual abilities and goals. In the context of special education, this adaptability is especially valuable, as it creates safe, engaging, and customizable spaces where students can develop essential skills without the risks or limitations often associated with real-world settings.

Motor skill development is a critical area where VR demonstrates significant potential. Both fine motor skills, such as grasping, writing, or buttoning clothes, and gross motor skills, including walking, balancing, or participating in sports, are fundamental to fostering independence, physical health, and social participation. For many children with disabilities, however, acquiring these skills through traditional methods alone can be challenging. VR provides an innovative alternative by offering repeated, motivating, and interactive practice opportunities tailored to each student's pace and needs.

Beyond supporting physical development, the benefits of VR extend to cognitive and social-emotional growth. Engaging in VR-based activities requires coordination, planning, and problem-solving, thereby strengthening cognitive functioning. Moreover, the sense of achievement that comes with mastering virtual tasks can build self-esteem, encourage social interaction, and increase motivation to participate in both academic and recreational contexts.

This chapter not only explores the role of VR in supporting SEN students but also situates it within the broader framework of physical education and motor development. Specifically, it addresses the following questions:

Objectives: What are the current goals of physical education and motor development for SEN students in this country?

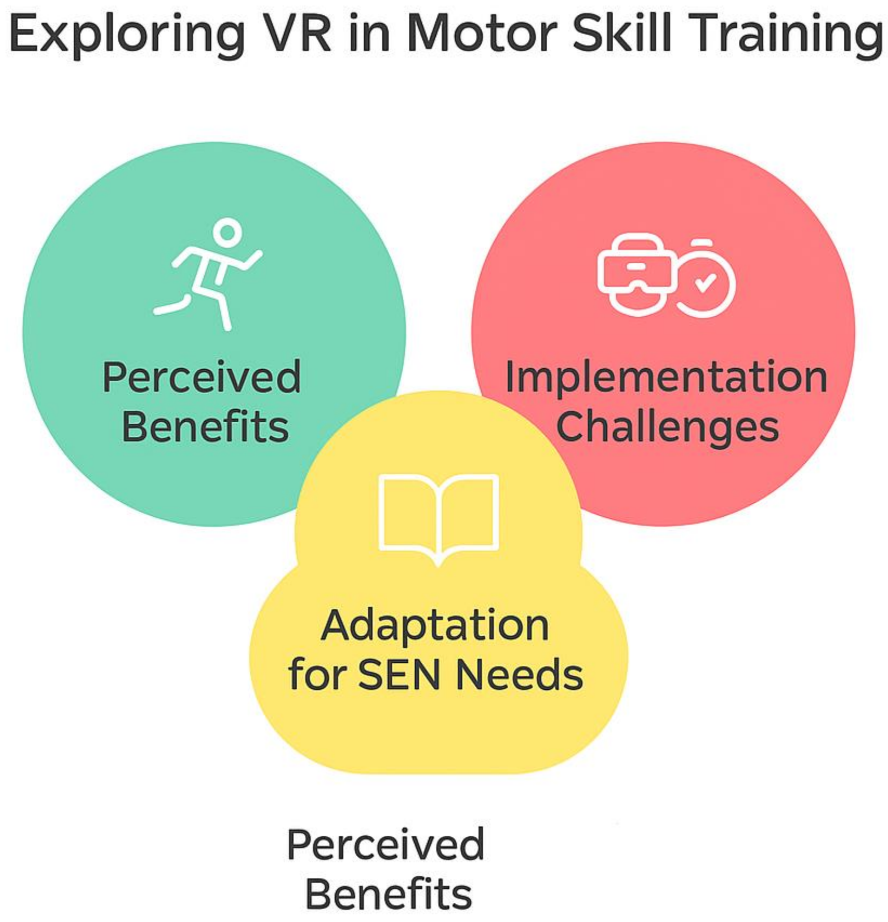
Physical Activities and Practices: What types of exercises, games, or strategies are commonly used, and are there structured guidelines for improving coordination, balance, strength, and other skills?

Adaptations and Inclusion Strategies: How is the curriculum modified for children with disabilities or coordination difficulties, and what role do assistive tools or differentiated instructional methods play?

Emerging Technologies: To what extent is VR or similar technology being integrated into physical education, therapy, or SEN programs, and what benefits or challenges are associated with its use?

Relevance to the VR Workout Project: How can insights from current practices inform the design of VR-based workouts? Which activities or strategies could be adapted, what features might improve accessibility and engagement, and where might VR fill existing gaps in the provision of physical education for SEN students?

By framing the discussion around these guiding questions, this chapter aims to demonstrate both the current state of SEN motor development practices and the transformative potential of VR as a tool for empowering children with special needs. It will also highlight opportunities for innovation, ensuring that emerging technologies like VR are leveraged to meet the diverse physical, cognitive, and social needs of SEN learners in ways that are contextually relevant and culturally responsive.



5.2 Curriculum analysis

5.2.1 Greece (Directorate of Protobathmia Ekpaidefsi Fthiotidas and Primary Special Education School of Lamia)

Objectives of Physical Education for Students with SEN

Within Greece's inclusive education framework and the Adapted Physical Education (APE) curriculum, Physical Education for students with Special Educational Needs (SEN) prioritizes inclusion and participation, ensuring equal opportunities through adapted, familiar activities that build a sense of belonging. It emphasizes the development of gross and fine motor skills—balance, coordination, agility, and strength—based on each child's developmental profile. Improving physical fitness (strength, flexibility, endurance, and cardiorespiratory health) and nurturing lifelong physical activity habits go hand-in-hand with goals for cognitive and social-emotional skills such as attention, memory, sequencing, teamwork, communication, and self-regulation. All instruction is individualized to the student's IEP, overseen by EDEAY (Multidisciplinary Educational Teams), and supported by assistive technologies and adapted equipment to maximize accessibility.

Activities and Practices

Teaching includes gross motor activities such as jumping, running, hopping, crawling, and climbing, along with fine motor exercises like threading, ball handling, and hand–eye coordination games. Play-based formats are used (obstacle courses, passing games, balance and orientation tasks), as well as music-and-movement with dance, rhythm, and movement to music. Therapeutic approaches include gymnastics for neuromotor challenges and, where available, hydrotherapy. Equipment is adapted (larger/lighter balls, textured materials, floor markers, balance aids), and learning tools are used such as busy books, social stories, visual schedules, and pictograms. Motor development is guided by IEP targets and evidence-based practices. PE teachers are trained through TEFAA/DPESS (Departments of Physical Education & Sport Science), drawing on frameworks like Dynamic Systems Theory (motor learning) and Task-Oriented Practice (motor control, sequencing, and adaptation).

Adaptations and Inclusion Strategies

Curriculum content is modified with individualized outcomes tailored to students' cognitive and motor abilities, and activities are broken into small steps with frequent repetition and visual/tactile prompts. Peer-assisted activities are encouraged to promote inclusion and cooperation. Differentiated communication supports (pictograms, gestures) and specialized equipment with tactile markers are employed, with ongoing collaboration from physiotherapists and occupational therapists to shape personalized programs.

Use of VR and Emerging Technologies in SEN Physical Activity

Virtual Reality adoption is in an emerging/pilot phase and is not yet formally embedded in the national curriculum. Nonetheless, pilots and research initiatives exist, such as exergames for Deaf/Hard-of-Hearing adolescents at the University of Thessaly comparing traditional balance training with VR-based games and showing balance improvements. Collaborations between the University of Thessaly and the University of the Aegean explore VR/AR for motor engagement in SEN, and the Hellenic Academy of Physical Education (EAFA) runs pilots with interactive VR games. Therapy centers and NGOs use commercial tools (e.g., FitXR, Tilt Brush, balance exergames), while university VR CAVEs provide research environments for adaptive movement. Reported benefits include increased motivation and participation (especially for students with ASD/ADHD), safe and controlled practice environments, personalization with adjustable difficulty and pacing, immediate feedback for motor correction, a broader range of activities, and targeted sensory training. Challenges include hardware/software cost, infrastructure gaps and unequal access, limited teacher training in immersive tech, risks of sensory overload/dizziness/fatigue, and the absence of national VR curriculum frameworks and evaluation metrics.

Relevance to the "VR Workout" Project

For VR Workout, suitable activities include obstacle navigation, target throwing, and balance walks in gamified environments; rhythm and dance-based motion games (including Greek folk music for cultural familiarity); multiplayer cooperative experiences that build teamwork and socio-emotional growth; and sensory-integration exercises with tunable intensity. To maximize accessibility, the platform should provide adjustable user interfaces (text size, audio, brightness/contrast), alternative input methods (eye-tracking, voice commands, adaptive controllers), guided tutorials with visual and haptic cues, adaptive difficulty that scales with progress, pause/replay options, and gamified reward/progress systems.

Gaps and Opportunities for VR Integration

There is a lack of structured motor-skill interventions in inclusive school settings, which VR can help address by simulating space- or equipment-intensive activities even in small gyms. The absence of SEN-specific VR curriculum in Greece is also an opportunity to develop platforms aligned with IEPs and the legal framework for inclusion.

Cultural and National Considerations

Resource disparities between urban and rural schools affect access. Interfaces must be in Greek and support symbol-based communication for nonverbal students. Cultural relevance—familiar Greek environments, playgrounds, landscapes, and music—can increase comfort and engagement. Teacher training is essential for sustainable VR integration, and strong family involvement in SEN education should be actively supported. Above all, social inclusion remains a core aim: VR should strengthen collaboration and community, not just individual engagement.

Conclusion

In Greece, physical activity for students with SEN focuses on inclusion, motor development, health, and social-cognitive skills through adapted practices and individualized planning. Virtual reality and exergames are promising—but still emerging—avenues that can address gaps in resources, accessibility, and motivation. When designed to align with Greek cultural contexts, inclusive education law, and SEN-specific needs, immersive technologies can become a valuable complement to Adapted Physical Education.

5.2.2 Romania (INSPECTORATUL ȘCOLAR JUDEȚEAN HUNEDOARA)

Objectives of Physical Education for SEN Students

Romania's PE and motor-development goals for students with Special Educational Needs align with the national curriculum and international inclusion standards, and are individualized through IEPs overseen by CJRAE/CMBRAE. The focus is on tailored motor development—enhancing gross and fine motor skills according to each student's physical and cognitive profile—while promoting health and physical wellbeing by encouraging active lifestyles that improve fitness and prevent secondary issues such as obesity and poor posture. Social integration is cultivated through teamwork, cooperation, empathy, and communication in group and paired activities. Cognitive and emotional growth is supported via structured movement that bolsters attention, memory, sequencing, and self-regulation. Above all, the national PE curriculum is adapted to each IEP to ensure full participation in inclusive school environments.

Physical Activities and Practices Used

Instruction blends a wide range of gross-motor activities—walking, running, jumping, animal walks, obstacle courses, ball play, line or balance-beam walking, and dance or rhythmic games—with fine-motor tasks such as threading, playdough/clay modeling, pegboards, tweezer work, tracing/drawing, and clothespin activities. Motor development is guided by structured, adapted IEP targets: goals are measurable (e.g., “maintains balance on one foot for 10 seconds”), responsive to functional capacity, diagnosis, and cognitive level, and emphasize coordination, balance, flexibility, and strength. Frequency and duration are individualized, and delivery involves specialist staff—physiotherapists, psychomotor specialists, and adapted PE teachers.

Adaptations and Inclusion Strategies

Curricular adjustments range from adapted content (the same goals taught with modified pace, repetition, and methods) to modified content (simplified or alternative tasks emphasizing functional motor skills over performance). Modifications span content (e.g., rolling a ball rather than aiming at a target, or focusing on movement quality), methodology (multisensory instruction with visual, auditory, and tactile cues; task analysis; step-by-step progression), materials/tools (larger or textured balls, tactile floor markers, lightweight paddles, balance aids), time/environment (extended time, calm and predictable settings, reduced distractions), and assessment (progress, effort, and participation rather than national standards). Differentiation leverages motor supports (large-grip balls, balance boards, adapted bats, tactile markers, visual timers), physical supports (walkers, adapted wheelchairs, postural equipment, weighted vests, compression garments), and instructional methods such as task simplification with gradual progression, visual supports (pictograms, photo cards, demo videos), tiered activities across three difficulty levels (imitation → structured task → independent play), peer-assisted learning, and multisensory approaches that combine music, movement, symbols, and gestures.

Use of VR and Emerging Technologies in SEN Physical Activity

VR adoption is emerging in Romania, with limited but growing use in therapy and special-education centers, and is not yet mainstream in public schools due to cost and infrastructure constraints. Examples include Asociația Help Autism (Bucharest), which uses VR for ASD therapy focused on social interaction role-play and sensory exposure to reduce anxiety and improve social-emotional learning; research at Babeș-Bolyai University (Cluj-Napoca) exploring VR for ADHD and motor coordination (attention control, reaction time, balance training) with findings of higher engagement and improved motor control compared to traditional tasks; and private therapy clinics (e.g., KinetoBebe, Provita) offering VR kinesiotherapy for cerebral palsy and developmental delays using VR balance boards and real-time motion-capture games to create motivating sessions.

Benefits and Challenges of VR Adoption

Benefits include high engagement that makes repetitive exercises enjoyable—especially for ASD, ADHD, and DCD—safe, controlled practice of real-world tasks (stairs, street crossing), personalized learning via adjustable difficulty, pacing, and sensory inputs, rich multisensory stimulation, and improvements in balance, postural control, and hand–eye coordination. Challenges center on high equipment and maintenance costs, limited teacher training in VR operation, SEN adaptation and safety, infrastructure barriers (space, Wi-Fi, technical setup), gaps in Romanian-language and culturally relevant content, and equity issues that make VR more accessible in private centers than in public schools. Relevance to the VR Workout Project

A Romania-aligned VR Workout should feature obstacle navigation, balance training, and interactive movement games; multisensory exercises that combine music, visuals, and haptics; and cooperative multiplayer modules that build social interaction and teamwork. Accessibility can be enhanced with customizable sensory intensity (brightness, sound, vibration), alternative input methods (eye-tracking, adaptive controllers, voice commands), step-by-step guided tutorials with pause/replay, adaptive difficulty algorithms, and gamified feedback and rewards.

Gaps and Opportunities for VR Integration

The near-absence of teacher training in VR integration presents an opportunity to develop targeted modules for adapted PE teachers and therapists. The scarcity of culturally relevant apps invites the creation of Romanian-language VR content aligned with the national curriculum and SEN IEPs. Infrastructure limitations in public schools argue for piloting affordable, portable VR kits in inclusive classrooms and expanding to rural areas as capacity grows.

Cultural and National Considerations

Romanian-language content is essential for accessibility, and culturally familiar environments—parks, schools, playgrounds—can increase comfort and relevance. Resources are concentrated in urban areas, leaving rural schools underserved, so equitable rollout matters. Pre-service teacher programs rarely cover VR, making professional development critical. Finally, NGOs and families play a central role in SEN education and should be engaged in design, implementation, and evaluation.

Conclusion

Romania's PE approach for SEN students emphasizes individualized motor development, health, social integration, and adapted inclusion through IEP-driven instruction. VR is at an early stage—mostly in private centers and research—but shows clear promise for boosting engagement, safety, and skill development. With educator training, affordable infrastructure, and Romanian-language, culturally aligned content, VR can substantially enhance adapted PE and therapy for SEN learners across Romania.

5.2.3 Latvia (Private school "Gaismas tilts 97")

Objectives of Physical Education for SEN Students

In Latvia, the physical education curriculum for students with severe intellectual and developmental disabilities focuses on health, functional development, and social inclusion. Core aims are to maintain and improve health and fitness; develop gross and fine motor abilities alongside coordination, balance, flexibility, and strength; and build everyday movement and self-care skills. Instruction also targets cognitive growth—attention, memory, sequencing, and problem-solving—through movement-based learning, while nurturing positive attitudes toward physical activity and lifelong participation. Group work promotes cooperation, communication, and social integration. Support is individualized through corrective and adaptive strategies guided by each learner's IEP, and PE content is frequently integrated with other subjects such as music, art, and daily living skills.

Physical Activities and Practices Used

Programs draw on basic movements like walking, running, crawling, jumping, and stair climbing, with coordination and balance tasks such as beam walking, single-leg stance, and eyes-closed walking. Strength and flexibility are addressed through stretching and developmental exercises using balls, hoops, sticks, and light dumbbells. Motor games include relays, imitation tasks, and object passing and collecting, while simplified sport elements adapt basketball, football, floorball, badminton, and aerobics. Sensory-motor play features bouncing and rolling balls and tactile exploration with sand, beans, and sponges; music and rhythm are woven in through dancing, clapping games, and rhythmic walking to songs. Relaxation and breathing work—guided breathing, calming stretches, and quiet routines—helps with regulation. Motor development emphasizes multisensory, functional learning with textured objects, temperature contrasts, and varied consistencies (water, sand, fabrics); object manipulation (grasping, threading, pouring, stacking, sealing containers); passive movement therapy; sensory equipment such as swings, hammocks, and trampolines; massage with rough/smooth textures; and the use of musical instruments and singing to support rhythm, timing, and coordination.

Adaptations and Inclusion Strategies

Curriculum is organized by levels rather than fixed grades so that expectations match ability rather than age, and teachers adjust pacing, sequencing, and repetition for each learner. Students with mobility impairments may substitute therapeutic exercise under specialist guidance. Play-based methods predominate to keep lessons engaging and developmentally appropriate. Differentiation relies on assistive tools—mats, textured balls, tunnels, trampolines, balance boards, cones, buckets, and a range of sensory items—plus visual supports like photos, pictograms, and symbols for instructions. Teaching methods include modeling, imitation, small-group or one-to-one work, sensory integration techniques, and music, with flexible participation that permits passive involvement or gradual activation depending on health and energy.

Use of VR and Emerging Technologies in SEN Physical Activity

VR integration in Latvia is emerging, first through therapy and rehabilitation and increasingly into education and SEN contexts. Examples include Mirror Therapy on Meta Quest 2 (developed by Mārcis Kalniņš, Anete Savicka, and Maksims Ivanovs) using mirrored hand movements and tasks such as a “Buzz Wire” game to retrain coordination; Virtual Reality Therapy adopted by physiotherapists and occupational therapists to simulate real-life tasks like cutting, washing, brushing teeth, and driving, with a focus on mobility, balance, posture, and cognitive rehab; and ClassVR, distributed by Insplay and Tomega, used in schools and STEAM labs for immersive, hands-on learning. Vaivari Rehabilitation Centre employs MiraRehab, a Kinect-based therapy platform that turns exercises into interactive games and tracks movements without handheld controllers. Multisensory rooms such as “Slaugivita” combine light, sound, and tactile input to support relaxation, emotional regulation, and sensory integration. Reported benefits include higher motivation and engagement, support for mobility, balance, strength, posture, and coordination, enhanced mood and cognitive functions, realistic task simulation, and safe, repeatable practice. Challenges involve possible side effects (disorientation, nausea, headaches, dizziness, eye strain) that limit sessions to roughly 20–45 minutes, along with technical and financial barriers, staff training needs, and a shortage of SEN-specific VR teaching materials in Latvian.

Relevance to the VR Workout Project

A VR Workout for Latvia's SEN learners should offer music- and rhythm-based movement tasks paired with breathing control, social interaction modules such as synchronized group movements, and functional tasks—stacking, collecting, and balance walking—within clear, gamified settings. Relaxation and guided breathing in calming virtual environments can aid regulation. Accessibility features should include adaptive difficulty (speed, range of motion, duration), a simple, low-clutter interface, immediate positive feedback, and options for step-by-step guidance, repetition, and adjustable pacing.

Gaps and Opportunities for VR Integration

Key gaps include limited SEN-specific VR resources and teacher training in Latvia, creating an opportunity to build localized, Latvian-language platforms that can be easily adapted to other languages. Because harsh autumn-to-spring weather restricts outdoor play, VR can provide indoor alternatives for active movement and exercise.

Cultural and National Considerations

Long, cold winters make indoor activity solutions particularly valuable, reinforcing the case for VR. Platforms should be available in Latvian and support symbols and visual communication aids. Given Latvia's strong reliance on IEPs and level-based learning, VR systems should enable individualized progression. Resource disparities between urban and rural schools must be considered, and design should reflect Latvia's inclusive practices where play, music, and rhythm are central to SEN PE.

Conclusion

Latvia's SEN physical education emphasizes health, functional mobility, daily living skills, and inclusion, with sensory and rhythm-based approaches playing a major role. VR is at an early stage in therapy and education but shows strong potential to expand adapted physical activity. With Latvian localization, careful session management, and culturally aligned methods—music, play, and sensory engagement—VR can substantially broaden opportunities for SEN students, especially as an indoor exercise option during long winters.

5.2.4 Italy (Igor Vitale International)

Objectives of Physical Education for SEN Students

Italy operates a fully inclusive education system: students with Special Educational Needs (SEN) pursue the same PE objectives as their peers, with individualized adjustments where needed. Since the 1970s, the country has abolished separate special schools, achieving near-universal inclusion. Within the national curriculum (Indicazioni Nazionali; MIUR/MIM, 2011–2025), PE targets motor development (gross/fine coordination, balance, strength, flexibility, laterality), body awareness (body schema, spatial orientation, movement control), healthy habits (lifelong activity and wellbeing), and inclusion and social skills (cooperation, peer interaction, teamwork). PE is framed as a driver of holistic growth—cognitive, affective, and social. Equity is ensured through *individualizzazione* (same goals via adapted pathways) or *personalizzazione* (different goals where appropriate), guided by the philosophy that the body is a fundamental mode of being in the world and central to dignity, autonomy, and participation.

Physical Activities and Practices Used

Practice spans fundamental movement skills (running, jumping, throwing, catching), games and sports (ball games, relays, gymnastics, athletics, dance), and coordination/balance work (obstacle courses, beam walking, adapted team games). Exploratory psychomotor play includes crawling, animal imitations, and soft-object play. Adapted sports are integral: Baskin (inclusive basketball with role-matching and multiple baskets), sitting volleyball, and torball/goalball for visually impaired learners. Motor development follows national guidance on bilateral integration, postural control, flexibility/mobility, and functional strength, with teachers using task analysis and progressive challenges (e.g., shorter throws, simplified dance steps) so tasks remain within everyone's reach.

Adaptations and Inclusion Strategies

PE is delivered in inclusive classes, never separately, with individualized education plans (PEI) specifying goals and accommodations. Multi-level task design lets students work on the same skill at varied difficulty (short vs. long throws; simple vs. complex choreography). Support teachers (*Insegnanti di Sostegno*) collaborate with PE teachers, while peers act as buddies (pushing a wheelchair, guiding a visually impaired classmate). Instruction is differentiated through step-by-step modeling, simplified rules, visual cues, and adjusted pacing. Assistive tools include sound-emitting balls, adapted tricycles/scooters, ramps, balance boards, grip aids, and communication devices, alongside environmental adjustments (ramps, color contrasts, safe play zones). The guiding principle is barrier removal—physical, sensory, and cognitive—so all students can participate meaningfully.

Use of VR and Emerging Technologies in SEN Physical Activity

VR adoption is emerging through pilot projects and rehabilitation contexts, supported by digital-innovation initiatives such as Piano Scuola 4.0 and the PNRR. While not yet mainstream in schools, VR is used in centres and school–university trials. Notable examples include IRCCS Medea's AstroLab (VR and robotics for gamified motor rehab), Fondazione Don Gnocchi's "Nirvana" semi-immersive room (motion-sensor therapy with personalized games), Erasmus+/EU-funded school exergaming pilots, and AR tools like tablet-based scavenger hunts or interactive dance apps. Reported benefits include high motivation, safe and repeatable practice, individual pacing with instant feedback, expanded access to simulated sports, and data tracking for IEPs. Challenges involve cost, limited teacher training, accessibility of headsets/controllers, risks of cybersickness or sensory overload, alignment with curriculum, and regional infrastructure disparities.

Relevance to the VR Workout Project

A VR Workout aligned with Italy's approach could translate Baskin into VR (multiple roles/baskets with peer cooperation), offer balance and coordination games (virtual beams, rhythm-based dance), and simulate inclusive sports (e.g., skiing, rowing, athletics) adapted for SEN users. To support accessibility and inclusion, it should prioritize multiplayer/cooperative modes, universal input options (eye gaze, single-switch, voice), adjustable sensory settings (sound, brightness, background), real-time feedback with progress tracking, and AR integrations that let entire classes participate together.

Gaps and Opportunities for VR Integration

Current gaps include limited personalization in crowded classes, engagement challenges for some learners with cognitive/attention needs, exclusion risks for students with mobility limitations, and a lack of objective, trackable PE data. VR presents opportunities to deliver tailored, adaptive exercise without constant 1:1 teacher presence, gamify repetitive motor practice, open virtual sports experiences to mobility-limited students, and generate quantitative performance data for IEP monitoring.

Cultural and National Considerations

Support teachers are central to Italy's inclusion model and must be involved in VR design, rollout, and training. Regional disparities (north/south; urban/rural) mean solutions must be affordable and scalable. Legal mandates (Law 104/1992; D.lgs 66/2017) require equal participation, so VR should be integrated into shared PE rather than isolated SEN-only activities. Because Italian PE emphasizes socialization and peer interaction, VR should avoid isolating learners and complement, not replace, real-world activity—reflecting schools' cautious approach to digital tools.

Conclusion

Italy's inclusive PE system sets shared motor-development goals for all students, with individual pathways and supports ensuring access. VR is gaining traction in rehabilitation and pilots, showing strong potential for motivation, safety, personalization, and data-informed practice. To succeed in Italian schools, VR workouts must foreground inclusion and cooperation, comply with legal and cultural expectations, and address training and infrastructure gaps.

5.2.5 Croatia (Centre for Autism, Rijeka)

Objectives of Physical Education for SEN Students

Croatia's Physical and Health Education (TZK) for students with special educational needs centers on body awareness and functioning—helping learners understand their bodies, capabilities, and limits—while promoting lifelong physical activity for health preservation and improvement. The curriculum supports harmonious growth and development through posture, motor-skill acquisition, and overall physical development, alongside academic and social benefits such as improved learning, work capacity, and personal and social skills. A key priority is guiding students with disabilities toward appropriate sports and structured physical activities. The overarching aim is to cultivate motor literacy, well-being, and a positive attitude to movement while respecting each student's unique abilities.

Physical Activities and Practices Used

Programs emphasize elementary motor exercises—walking, running, hopping, jumping, throwing, catching, climbing, descending, crawling, rolling, and skipping—complemented by recreational and outdoor experiences like simple hiking, snow and water games, and orienteering. Daily-life application is a throughline: students are encouraged to use learned skills to improve quality of life and maintain health. For SEN learners, activities are tailored to individual capacity and directed toward suitable sports and programmed physical activity. Motor development guidelines focus on improving coordination, balance, strength, and flexibility via kinesiotherapy and targeted training; building functional capacity while respecting personal limits; maintaining the locomotor system; and reinforcing healthy habits such as balanced work–rest, everyday movement, and hygiene/safety practices.

Adaptations and Inclusion Strategies

Curriculum modifications privilege simple, accessible exercises and teach students to recognize the value of breaks and appropriate pacing for both exercise and study. Natural, everyday movements are practiced and then transferred to sports and recreation settings. Teaching is individualized and flexible, with student-centered goals, strategies, scope, depth, and assessment adapted to each learner's abilities. Holistic development is embedded—interpersonal skills, fair play, social inclusion, teamwork, critical and creative thinking, self-concept, and decision-making. Assistive support prioritizes adapted instruction and individualized scaffolding over specialized devices, while tools such as cameras or motion-detection systems can be used to track movement. Environmental and procedural adjustments are emphasized to maximize engagement and safety.

Use of VR and Emerging Technologies in SEN Physical Activity

VR adoption status is not currently integrated into standard PE, therapy, or SEN programs. The ClassVR platform exists across subjects and could be adapted for motor tasks, but it is not widely used in PE. Potential benefits include higher motivation, engagement, and objective movement tracking via cameras; challenges include sensory hypersensitivity that may lead some students to refuse VR and the need for guidance to navigate VR interfaces.

Relevance to the VR Workout Project

A Croatia-aligned VR Workout could translate simple motor games—walking, running, hopping, jumping, throwing, catching, climbing/descending, crawling, rolling, and skipping—into safe, guided virtual tasks. It can also simulate outdoor and recreational activities (hiking, snow and water games, orienteering) and enable practice of exercises otherwise difficult to offer due to material, technical, or safety constraints (e.g., skiing, diving, high jump). Features that improve accessibility and motivation include focused, low-distraction environments; novelty that boosts engagement; and safe simulations for inherently risky activities.

Gaps and Opportunities for VR Integration

Current gaps include infrastructure and safety limits that constrain many physical activities, difficulty delivering fully individualized motor exercise in larger classes, and minimal use of technology for engagement or progress tracking. VR offers opportunities to simulate otherwise inaccessible activities, deliver individualized, safe, and motivating motor training for SEN students, and collect movement data and feedback to support teachers in monitoring progress.

Cultural and National Considerations

Croatian schools often face material constraints, with limited budgets for equipment and facilities, and there is a need for teacher training to implement technology-based interventions. Sensory sensitivities are common among some students, requiring careful VR design and opt-in usage. Above all, inclusion remains central: instruction is individualized and student-centered, and any VR use should complement—never replace—the social and cooperative dimensions of PE.

Conclusion

Croatia's SEN PE emphasizes motor literacy, functional capacity, healthy habits, and holistic development through flexible, student-centered teaching. While VR is not yet implemented in standard practice, it holds clear potential to simulate hard-to-access activities, increase engagement, and provide safe, individualized motor practice. Realizing this potential will depend on addressing resource constraints, investing in teacher training, and designing sensory-aware, inclusive experiences that enhance—not substitute—the social heart of physical education.

5.3 Comparative analysis

A deeper analysis of the physical education (PE) curricula for students with special educational needs (SEN) across Greece, Romania, Latvia, Italy, and Croatia reveals not only structural and methodological commonalities but also the nuanced ways in which national policies, cultural contexts, and resource availability shape practice.

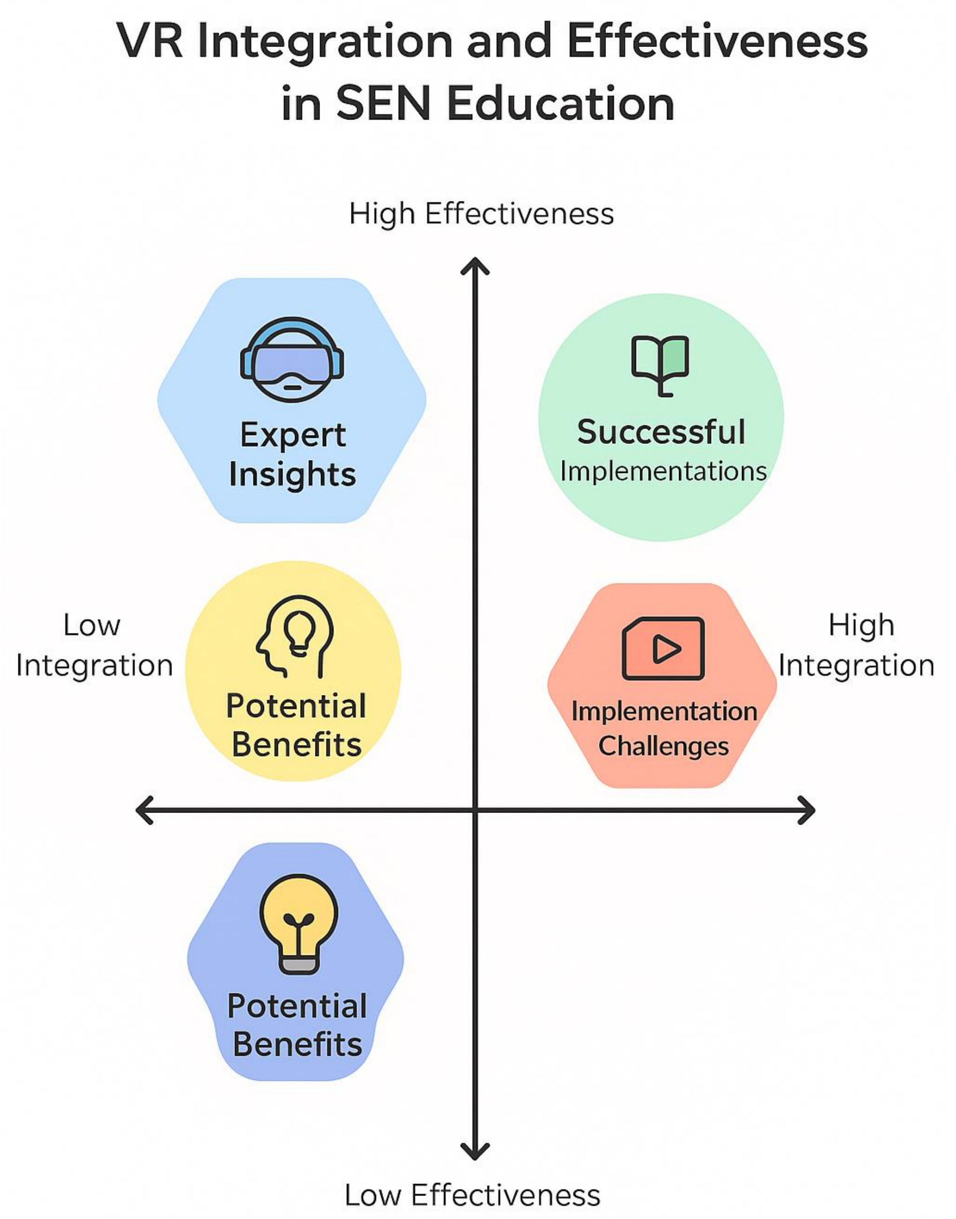
A key similarity across all five countries is the recognition of PE as a multidimensional tool for SEN students. Each curriculum emphasizes the development of motor skills, physical health, and social-emotional growth, reflecting a shared understanding that physical education is not merely a physical activity but a medium for holistic development. All five countries employ individualized approaches—through IEPs or differentiated instruction—to tailor activities to students' abilities, ensuring that each child can participate meaningfully. Play-based and multisensory strategies are also commonly applied, demonstrating a consensus that engagement and enjoyment are critical to effective motor learning for children with disabilities.

However, closer analysis reveals that the scope and sophistication of inclusion and adaptation vary substantially. Italy stands out for its fully inclusive philosophy, which integrates SEN students into mainstream PE classes and employs innovative adapted sports such as Baskin, sitting volleyball, and torball. These activities explicitly foster collaboration between disabled and non-disabled students, promoting both social inclusion and skill development. Latvia, in contrast, emphasizes corrective and therapeutic exercises embedded within daily tasks and sensory-motor activities, showing a strong link between PE and functional, daily-life competence. Croatia's curriculum is heavily focused on motor literacy and lifelong physical activity, yet its implementation is constrained by material and infrastructural limitations, which may reduce opportunities for diverse or adaptive activities. Greece and Romania prioritize general motor development and health outcomes but display less evidence of specialized adapted sports programs or sophisticated inclusive methodologies.

Emerging technology use, particularly VR, further differentiates the countries. Italy and Latvia have begun exploring VR to enhance engagement, motivation, and individualized training. VR allows students with mobility or cognitive challenges to participate in activities otherwise inaccessible, offering controlled, safe environments with real-time feedback. Italy’s pilot programs highlight immersive experiences that simulate adapted sports, whereas Latvia’s applications focus on sensory-motor development. Croatia, Greece, and Romania have minimal to no VR integration, reflecting both technological and infrastructural barriers. This technological gap underscores a broader pattern: while policy frameworks often advocate inclusion, practical implementation is heavily influenced by resources, teacher training, and national investment in educational innovation.

Finally, cultural and systemic differences shape how PE is conceptualized. Italy’s long-standing legal and cultural commitment to full inclusion of students with disabilities fosters a more proactive approach to integration and adaptation. Latvia emphasizes functional autonomy and daily-life skill development, reflecting an approach rooted in therapeutic education. Croatia highlights practical motor literacy but faces socioeconomic and infrastructural constraints. Greece and Romania, while embracing inclusive principles, show variability in support mechanisms, adaptations, and innovative practices, suggesting regional disparities and differences in professional development opportunities for teachers.

In sum, while the five countries share the overarching goal of developing motor skills and promoting inclusion for SEN students, the degree of curricular sophistication, the use of adapted sports, the integration of emerging technologies, and the influence of cultural and systemic factors create a spectrum of practice. Italy and Latvia represent more advanced, structured approaches to inclusion and individualized support, whereas Croatia, Greece, and Romania demonstrate foundational but resource-limited strategies. These differences highlight both the potential for cross-national learning and the persistent challenges in achieving equitable and fully inclusive physical education for all SEN students.



5.4 Conclusion

In conclusion, while all five countries prioritize motor development, health, and social inclusion for SEN students, significant differences emerge in curricular sophistication, adaptation strategies, and technological integration. Italy and Latvia exemplify advanced inclusive practices and the early adoption of VR, whereas Greece, Romania, and Croatia rely on foundational approaches constrained by resources. These variations highlight both shared goals and the importance of context-specific strategies to ensure equitable and effective physical education for students with special needs.

Chapter 6: Evaluating VR Hardware & Software Compatibility in Institutions across Partners' countries

6.1 Introduction

The purpose of this survey is to systematically collect and analyze data from institutions such as schools, therapy centers, special education organizations, and rehabilitation clinics regarding their current level of virtual reality (VR) adoption. In line with established frameworks on technology acceptance and institutional readiness (e.g., Technology Readiness Index, ICT adoption models), the survey is designed to evaluate both the presence of VR hardware and software and the organizational capacity to integrate immersive technologies into therapeutic or educational practices. A particular emphasis is placed on assessing whether the available technological infrastructure and institutional ecosystems are adequate to support VR-based workouts aimed at enhancing physical coordination in children with special educational needs.

Conducting such an evaluation across partner countries provides a comparative perspective on disparities and commonalities in VR integration within educational and therapeutic environments. Mapping the degree of compatibility and readiness not only identifies infrastructural gaps but also highlights enabling conditions, such as staff expertise, institutional policies, and existing digital strategies, which may facilitate successful adoption. The data gathered contributes to an evidence-based understanding of the feasibility of deploying VR-supported interventions in diverse contexts, ensuring that subsequent program design aligns with institutional capacities and the specific requirements of children requiring specialized support.

6.2 Greece

The survey responses from the Special Education Needs School of Agria, located in Volos, Greece, provide an informative profile of the institution's existing VR infrastructure and practices in relation to supporting children with special educational needs (SEN). As a dedicated special education school, the institution primarily serves students in the primary school age group (7–12 years). Unlike many institutions that remain in the planning stage, this school has already begun implementing VR technologies in its daily practices. Current usage encompasses physical activity and exercise, classroom learning, motor skill development, and cognitive or sensory training, which demonstrates an applied, multi-purpose integration of VR into both pedagogical and therapeutic activities.

In terms of hardware and setup, the school does not currently use mainstream standalone devices such as Oculus/Meta Quest or HTC Vive, but instead relies on VR-compatible mobile devices combined with motion tracking sensors and haptic devices/wearables. This hardware configuration supports PC-based VR systems and mixed setups, allowing for relatively flexible deployments despite the absence of high-end, dedicated head-mounted displays. The availability of a wired LAN connection ensures stable connectivity, although the lack of high-speed Wi-Fi may limit mobile and flexible VR deployment options. Physical space for VR activities is constrained, as sessions are conducted in shared classrooms with limited dedicated space for VR workouts. This limitation is particularly relevant given the needs of SEN students, where safety and movement freedom are critical for motor skill–oriented interventions.

Despite these constraints, the school expresses a strong willingness to adopt new VR workout content specifically designed for motor skill development in SEN learners. The institution favors platforms such as Android/Google Play, reflecting its reliance on mobile VR devices. The openness to integrating new content highlights institutional readiness and interest in expanding VR use, but also underscores the importance of designing content that is accessible, customizable, and adaptable to SEN populations.

The challenges identified by the school resonate with those found in broader literature on technology adoption in SEN contexts. The most pressing barriers include high equipment costs, student safety concerns, and the need for accessibility adaptations to ensure equitable participation. These concerns reflect both financial and pedagogical dimensions, as safety and inclusivity are central to SEN education. Interestingly, unlike many institutions, the school does not identify a lack of technical expertise as a challenge, suggesting that its staff already possess some experience with VR deployment. Nevertheless, the institution emphasizes the importance of staff training, technical support, customizable SEN-friendly content, and equipment recommendations as priority areas for support.

Overall, the case of the Special Education Needs School of Agria illustrates a proactive approach to VR integration in special education, with existing deployments already supporting physical, cognitive, and motor development goals. While infrastructure constraints—particularly limited space and high equipment costs—pose barriers to scalability, the school's willingness to adopt new, tailored VR content demonstrates significant potential for further innovation. By prioritizing staff training, safety protocols, and SEN-focused content development, this institution can serve as a valuable test site for the adaptation and refinement of VR interventions designed to enhance motor coordination and learning outcomes among SEN students.

The survey results from the Unified Special Vocational High School–Lyceum of Lamia, located in central Greece, provide a clear picture of an institution at the planning stage of VR adoption. As a special education school serving secondary-level SEN students (13–18 years old), the institution expresses interest in exploring VR technologies primarily for classroom learning purposes. This orientation reflects a recognition of the pedagogical potential of immersive tools to enhance engagement and learning outcomes in older student populations, while also highlighting a need for further development toward therapeutic or motor skill–focused applications.

In terms of infrastructure, the school has access to Oculus/Meta Quest devices and reports a mixed setup capacity, suggesting the potential for flexible deployment that could accommodate both standalone and PC-linked applications in the future. Available physical spaces for VR use include shared classrooms, which may limit the scope of physical activity–based interventions but remain sufficient for instructional or learning-centered applications. Network infrastructure is supported by a wired LAN connection, ensuring reliable connectivity for VR use, though the lack of reported high-speed Wi-Fi could restrict mobile or flexible applications. At present, no specific VR applications are in use, indicating that the institution is in the early stages of adoption and requires structured guidance for integration.

The institution identifies several critical challenges to VR implementation. These include high equipment costs, lack of technical expertise, limited space, student safety concerns, and software compatibility issues. Taken together, these barriers reflect both infrastructural and human resource limitations, which are common across special education contexts adopting emerging technologies. The absence of accessibility and SEN adaptation concerns in the responses may suggest that such issues have not yet been fully considered, given that implementation has not yet begun.

Despite these challenges, the institution demonstrates a strong willingness to adopt new VR workout content, particularly if it is accessible and aligned with the needs of SEN learners. The school indicates no preference for a specific software platform, which reflects an openness to exploring different ecosystems, but also underscores the need for expert recommendations to ensure cost-effective and sustainable choices.

To overcome barriers, the institution identifies funding and grants, staff training, technical support, ready-to-use workout programs, customizable SEN-friendly content, and equipment recommendations as essential forms of support. This comprehensive list suggests that the school is aware of the multiple layers required for successful VR integration—financial, technical, pedagogical, and content-related.

In conclusion, the Unified Special Vocational High School–Lyceum of Lamia demonstrates a strong interest but limited readiness for VR adoption. While infrastructure is partially in place, significant gaps remain in expertise, space, and content deployment. The school's willingness to adopt VR for SEN students, combined with access to Oculus hardware, makes it a promising candidate for pilot projects. However, successful implementation will depend on securing external funding, investing in staff capacity-building, and ensuring access to SEN-appropriate, modular content that prioritizes safety and accessibility in shared classroom environments.

6.3 Turkiye

The survey conducted with Istanbul University–Cerrahpaşa (Istanbul, Turkey) provides an overview of the institution's current level of readiness and compatibility for implementing virtual reality (VR) interventions in the context of supporting children with special educational needs (SEN). As a university and research center, the institution serves SEN students in the primary (7–12) and secondary (13–18) age groups. Although VR implementation is currently in the planning phase, the institution demonstrates a proactive orientation toward exploring immersive technologies for therapy, rehabilitation, classroom learning, motor skill development, and cognitive or sensory training.

In terms of infrastructure, the institution reports access to Oculus/Meta Quest devices, VR-compatible mobile technologies, and motion tracking sensors, supported by both stable high-speed Wi-Fi and wired LAN connectivity. Spaces available for VR deployment include a dedicated VR room, shared classrooms, and an open physical therapy area, thereby offering flexibility in terms of implementation environments. The technological setup is primarily based on standalone and mobile VR systems, which aligns with contemporary trends favoring low-overhead, portable solutions for educational and therapeutic use. This infrastructure suggests a relatively strong baseline for piloting VR interventions focused on motor coordination.

Despite these assets, the survey also highlights several challenges. The institution identifies high equipment costs, limited technical expertise, and the need for SEN-specific adaptations as significant barriers. Additional concerns include software compatibility and the lack of suitable content tailored to SEN populations. These findings are consistent with broader literature noting that cost, human capacity, and content appropriateness often represent key obstacles to VR adoption in educational and therapeutic settings. Importantly, the institution acknowledges that staff training, technical support, and access to ready-to-use, SEN-friendly VR programs would be essential for successful implementation.

From a compatibility perspective, the reliance on standalone headsets such as the Meta Quest provides advantages in terms of ease of deployment, scalability, and cost-effectiveness. The availability of motion tracking sensors also enables potential integration of more advanced motor assessment tools, provided that software platforms are compatible with existing hardware. The institution expresses openness to adopting new VR workout content, though this is contingent on compatibility with their systems and adaptability for SEN learners. Preferences for multiple software platforms, including Android, the Meta Quest Store, custom PC applications, and web-based VR, further underscore a flexible yet technically demanding deployment landscape.

Overall, the findings indicate that Istanbul University–Cerrahpaşa has a strong foundation for piloting VR-based interventions for SEN students, but would benefit from targeted investments in staff training, content development, and accessibility adaptations. As a research-oriented institution, it is particularly well positioned to design and evaluate pilot studies that assess not only the feasibility and usability of VR systems, but also their impact on motor coordination outcomes for SEN learners. The expressed interest in cross-disciplinary collaboration—bringing together expertise from special education, physiotherapy, and technology development—further strengthens the potential for innovative and inclusive VR solutions.

In conclusion, the survey responses suggest that while the institution is not yet fully equipped for large-scale deployment, it demonstrates readiness for structured pilot projects and applied research. Addressing gaps in technical expertise, SEN-specific content design, and financial resources will be crucial steps toward creating a sustainable VR ecosystem. The case of Istanbul University–Cerrahpaşa illustrates both the opportunities and the barriers faced by institutions seeking to adopt VR-based interventions in special education and rehabilitation, offering valuable insights for comparative evaluation across partner countries.

6.4 Romania

The responses collected through the Inspectoratul Școlar Județean Hunedoara provide valuable insights into the readiness of mainstream schools in Romania that integrate students with special educational needs (SEN). A total of fifty schools contributed to the survey, offering a broad institutional overview. The findings indicate that many of these schools have recently received VR equipment through a national project grant, primarily in the form of VR glasses that are expected to be integrated into the curriculum in the upcoming academic year. This positions the institutions at an early stage of adoption, with most schools still in the planning phase of VR implementation.

The participating schools primarily serve secondary school students (13–18 years old) and are oriented toward using VR in classroom learning and cognitive or sensory training. Reported hardware availability includes Oculus/Meta Quest devices and VR-compatible mobile devices, which enable both standalone and mobile VR setups. However, schools face notable limitations in terms of physical space, with most indicating only restricted areas available for VR use. Internet infrastructure is relatively strong, as stable high-speed Wi-Fi is widely available, which facilitates standalone and mobile VR applications without dependence on wired LAN connectivity.

While current VR usage remains limited, schools express openness to adopting new VR workout content aimed at motor skill development, though this is conditional on compatibility with existing systems. Preferences lean toward Android/Google Play platforms, reflecting a reliance on mobile technologies and simpler deployment models. The survey reveals a broad set of challenges to implementation, including high equipment costs, lack of technical expertise, limited physical space, student safety concerns, and the need for SEN-specific accessibility adaptations. These concerns align with barriers documented in international studies on technology integration in mainstream education, particularly when serving diverse learners.

To address these challenges, schools identified the need for funding, staff training, technical support, ready-to-use VR programs, and customizable SEN-friendly content as their highest priorities. The combination of infrastructural support and pedagogical resources will be critical in ensuring sustainable implementation. Importantly, the additional comments provided by respondents suggest a pragmatic and incremental approach: launching a pilot program in one or two schools to test VR integration in controlled conditions. Such a program would include establishing a dedicated VR corner with basic hardware (e.g., Meta Quest 2 or a PC-based headset), selecting targeted applications for motor skill development and social-emotional learning, and systematically tracking progress through observation forms, teacher and student feedback, and pre/post assessments of coordination or attention.

In summary, the Hunedoara case highlights both the opportunities and barriers for VR integration in mainstream schools that serve SEN students in Romania. The availability of newly acquired hardware provides a solid foundation for experimentation, but the successful deployment of VR will depend on addressing technical expertise gaps, ensuring accessibility, and creating structured pilot studies that generate evidence of impact. The proposed pilot program model—beginning small, measuring outcomes, and using data to justify scaling—offers a feasible pathway for advancing VR use in inclusive education within the national context.

6.5 Latvia

The Nacional Rehabilitation Centre "Vaivari", located in Jūrmala, Latvia, represents a highly specialized therapy and rehabilitation center that serves a broad age range, including primary school children, adolescents, and adults with special educational needs (SEN). Unlike many educational institutions in the partner network, Vaivari already operates as a fully established VR user, integrating immersive and robotics-based technologies into rehabilitation programs. This positions the center at the advanced end of the VR adoption spectrum, where technologies are not exploratory but embedded in therapeutic routines.

The institution's VR usage is focused on therapy, rehabilitation, and motor skill development, with a strong emphasis on gait, balance, and upper limb training. A wide range of advanced systems are already in use, including BalanceTrainer, Walker View, C-Mill VR+, Armeo Spring, Armeo®Senso, Mirarehab VR, and various robotics-integrated feedback systems. These platforms illustrate a focus on precision rehabilitation supported by PC-based VR setups, motion tracking sensors, haptic devices, and robotic interfaces. Sessions are conducted in open physical therapy areas, supported by robust connectivity infrastructure through both stable high-speed Wi-Fi and wired LAN.

Despite the advanced level of technological integration, the center reports no interest in adopting additional VR workout content for SEN students, reflecting its current reliance on highly specialized systems already tailored to rehabilitation needs. Preferred software platforms include custom PC applications and web-based VR, which are aligned with the bespoke requirements of medical rehabilitation contexts rather than general-purpose VR applications designed for educational or recreational use.

The challenges identified highlight the complexity of maintaining such advanced infrastructure. These include high equipment costs, lack of technical expertise, accessibility adaptations for SEN users, and concerns about the suitability of content for specific patient groups. These challenges indicate that, even within a highly resourced environment, sustainability and relevance remain ongoing issues. In terms of support needs, the center emphasizes a comprehensive set of requirements: funding, staff training, technical support, ready-to-use VR programs, customizable SEN-friendly content, and equipment recommendations. This reflects the continuous evolution of rehabilitation technologies and the necessity of ensuring that staff remain adequately prepared to use them effectively and safely.

In summary, the Nacional Rehabilitation Centre "Vaivari" exemplifies a highly advanced institutional context where VR and robotics-based systems are already embedded in therapeutic practice. While the center is not seeking new workout programs for SEN students, its emphasis on precision rehabilitation, coupled with its recognition of challenges related to cost, expertise, and adaptation, highlights the complexities of sustaining innovation in clinical and rehabilitative environments. The Latvian case therefore underscores a key contrast within the partner network: while many educational institutions are at the stage of planning or piloting VR adoption, advanced rehabilitation centers are already in an implementation and optimization phase, where the focus shifts from access to sustainability and adaptability.

6.6 Croatia

The Center for Autism in Rijeka, Croatia, represents a specialized institution dedicated to supporting students on the autism spectrum. While not formally categorized as a special education school in administrative terms, its profile is aligned with the provision of individualized and adaptive learning experiences for children with special educational needs (SEN). The institution currently integrates VR technology into its daily educational practice, reflecting a relatively advanced stage of adoption compared to many mainstream schools that remain in the planning phase.

The center's VR implementation is structured around Class VR systems, acquired through Carnet Class VR+ licenses, which provide access to curated educational content specifically designed for classroom learning. Although the devices are categorized as standalone VR hardware, their use is tailored to controlled classroom environments, where space is limited but sufficient for structured activities. Connectivity infrastructure details remain unspecified, but the integration of Carnet's platform suggests at least a functional baseline of digital readiness to support daily VR use.

VR applications are used every day in computer science classes, where students with autism demonstrate high levels of acceptance of immersive technologies. This is an important finding, as it reinforces the growing body of research suggesting that students on the autism spectrum often engage positively with structured, predictable, and visually rich digital environments. The focus at the Center is thus not on motor skill development or physical rehabilitation but rather on enhancing cognitive engagement, classroom participation, and exposure to high-quality educational content.

The institution identifies limited space as a primary challenge for expanding VR use, a constraint that is common among schools and therapy centers where physical layouts were not originally designed for immersive learning activities. Support needs are minimal compared to other institutions in the network, with only technical support highlighted as a requirement, which suggests that the staff already possess a baseline of familiarity with the system and its integration into pedagogy.

In conclusion, the Center for Autism in Rijeka exemplifies a case where VR has already become a normalized element of classroom practice rather than an experimental or pilot initiative. The adoption of Class VR technology demonstrates how carefully selected, curriculum-aligned tools can provide both accessibility and relevance for students with autism. Furthermore, the positive reception among learners highlights the institution's potential role as a reference point or best-practice example within the wider partner network, particularly regarding the successful integration of VR into everyday learning for SEN populations.

6.7 Conclusion

The six institutional cases examined across Greece (Agria and Lamia), Romania (Hunedoara County), Latvia (Vaivari), Croatia (Rijeka), and Turkey (Istanbul University–Cerrahpaşa) reveal both promising developments and persistent challenges in the integration of virtual reality technologies into special education and rehabilitation contexts. Collectively, the findings demonstrate that VR adoption in SEN-focused environments is progressing unevenly across partner countries, with significant variation in technological readiness, institutional priorities, and infrastructural support.

Emerging Trends

Several trends are evident across the cases. First, there is a growing recognition of VR as a relevant tool for both therapeutic purposes (e.g., motor skill development, physical rehabilitation at NRC Vaivari) and educational engagement (e.g., classroom learning in Greece, Romania, and Croatia). Second, institutions increasingly express openness to adopting new VR content, particularly for motor skills, coordination, and cognitive training, though the degree of readiness ranges from exploratory "in planning" phases to established daily use (as in Croatia's Center for Autism). Third, hardware adoption is gradually becoming standardized, with Oculus/Meta Quest and Class VR emerging as the most common devices, supported by motion tracking and haptic technologies in more advanced rehabilitation contexts.

Identified Gaps

Despite these positive developments, several gaps hinder the seamless implementation of VR in SEN education and therapy. Financial barriers remain a universal challenge, with high equipment costs cited across all institutions. In addition, lack of technical expertise and the need for staff training are recurrent themes, particularly in schools where VR has only recently been introduced through grant-funded projects (e.g., Romania). Moreover, space limitations present a physical constraint in multiple contexts, restricting the use of VR for activities requiring mobility. Accessibility and

SEN-specific adaptations are also inconsistently addressed, with some institutions highlighting this as a barrier (Latvia, Romania), while others have yet to integrate such considerations systematically.

Cross-Country Differences

The comparative analysis reveals marked national and institutional differences. Latvia's Vaivari Rehabilitation Centre stands out for its advanced integration of VR into robotics-assisted rehabilitation, positioning it at the high end of technological readiness. In contrast, Greek institutions are in transitional phases, with Agria already implementing PC-based VR for multiple educational purposes, while Lamia remains in the planning stage with limited hardware and expertise. Romania's mainstream schools benefited from recent national funding initiatives, but their use of VR is still prospective, with uncertainty about long-term sustainability and adaptation for SEN learners. Croatia's Center for Autism demonstrates successful day-to-day classroom use of Class VR, particularly for cognitive engagement among autistic students, yet lacks focus on motor skills or rehabilitation applications. Finally, the Turkish partner institution reflects a hybrid case where VR has been introduced but is still constrained by cost and limited adaptation for SEN needs.

Overall Assessment

Taken together, the cases suggest that while VR readiness is increasing across partner countries, it is occurring at different levels of maturity, ranging from pilot planning to advanced therapeutic ecosystems. The principal enablers of progress include external funding (e.g., grants, national projects), institutional openness to innovation, and evidence of student engagement with VR technologies. Conversely, the main inhibitors are cost, lack of expertise, and space constraints, alongside insufficient adaptation of content to the diverse needs of SEN learners.

The comparative insights highlight the necessity of adopting a phased, context-sensitive approach to scaling VR integration. Pilot programs, targeted training, and the development of customizable SEN-friendly content are essential next steps to bridge gaps and ensure equitable access to VR's potential benefits across educational and rehabilitation settings.

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