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Interactive Scientific Sport Fun Games for Early Childhood Education (ISSFG-ECE): The Needs and Perceptions of Early Childhood Teachers

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Abstract. This study examined the interactive scientific sports fun games for early childhood education (ISSFG-ECE) approach, which integrates sports education with a scientific framework to support young children's physical, cognitive, language, social, and emotional development. The research aimed to understand teachers' needs and perceptions regarding ISSFG-ECEs through a mixed-method embedded design, combining quantitative needs analysis with qualitative interviews. A random sampling technique was used to select 104 teachers from various regions in Indonesia for a needs analysis questionnaire, and 12 teachers, who participated in training, as respondents for interviews. Data analysis included percentage calculations for the questionnaire responses and thematic coding for the qualitative insights. The findings revealed that most schools lack teachers with relevant academic qualifications in sports education, and sports activities, primarily consisting of gymnastics, swimming, horse riding, and outing classes, are often not integrated with learning themes. However, the training and implementation of ISSFG-

ECE led to positive shifts in teachers' perceptions, improving their ability to design engaging, developmentally appropriate activities. The approach also enhanced children's self-confidence, collaboration, and physical activity levels. Despite its benefits, this study identified challenges, including limited open areas and children's egocentric tendencies, which require further examination. These findings highlight the need for better teacher training, curriculum integration, and improved facilities to maximize the impact of ISSFG-ECE on early childhood education.

Keywords: Scientific sport fun games; early childhood education; teachers' needs and perception

1. Introduction

Sports play a crucial role in the early development of children, contributing not only to physical growth but also to stimulating cognitive, language, and social-emotional development (Sun & Chen, 2024). Simple sports games can help children understand cause and effect, thereby improving their critical thinking skills. Engaging in collaborative sports activities can foster cooperation, communication, empathy, and self-confidence (Jones, 2024; Bartolomeo & Papa, 2019; Amiel, 2023). Participation in appropriate sports activities not only promotes physical health but also supports children's overall development.

Optimizing children's development in sports learning can be successful if the activities not only focus on the physical aspects but also incorporate any themes being studied to make learning more contextual (Juih et al., 2021; Yuliastrin et al., 2024). Theme-based learning in schools is implemented through a scientific approach, which allows children to learn through direct and relevant experiences, stimulating curiosity and critical thinking skills (Soni, 2015).

Even though young children may not be able to conduct complex investigations and experiments, the principles of the scientific method can be adapted to their developmental stage. Children can make observations using their senses, carry out simple experiments, and ask questions about the objects and events around them (Vartiainen & Kumpulainen, 2020). These activities, under the guidance of teachers, can be conducted in group settings, providing children with the opportunity to explore and construct knowledge actively, based on their learning experiences (Eti & Sığırtmaç, 2021; Zudaire et al., 2022). Therefore, incorporating sports activities into the context of the themes being studied can enhance children's developmental progress in sports learning.

A research gap lies in the lack of exploration regarding the integration of a scientific approach in early childhood sports education. Previous studies have primarily focused on the benefits of sports for physical, cognitive, social, and emotional development but those studies have not extensively discussed scientific principles. Furthermore, limited research exists on science-based pedagogy in early childhood sports education, such as inquiry-based or experimental learning. Therefore, research that integrates a scientific approach to sports education will fill this gap and contribute to the fields of education and sports.

The integration of scientific approaches in sports learning is essential for children's holistic development (Donaldson & Hammrich, 2016). Children can effectively grasp learning themes by integrating scientific activities and engaging in physical exercises. This can be achieved through educational games that offer challenging, interactive, and enjoyable experiences. Educational games exemplify the principles of early childhood learning, particularly emphasizing the significance of play, which is pivotal to children's development (Alotaibi, 2024; Whitebread et al., 2012). Play allows children to learn in engaging ways, fostering creativity and positive interactions with their environment (Cheung, 2018; Garaigordobil et al., 2022; Yildirim & Yilmaz, 2023). Therefore, integrating play into learning is essential, regardless of the approach or method. It is crucial to base the development of sports learning on a scientific approach based on the principles of play for early childhood.

The combination of a scientific approach and play principles in sports learning has significant potential (Henriksson et al., 2023). The scientific approach encourages children's thinking skills by helping them understand objects and events through exploration-based learning (Haenilah et al., 2021). It also helps children manage their emotions through observation activities that require precision. Play activities allow children to move, be creative, develop imagination, and to associate physical activity with pleasure, encouraging them to remain active (Irvin, 2017; Zosh et al., 2017). Sport teaches not only physical skills but also an understanding of rules, strategies, and tactics, while instilling values of discipline and supportiveness that are crucial for children's social-emotional development (Martin et al., 2020; Mosston & Ashworth, 2008; Wang, 2022). Additionally, sport promotes awareness of healthy living by encouraging sport activities that help maintain physical and mental health in the future (Angba, 2022; Mahindru et al., 2023).

The main problem addressed in this study was the absence of an integrated sports learning model that aligns with early childhood education curriculum themes and methodologies. While sports are crucial for children's physical, cognitive, and socio-emotional development, current early childhood sports activities often focus solely on physical aspects without having a meaningful connection to broader learning themes.

The interactive scientific sports fun games for early childhood education (ISSFG-ECE) learning model offers a holistic approach to early childhood education by seamlessly integrating physical activity, scientific exploration, and play-based learning. This innovative model enhances children's physical, cognitive, and socio-emotional development, while fostering critical thinking, creativity, and collaboration. However, its successful implementation depends on well-trained educators who can effectively apply scientific and play-based principles in sports learning. Therefore, teacher training and capacity building are essential to equip educators with the knowledge, skills, and resources to design engaging, developmentally appropriate sports-based learning experiences. Structured guidance through workshops, seminars, and hands-on practice can empower

teachers to create interactive, meaningful, and curriculum-aligned activities that maximize learning outcomes for young children.

The main goal of this project was to improve teachers' ability to create early childhood education-specific sports-based learning experiences that align with pertinent curriculum themes and methodologies. The following goals were intended to be accomplished by this study:

a. Identify the need and perception for developing a sports learning model by analyzing the requirements and challenges faced by early childhood education teachers.
b. Explore teachers' perceptions of the ISSFG-ECE approach in early childhood education, focusing on changes in teachers' mindsets regarding physical education, the impact on children, and the challenges encountered during implementation.

2. Review of Literature

2.1 Scientific Approach in Early Childhood Learning

The scientific approach is a learning strategy that can motivate students to learn. In the classroom, the scientific method is a very powerful tool for children to engage actively with their learning. By developing inquiry, observation, experimentation, and reflection in pupils, this method helps with the process of creating knowledge (Kartini, 2017). This approach, which is grounded in inquiry-based learning, encourages students to participate actively, rather than to listen passively to a lecture, which significantly increases students' critical thinking, problem-solving skills, and natural curiosity (Gholam, 2019; Siahaan et al., 2023). By enabling students to participate in practical experiences, they gain a better understanding of challenging concepts.

The implementation of the scientific approach in early childhood education consists of observing, asking, collecting information, reasoning, and communicating (Halifah et al., 2024). In the observing stage, children are encouraged to use their senses to explore objects or natural phenomena around them. Furthermore, children are encouraged to ask questions about what is observed. To help answer these questions, teachers facilitate children to explore and collect information through experimental activities, conducting investigations and making simple projects. After gathering information, children work with the teacher to formulate conclusions and share with their peers. This is part of the communication stage, which can be done through storytelling, drawing, or demonstrating activities. With this approach, children can develop curiosity, critical thinking, and creativity from an early age, making learning more meaningful and enjoyable.

2.2 Sports in Early Childhood Education

Sports in early childhood are not only designed to improve physical development but also cognitive, social, and emotional development (Tan et al., 2025; Wang & Wang, 2015). These activities include basic movements, such as running, jumping, throwing, and balancing, that allow children to collaborate and develop problem-

solving. For the children, sports are oriented on fun, play, and development, rather than physical skills (Bakirtzoglou, 2017; McGowan et al., 2023).

Sports can significantly impact children's holistic development (Felfe et al., 2016). Many studies have been conducted on this topic. In terms of physical development, sports can strengthen muscles and bones; it has an impact on gross motor development through various fundamental movements such as running, jumping, kicking, or throwing (Dapp et al., 2021; Sutapa & Suharjana, 2019; Tandon et al., 2020). Cognitively, sport games that involve strategy, rules, and decision-making improves concentration, memory, and critical thinking skills (Al-Thani, 2022; Bidzan-Bluma & Lipowska, 2018; Coppola et al., 2024). When children are involved in a game, there is a process of coordination between the mind and body movement, which makes learning more meaningful so that it can increase memory retention in children. In terms of social and emotional aspects, sports learning can be an effective means of teaching social skills, such as cooperation, communication, and empathy (Li & Shao, 2022; Mania et al., 2024; Wang, 2022). Through various games that involve interaction with peers, children learn to share, follow rules, and respect the opinions of others.

A research gap lies in the limited exploration of integrating a scientific approach into early childhood sports education, as previous studies mainly focus on its developmental benefits. Research on science-based pedagogy, such as inquiry-based or experimental learning, is scarce, making this study essential to bridging the gap and advancing education and sports.

2.3 Integrating the Scientific Approach in Sports for Early Childhood Education

Integrating the scientific method into sports within early childhood education significantly enhances the learning experience by merging physical activity with inquiry-based exploration (Mavilidi et al., 2017). The scientific method, which encompasses processes of observation, questioning, hypothesis formation, experimentation, analysis and forming a conclusion, can be personalized to accommodate the developmental stages of young learners. Through structured play and interactive sports activities, children engage in hands-on learning experiences that promote curiosity, problem-solving skills, and critical thinking (Mauro, 2024). The ISSFG-ECE introduces new ways to apply scientific thinking through physical activities, leading to cognitive and motor skill development. Students already embody principles of science and learning through organized play and physical movement-based experimentation, allowing for a more valuable approach to meaningful content retention. Balance and motion games help students to understand gravity, while water play experiments introduce upper-level concepts in buoyancy and density. In addition, when children engage in activities involving speed and force, such running and throwing things, this experience helps them gain an understanding of the relations between forces, speed, and direction. As students experience these, they learn to observe, predict, test, and analyze, which not only uses their scientific understanding but also strengthens their fine motor skills.

The integration of scientific methods into sports not only encourages physical development but also encourages other growth. When children try various

movement strategies to find the most effective one, they indirectly perfect their motor skills and coordination. Therefore, this approach can build children's ability to think strategically in solving problems. In addition, the movement carried out in a team physical activity can encourage children to collaborate in testing ideas and strategies and exploring various results. If children fail to find the results, they will be trained to be more resilient in solving problems. By combining scientific exploration with sports activities, the learning that is created can foster a lifelong curiosity, active participation, and a desire to discover (Donaldson & Hammrich, 2016).

3. Research Methodology

3.1 Research Design

This study used a mixed-method embedded design, combining quantitative needs analysis with qualitative interviews. This approach allowed for a deeper exploration of teachers' needs and perceptions regarding ISSFG-ECE. The quantitative component plays a dominant role through a survey-based needs analysis, while the qualitative component provides deeper insights through semi-structured interviews.

3.2 Participant

A survey was conducted using a questionnaire to determine the requirements of early childhood education teachers for the creation of sports learning models. The sampling techniques used in this study were random and purposive sampling was used in two different stages. A random sampling technique was used in the needs analysis stage to recruit several teachers who were willing to fill out the questionnaire distributed online. At this stage, 104 teachers were recruited from various regions in Indonesia with very diverse characteristics in terms of academic qualifications, educational linearity, and length of service. With this diversity, it was expected that the data obtained would represent the conditions commonly faced by teachers related to the implementation of sports learning in early childhood education. The second sampling technique was purposive sampling used in the interview stage. At this stage, 12 training participants were purposively selected as interview respondents based on the considerations in selecting sampling which was the teacher's level of insight into ISSFG-ECE and their experience in implementing it in the classroom.

3.3 Research Procedure

A six-day training program was conducted to establish a shared understanding of the ISSFG-ECE learning approach. On the first day, the 12 training participants attended a seminar on sports learning and scientific approaches to early childhood. The second day involved practical engagement in sports games aligned with child development themes. This was followed by an immersive workshop on designing sports learning for early childhood, held on the third and fourth days. On the fifth day, a simulated session of sports learning was conducted. The program concluded on the sixth day with focus group discussions led by experts and teachers to reflect on the implementation of ISSFG-ECE. During the focus group discussions, teachers described the learning process and identified both the positive aspects and obstacles encountered during implementation. Each teacher shared best practices for implementing the

approach and, together, they formulated solutions to overcome the identified obstacles.

3.4 Data Collection

The data collection technique in this study was distributing a mixed-format questionnaire during the needs analysis stage, which consisted of closed-ended questions with predefined answer options, as well as open-ended questions that allowed respondents to provide answers based on their own experiences. The questions focused on aspects such as the availability of teachers or trainers with a background in sports education, the sources of information accessed by teachers regarding sports learning for children, the types of sports activities conducted, the development of specific lesson plans for sports education, and the developmental aspects being stimulated.

To ensure the quality of the instrument, the questionnaire underwent validity and reliability testing before being distributed. Content validity was ensured through expert judgment, in which specialists in sports education and early childhood learning reviewed the questionnaire to assess its relevance and appropriateness. Construct validity was tested statistically using the Pearson product-moment correlation, in which each item's correlation coefficient (r-value) with the total score was analyzed. Items with an r-value greater than 0.30 and a significance level (p-value) less than 0.05 were considered valid. Meanwhile, reliability was assessed using Cronbach's alpha coefficient to determine internal consistency. A questionnaire was deemed reliable if Cronbach's alpha value was 0.70 or higher, indicating a strong level of consistency in responses across multiple items.

Semi-structured interviews were conducted with teachers who participated in the training to explore their initial understanding and experiences in implementing the ISSFG-ECE approach. This method provided deeper qualitative insights into the challenges and benefits teachers perceive in integrating sports education into early childhood education. The semi-structured interview instrument was validated through expert judgment, in which experts assessed the relevance of questions and pilot interviews to ensure they would effectively gather the intended information. Reliability was tested using inter-coder reliability, in which multiple researchers analyzed the data to ensure consistent interpretation and test-retest reliability, which involved repeating interviews to check response stability. Additionally, an audit trail documented the interview process in detail for replication. These approaches ensured that the interviews were valid and reliable, producing accurate, consistent, and trustworthy data in qualitative research.

3.3 Data Analysis

The data analysis in this study used quantitative and qualitative approaches as the mixed-method embedded research design. The data collected from questionnaires were analyzed descriptively and quantitatively by calculating percentages and frequency distributions. This analysis aimed to identify trends and patterns of teacher perceptions regarding the needs and implementation of sports learning in early childhood education so that it provided an overview of the readiness and challenges they face in implementing ISSFG-ECE.

The data from the in-depth interviews with teachers selected through purposive sampling were analyzed using thematic coding techniques. This analysis stage included the transcription of interview data, identification of main themes, and in-depth analysis. This process aimed to understand teachers' understanding better, their experiences in implementing ISSFG-ECE, and the challenges and benefits they perceive in the learning.

4. Findings

4.1 Analysis of the Need to Develop a Capacity-Building Program

The findings from the analysis of sports development needs for early childhood education highlighted several critical components. These included the availability of human resources, teacher experience in accessing information about sports learning methods, types of sports activities, and developmental aspects enhanced through sports learning. Additionally, the challenges identified should be interpreted as factors that hinder the effective implementation of sports education in early childhood settings. These obstacles emphasized the urgent need for a specialized capacity-building program aimed at enhancing teachers' knowledge and skills in delivering quality sports education for young children. The results of the questionnaire analysis revealed the following data, as presented in Table 1.

Table 1. The need analysis of early childhood education teachers

No	Aspect	Percentage of answer	Description
1	**Availability of special teachers for sports activities**		
	Yes	26,2%	Only **26.2%** of schools have specialized sports teachers and, among them, **21.4%** possess relevant academic qualifications or certified competencies in the field of sports. Meanwhile, a significant **73.2%** of schools do not have specialized sports teachers.
	No	73,2%	
2	**Accompanying the child during sports activities**		
	Teachers	93,2%	The majority of children (**93.2%**) are accompanied by their classroom teacher during sports activities, while a small percentage (**4.9%**) have a dedicated sports teacher. Additionally, certain activities involve sports major students **(1%)** and pre-service early childhood education teachers **(1%)**. Furthermore, **23.5%** of the responses fall under the "Other" category, which includes support from external instructors for specialized activities, such as swimming, horseback riding and archery.
	Special teachers	4,9%	
	Sports major student	1%	
	Preservice early childhood education teacher	1%	
	Other	23,5	
3	**Sources of information used to obtain information about sports activities for early childhood education (respondents may choose more than one answer)**		
	Media social (WA, TikTok, IG, Dll)	74,8%	In general, the teachers' responses indicated that they seek information independently from various media or forums, and it is also known that teachers obtain information through sharing activities with other teachers or with an available school psychologist team. Seminars and workshops on sports education for early childhood are very rarely found because most seminars and workshops are related to learning administration, curriculum, child development, or parenting.
	YouTube	67%	
	During the lecture	47,6%	
	Seminar/ workshop	28,2%	
	Book	17,5%	
	Others	35,3%	
4	**Types of activities conducted at school**		
	Gymnastics	87,4%	Gymnastics is the most commonly practiced activity. Other activities include ball toss games, swimming, outing classes, and various other games. These additional games include simple relay races, obstacle jumping, balance exercises, rhythmic movement to music, catch-and-throw games, parachute play, and chasing or dodging games. Children also engage in hopping between circles, interactive teamwork activities, and other playful exercises that promote motor skills, coordination, and social interaction.
	Ball toss game	7,8%	
	Swimming	3,9%	
	Outing class	1%	
	Others	5,9%	

5	**The teacher made a special lesson plan for sports activities**		
	Yes	35%	The lesson plan is specifically made for the predetermined schedule or specific activities such as swimming and outings. The allocation of time for sports activities is usually at just one stage: the opening, core, or closing of the activity, and is not designed to be continuous from the beginning to the end of the learning process.
	Sometimes	39,8%	
	No	24,8%	
6	**Aspects of development stimulated in sports activities for children (respondents can choose more than one answer)**		
	Motor skills	98,1%	The data suggest that the majority of teachers primarily view sports education as a tool for enhancing children's motor skills, with a strong emphasis on improving physical abilities, such as coordination, strength, and flexibility. This indicates that sports activities in early childhood education are largely designed to support gross and fine motor development rather than a holistic approach to child growth.
	Social emotional	53,4%	
	Cognitive	44,7%	
	Language	26,2%	
	Art	29,1%	
	Religious	16,5%	

The questionnaire results in Table 1 show several important points that can be used as a basis for developing a capacity building program related to sports learning for early childhood education. The results are as follows:

1. The data revealed that only a small percentage of schools have specialized sports teachers, with even fewer possessing relevant academic qualifications or certifications in the field. The majority of sports activities are conducted by classroom teachers who may not have received formal training in sports education. This highlights a critical gap in teacher competence, as the lack of specialized sports instructors can lead to a limited understanding of how sports can be effectively integrated into child development. There is an urgent need for capacity-building programs to equip early childhood educators with the necessary knowledge and skills to deliver structured and developmentally appropriate sports activities. A workshop on scientific integration in sports education would help teachers understand the principles of child development, biomechanics, motor learning, and psychology, ensuring that sports activities contribute to holistic growth rather than just physical development.
2. Most children participate in sports under the supervision of their classroom teachers, with very few receiving guidance from specialized instructors or sports major students. Some institutions involve external instructors for specific activities such as swimming, horseback riding, and archery. The lack of trained facilitators in sports education may lead to improper implementation of physical activities that fail to maximize developmental benefits beyond motor skills. A workshop could provide evidence-based strategies on how teachers can integrate scientific concepts, such as movement analysis, cognitive engagement in sports, and structured play, to optimize the learning experience for young children.
3. Teachers primarily rely on social media platforms and YouTube as their main sources of information. Formal training through seminars or workshops is rarely available and most professional development programs focus on general aspects of early childhood education, such as curriculum planning, child psychology or parenting, rather than sports pedagogy. Self-taught methods based on social media or non-structured content may lead to inconsistent and unscientific approaches in sports education. There is an evident need for structured and research-based

training programs, such as workshops, to introduce teachers to scientifically validated methods of integrating sports into holistic child development.

4. Gymnastics is the most commonly practiced activity, followed by ball toss games, swimming, and class outings. Some teachers also incorporate other movement-based games, but these activities may not be strategically designed to support a full spectrum of child development. The heavy focus on traditional physical activities, such as gymnastics, suggests that other essential movement-based learning opportunities, such as cognitive-motor integration, exploratory play and interdisciplinary sports activities, may be underutilized. A workshop could introduce teachers to innovative movement-based learning models that incorporate scientific approach to enrich children's learning experiences.
5. A significant portion of teachers either do not create specific lesson plans for sports activities or only prepare them occasionally. When plans are made, they tend to be fragmented, focusing on a single stage of learning (opening, core, or closing) rather than being a continuous learning process integrated throughout the curriculum. The lack of structured lesson planning for sports education suggests that many activities are conducted without clear learning objectives or a scientific framework to guide developmental outcomes. A workshop could teach educators how to design structured lesson plans that integrate sports with cognitive, emotional and social learning objectives, ensuring that children receive a well-rounded developmental experience.
6. The data showed that motor skill development is overwhelmingly prioritized, while other crucial developmental domains, such as social-emotional, cognitive, language, artistic and religious aspects, receive significantly less attention. This indicated that sports education in early childhood settings is still largely viewed as a tool for physical development rather than holistic learning. A narrow focus on motor skills may limit the potential of sports education in fostering well-rounded child development.

The findings highlighted significant gaps in sports education for early childhood learners, particularly in teacher training, structured lesson planning, and holistic developmental integration. While sports activities are widely implemented, their educational potential remains underutilized due to the lack of specialized knowledge and evidence-based methodologies. A workshop on the scientific integration of sports in early childhood education would address these gaps by providing teachers with scientific knowledge on how sports activities contribute to multiple aspects of child development beyond motor skills, introducing structured lesson planning strategies that ensure sports are effectively integrated into the overall learning experience, enhancing teacher capacity to use sports as a tool for cognitive, social and emotional learning, and encouraging interdisciplinary learning in which sports education intersects with subjects such as science, mathematics, language, and social-emotional learning. By implementing such a workshop, early childhood educators will be better equipped to provide meaningful, developmentally appropriate sports

experiences, ensuring that young children benefit from a scientifically informed, well-rounded approach to movement-based learning.

4.2 Teacher's Perception

The findings in this section outline the perceptions of 12 teachers who were interviewed after they completed training and implemented its strategies in their classrooms. The aspects being inquired about include teachers' mindset shifts regarding early childhood sports education before and after participating in the ISSFG-ECE training, the impact on children's development, and the challenges in implementing ISSFG-ECE. The following is a description of each of these aspects.

4.2.1 Teachers' Mindset Shifts Regarding Early Childhood Sports Education Before and After Participating in the ISSFG-ECE training

All the teachers generally responded positively to the transformation in their mindset about early childhood sports education. Some of them stated that, initially, they were unaware that sports education could be integrated with learning themes, as sports activities had always been conducted as physical exercises packaged in games, separate from learning themes. Other teachers mentioned that they had previously understood sports education as primarily stimulating physical and motor development. However, they later realized that other aspects could also be developed proportionally. A teacher commented:

> *"I used to think that sports learning was just about moving around and being active, but after checking out the interactive scientific sports fun games learning approach, I realized that can actually help kids develop their thinking skills and social-emotional sides too. It's all about making learning fun with cool interactive games!"*

Another teacher shared the opinions:

> *"We've been doing sports activities at different times, and they haven't really tied into what we're learning. But now, we can mix sports into our lessons any day! We're thinking about movements that mimic animals or different types of transportation, along with some obstacles. We could also create fun movement games with puzzle questions. For instance, if we're learning about fruits and vegetables, we can connect those themes through our activities."*

Based on the interview results, several key themes emerged, reflecting the changes in teachers' mindsets regarding early childhood sports education after participating in ISSFG-ECE training:

1. Integration of Sports with Learning Themes
   Before the training, most teachers perceived sports activities as separate from learning themes and unrelated to daily classroom topics. However, after attending the training, they realized that sports can be effectively integrated with thematic learning, making the learning process more comprehensive and meaningful. This approach allows children to not only develop motor skills but also gain a better understanding of the concepts taught in class.
2. Structured Planning in Sports Learning

Some teachers previously conducted sports activities spontaneously, without structured planning. After the training, they recognized the importance of designing sports activities that are interactive, engaging, and aligned with the learning themes. With better planning, sports would no longer be just a physical activity but become an integral part of the structured learning process

3. Sports as a Means of Cognitive and Socio-Emotional Development
   Before the training, the teachers mainly focused on sports as a physical and motor activity. However, after the training, they understood that when linked to learning themes and properly designed, sports can also foster cognitive skills, communication, and emotional regulation. This newfound perspective highlighted that sports can play a broader role in children's overall development.
4. Flexibility in Implementing Sports Activities
   Only two teachers initially believed that sports must be conducted in large open spaces. After the training, they realized that sports can also be effectively implemented in classrooms through various engaging activities that remain beneficial for children's development. This understanding allows teachers to be more flexible in adapting sports activities based on the available environment.

4.2.2 The Impact of ISSFG-ECE on Children's Development

When questioned about their learning process, the teachers revealed that they had created and executed sports activities that incorporated scientific stages in accordance with a theme under study. One teacher said,

> *"At that time I provided several types of native vegetables with various colors, such as carrots, eggplants, tomatoes, potatoes, and corn, and asked the children to observe while asking questions about the differences in color and shape. I provoked questions about what dishes could be made from the vegetables I brought. After observing and also question and answer session, the children were then invited to play sports by running, jumping, or walking zigzag from the start line to the finish line while carrying pictures of vegetables and sticking them on the board. The children were very enthusiastic about participating in the activity; they cheered and clapped their group members who were competing so that their friends became more enthusiastic to complete the activity. At the end of the activity, I asked the children to cool down by doing an activity making potato stamps."*

In a different approach, another teacher implemented the learning theme about fruits in almost the same way. It began with an activity of observing real fruits and asking several relevant questions to explore the children's initial knowledge, then carrying out a physical activity game by jumping on one leg to stimulate balance, crawling, and running to match the picture of the fruit with its tree. Cooling down was carried out through artistic activities such as coloring, making mosaics, and others. The teacher commented:

> *"...children are not only active in moving, but they are also invited to think when observing, exploring information, and also discussing when looking for answers. This new and modern approach makes children*

> *physically more healthy but also helps children understand the material and improves children's language skills when delivering answers."*

Teachers perceived some benefits from observing students when implementing ISSFG-ECE learning in class. Almost all the teachers said that ISSFG-ECE learning made the children braver, more confident and empathetic to their friends. Children were more active in working together to complete games that were played in groups. This was because there were elements of competitive activities that enabled all group members to help each other to achieve victory. One teacher said that:

> *"I saw a special incident; there was a child who was shy and usually never wanted to actively participate, but this time when the child saw the excitement of his friends when playing sports, he was tempted to join the activity. Although the child has not shown significant enthusiasm, for me it reflects extraordinary progress."*

It was also reported by other teachers that ISSFG-ECE learning was effective in stimulating movement in several children who were usually passive. A teacher stated that there were children:

> *"... usually too lazy to move; sometimes in class they were seen lying down and just sitting. However, during the ISSFG-ECE activity, children also ran and jumped while playing the game. At the end of the activity, the child told his friends about his experience of playing this activity."*

The thematic analysis of the teachers' experiences in implementing ISSFG-ECE, which had an impact on children's development, highlighted several key benefits, including:

1. Enhanced cognitive engagement—children not only move but also think, explore, and communicate.
2. Improved social-emotional development—activities encourage shy children to participate and build confidence.
3. Increased physical activity—even previously inactive children became more motivated to move.
4. More enjoyable and interactive learning—sports activities integrated with thematic learning create a fun and engaging classroom experience.

The conclusion is that ISSFG-ECE is a sports learning approach that can be carried out by involving a series of scientific activities, such as observation, exploration, or investigation activities about something that is integrated with sports games, by involving physical activities or fundamental movements that are important for children. Sports learning becomes more fun and meaningful because, in addition to making children active and fit, children will also feel happy psychologically and cognitively intelligent. Children become more active in socializing with their peers, working together to play games, discussing problems, and competing healthily.

4.2.3 The Challenges in Implementing ISSFG-ECE

The positive side of ISSFG-ECE learning is inseparable from several challenges that were conveyed by teachers from the interview results. One teacher said:

> *"The very limited open area in the school makes it rather difficult for us to control children's movement and ensure their safety during outdoor activities."*

Open areas allow children to do physical movements without obstacles, which supports children's gross motor development optimally and minimizes the risk of accidents when doing movement activities. In addition, children are more comfortable and freer in exploring various activities in learning activities so that they can support observation and exploration activities through direct experience. Another challenge was also reported by the teacher:

> *"Children are very happy to participate in activities, but sometimes I find some children do not want to accept defeat during the match. Whenever that happens, I usually give the child an understanding that the activities carried out are mere games."*

A potential risk of conflict between children during competitive sports games remains very high because early childhood children are mostly egocentric, so they cannot accept situations which are outside their expectations and thoughts logically. Egocentrism in early childhood is quite normal. Toddlers have a different perception of the world around them. They believe that things should go according to what they feel is right. They may feel dreams come alive at night or their imaginary friends are real. A study suggests that egocentrism is one of the main characteristics of a child's thought process until around the ages of 6 or 7 years old (Prakash, 2020).

Based on interviews with the 12 early childhood teachers regarding the challenges they faced in implementing ISSFG-ECE, four main themes emerged:

1. Lack of infrastructure
   One of the most frequently mentioned challenges was the lack of adequate infrastructure, particularly limited play areas and insufficient sports equipment. Teachers found it difficult to fully implement ISSFG-ECE activities when they lacked the necessary space and tools to facilitate movement-based learning. The unavailability of proper facilities restricted the variety of activities that could be conducted, potentially affecting the overall effectiveness of the program.
2. Time and classroom management difficulties
   Teachers expressed concerns about time limitations in planning and implementing ISSFG-ECE. The preparation process—such as setting up play areas, preparing equipment, and designing lesson plans—was considered time-consuming. Additionally, managing large class sizes posed a challenge, as maintaining order and ensuring that all children remained engaged required extra effort. The combination of preparation demands and classroom management difficulties made it challenging for teachers to effectively execute ISSFG-ECE.
3. Children's behavioral tendencies
   Several teachers faced challenges related to children's egocentric behavior during ISSFG-ECE activities. Some children insisted on winning, became upset when losing, or refused to cooperate in groups, especially when assigned teammates by the teacher. These behavioral tendencies

sometimes disrupted the flow of activities, requiring teachers to find strategies to foster sportsmanship, cooperation, and emotional regulation among students.

4. Environmental concerns
   Another significant challenge was negative responses from the surrounding environment, particularly complaints about noise levels. Since ISSFG-ECE involves active movement, cheering, and lively interaction, some teachers reported that the noise disturbed other classes. This created a dilemma between maintaining an engaging learning atmosphere and minimizing disruptions for neighboring classrooms. These challenges indicate that while ISSFG-ECE offers significant benefits, successful implementation requires proper infrastructure, effective time management, strategies for behavioral guidance, and consideration for the surrounding learning environment. Addressing these issues can help optimize the effectiveness of ISSFG-ECE in early childhood education.

These challenges indicated that, while ISSFG-ECE offers significant benefits, successful implementation requires proper infrastructure, effective time management, strategies for behavioral guidance, and consideration for the surrounding learning environment. Addressing these issues can help optimize the effectiveness of ISSFG-ECE in early childhood education.

5. Discussion

The purpose of this study was to investigate the teachers' need and perception about scientific sports learning for early childhood education. The need analysis results show that many schools do not have teachers with relevant academic qualifications or sports competency certifications to accompany children in sports activities. Teachers' knowledge and understanding of sports education for early childhood education are limited because information and training on sports for young children, such as seminars and workshops, remain very minimal.

The limited information and knowledge about sports learning or physical activity have several consequences for the children such as limited physical development and social skills (Opstoel et al., 2020; Ravi Kumar, 2017). Furthermore, children miss learning opportunities for enhancing cognitive development creativity and problem-solving. Previous research shows that structured and unstructured physical play can encourage brain function, memory, concentration, creativity, strategic thinking, and problem-solving (Al-Thani, 2022; Best, 2010; Bollimbala et al., 2023; Yanti et al., 2024).

The limitation of teachers is also a risk for inequity in the learning experience and promoting lifelong physical activity or sports behavior. Teachers who lack knowledge of physical activity and sports may not be able to offer the same quality of instruction as those trained in this area, leading to disparities in children's learning experiences (Ha et al., 2008; Jenkinson & Benson, 2010; Morgan & Hansen, 2008; Quennerstedt, 2019). Improper instruction or lack of understanding about safety protocols can lead to physical injuries during

activities, which may also discourage children from participating in sports and other activities in the future.

Sports activities conducted in early childhood education mostly consist of gymnastics, fundamental movements or specific sports, such as swimming and horseback riding. Activities still rarely involve interactive games and are often only conducted at one stage of learning without continuity from start to finish. Integrating physical activities in sports and play-based learning with the scientific approach may have a good influence on children's development particularly in the context of peer interactions and may serve as a remedy for an age that necessitates children to possess exceptional skills across several domains to succeed in the future (Kons et al., 2015; Siagian et al., 2022). Learning activities become mutually continuous with one another, not only oriented towards physical movement stimulation but also stimulating the psychological and cognitive gains (Henriksson et al., 2023).

The ISSFG-ECE training has resulted in significant changes in teachers' perceptions of sports learning in early childhood education. Teachers came to realize that sports do not only focus on physical activities but may also stimulate children's cognitive and socio-emotional development. The teachers became more capable of integrating sports with learning themes, creating relevant and interactive activities, and combining elements of play and problem-solving.

The ISSFG-ECE approach is also an interactive and scientific sports learning approach that can support the holistic development of children. This approach combines observation and exploration with physical activities, making learning more enjoyable, meaningful, and beneficial for the child's physical, cognitive, and socio-emotional development. The positive impact of implementing ISSFG-ECE on children is that it makes them more confident, braver, and empathetic towards their friends. Children become more active in cooperating and more engaged in group activities due to the presence of a healthy competitive element. In addition, this method is effective in encouraging children who are usually passive to be more active and participate in sports and other physical activities.

The main challenge faced in the implementation of ISSFG-ECE in schools is the limited open areas that can hinder children's freedom of movement. An open area is an important facility to accommodate children's needs to move and explore freely. The limitations of the facilities can increase the risk of accidents and restrict the child's physical exploration (Sharma & Parveen, 2022). This can be addressed by modifying physical games to suit the limited space. For example, the teacher can reduce the number of children playing in one group or arrange the games in turns. The type of movement can be adjusted to movements that do not require much space, such as small jumps in place, zigzag walking, or crawling on a short track.
Another challenge is that some children have difficulty in accepting defeat while playing, showing the egocentric characteristics common in early childhood. Egocentrism in childhood does not denote selfishness or self-centeredness; rather, it pertains to the child's comprehension of the world, characterized by their

incapacity to grasp it from perspectives other than their own (Lee, 2021). To reduce children's egocentrism when implementing learning, teachers can use an approach that encourages children to understand the importance of cooperation, appreciate their friends' feelings, and share experiences in sports activities. The effective ways to reduce egocentrism in children are teaching empathy (appreciating children's feelings and modeling how to understand the feelings of others), encouraging teamwork because it can encourage collaboration and concern for the needs of others, helping children to identify problems and work together for solutions that are beneficial for everyone, and providing opportunities to help others when they play in sports activities (Kelly, 2015; Lee, 2021; Schonert-Reichl, 2020; Tuekkhow et al., 2024).

The challenges encountered in implementing ISSFG-ECE, particularly time constraints in lesson preparation, difficulties in managing large class sizes, and noise levels during sessions, highlight key areas that require strategic intervention. Time constraints pose a significant barrier, as teachers must allocate considerable effort to designing lesson plans, preparing equipment, and setting up play areas. To address time constraints, teachers can work collaboratively in designing ISSFG-ECE lesson modules, preparing equipment, and setting up shared activity areas. By distributing tasks among colleagues, the workload becomes more manageable, and preparation time can be significantly reduced. This collaborative approach fosters efficiency and ensures that ISSFG-ECE activities are well-structured and effectively implemented.

Additionally, large class sizes make it difficult for teachers to maintain engagement and control, often leading to disruptions during activities. Implementing smaller group rotations or additional teacher assistance could help optimize classroom management. Noise levels also present a challenge, as the dynamic and interactive nature of ISSFG-ECE may disturb other classes. To mitigate this, schools could designate specific areas for movement-based learning or establish schedules that minimize conflicts with other lessons. Addressing these challenges through proper planning, resource allocation, and institutional support will be crucial in ensuring the effective and sustainable implementation of ISSFG-ECE in early childhood education.

6. Conclusion

The findings highlighted the critical need for a capacity-building program to enhance early childhood teachers' competencies in sports education. The majority of schools lacked specialized sports teachers, and most sports activities were led by classroom teachers without formal training in sports pedagogy. The teachers primarily relied on social media for information, with limited access to structured training programs. Sports activities were often unstructured and primarily focused on motor skills, neglecting cognitive, social-emotional, and interdisciplinary learning opportunities.

The introduction of the ISSFG-ECE approach significantly shifted teachers' perspectives, enabling them to integrate sports with learning themes, apply structured lesson planning, and recognize sports as a tool for cognitive and social-emotional development. The teachers observed that the children became more

engaged, confident, and physically active, while also improving their problem-solving, communication, and teamwork skills.

Despite its benefits, ISSFG-ECE implementation faces several challenges, including limited infrastructure, time constraints, classroom management difficulties, and children's behavioral tendencies, such as egocentrism and competitiveness. Teachers also reported environmental concerns, such as noise complaints from other classes. Addressing these issues requires better infrastructure, efficient time management strategies, behavioral guidance techniques, and support from the school community. Overall, ISSFG-ECE has proven to be an effective approach in making sports education more engaging, holistic, and meaningful for young children, fostering not only physical fitness but also cognitive and socio-emotional growth.

Despite its contributions, this study has several limitations. The sample size was relatively small, which may limit the generalizability of the findings across diverse educational settings. Additionally, the study primarily relied on self-reported data from teachers, which could introduce bias in responses. The research also did not examine the long-term impact of the ISSFG-ECE approach on children's development, leaving room for further exploration.

Future research should focus on expanding the sample size and incorporating diverse educational contexts to validate the effectiveness of ISSFG-ECE more broadly. Longitudinal studies could provide deeper insights into how this approach influences children's development over time. Moreover, experimental research comparing ISSFG-ECE with traditional sports education models could help establish its relative benefits and best practices for implementation. Investigating teachers' professional development needs and designing targeted training programs will also be crucial in ensuring success.

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