



Impact of a physical education service-learning programme on ASD children: A mixed-methods approach

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ABSTRACT

Background. Children with Autism Spectrum Disorder (ASD) have few opportunities to engage in physical activity, which affects their already limited social and motor skills. Different Service-Learning (SL) proposals designed to meet this need have started to emerge, and research is required to better understand the services provided. **Objective.** Two objectives were established in this study: (1) to understand the impact of a physical education SL programme from the viewpoints of Physical Education Teacher Education (PETE) students and the families of the children with ASD involved; and (2) to analyse the programme's effects on the motor domain of children with ASD (physical activity levels and basic motor skills). **Method.** The study used a mixed-methods approach. Thus, for the first objective, a qualitative approach consisting of group interviews and reflective journals was used with a sample composed of 12 parents of the participating children with ASD and 52 PETE students. For the second objective, a quasi-experimental design was used with a sample of 25 children with ASD, 15 in the experimental group (4 girls, 11 boys; age: 10.13 ± 2.56 years) and 10 in the control group (1 girl, 9 boys; age: 10.13 ± 3.09 years). In this part, triaxial accelerometers (Actigraph, xGT3X-BT) and the Movement Assessment Battery for Children-2 (MABC-2) were used. **Results.** Five content categories emerged from the qualitative approach, three of which were shared by the families and the PETE students: 'Motor-related benefits for children', 'Social impact regarding inclusivity', and 'Teacher training quality'. In addition, the 'Personal growth' category emerged from the PETE students, and 'Desire for consolidation of the programme' emerged from the families. Regarding the quantitative approach, the experimental group showed significant improvements in moderate Physical Activity performed on weekdays ($p \leq 0.001$), as well as on the Manual Dexterity ($p \leq 0.05$) and Balance ($p \leq 0.05$) variables from the MABC-2 test. Meanwhile, the results in the control group remained stable or decreased. **Conclusion.** The SL programme implemented was beneficial for all the parties involved and successfully achieved the objectives established *a priori*. In any case, further research on programmes and services for children is needed to guide future proposals.

1. Introduction

Relationships in early adulthood are affected by social experiences in childhood and adolescence, including factors related to special educational needs and social isolation (Velsvik & Kvalsund, 2016). Disability is a universal issue affecting child welfare around the world (Kayama & Haight, 2012). Particularly, the prevalence of Autism Spectrum Disorder

(ASD) has increased considerably in recent decades (Hamm & Yun, 2019). According to the latest report from the Center for Disease Control and Prevention, the prevalence of ASD is 18.5 per 1,000 (one in 54) in children at the age of eight (Maenner et al., 2020). ASD refers to a range of multisystem neurodevelopmental disorders that affect individuals from early childhood and come with challenges in terms of social communication and interactions (APA, 2013; Benson et al., 2019; Bo

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et al., 2019; Hamm & Yun, 2019).

Individuals with ASD are characterized by presenting repetitive patterns of behaviour, as well as restricted social interests and motivations (Jones & Frederickson, 2010; Robertson, Chamberlain & Kasari, 2003; Vakil, Welton, O'Connor & Kline, 2009). Moreover, many of them tend to have difficulties in important areas that affect development, such as creative play, sensory processing, contact with other people, maintaining eye contact, and adapting to noisy environments (Bowe, 2004; Wilmshurst & Brue, 2010). Some of their greatest difficulties in relating to others are conditioned by their narrow range of interests, resistance to change, and difficulty following rules (Habib, Montreuil & Bertone, 2018). These difficulties negatively affect their educational process, producing distortions in terms of learning, communication, and attention (Foti et al., 2014).

Children with ASD also show motor-related difficulties (Green et al., 2009; Whyatt & Craig, 2012). For example, in the case of basic motor skills, they present deficits in postural control and gait, alterations in laterality, and deficits in the control of fine motor skills, including manual dexterity, writing, and object control requiring visuomotor integration (Fournier, Hass, Naik, Lodha & Cauraugh, 2010; Kaur, Srinivasan & Bhat, 2018; McPhillips, Finlay, Bejerot & Hanley, 2014). In relation to fine motor skills, the literature reports that ASD populations show increasingly worse performance from adolescence into adulthood, and this deficit has a clear relationship with the adaptive skills of daily life (Travers et al., 2017).

Although motor difficulties are not universally reported in ASD populations, they may be quite common (Dewey, Cantell & Crawford, 2007). It is unclear whether all of these motor difficulties stem from the ASD itself or from a combination of different factors, such as lack of access, poor instruction, or decreased motivation (Fournier et al., 2010). In fact, Dewey et al. (2007) reported that gestural impairments displayed by children with ASD are not solely attributable to deficits in motor coordination skills. For instance, some motor difficulties may be due to failure to carry out physical activities with proper guidance such as how to do them in an organized way and providing clear and concise explanations to counteract ASD features (Colombo-Dougovito & Block, 2019). However, it is clear that there is a need to promote needs-led, context-specific, user-centred physical education programmes in the context of protecting children with ASD, in order to reduce their risk of social exclusion.

Although the educational inclusion of students with disabilities, including ASD children, has been widely promoted in recent years in the school setting (Eldar, Talmor & Wolf-Zukerman, 2010), there is still a need to truly foster their inclusion in society. In fact, the social isolation of children with ASD is well documented (McConkey, Cassin & McNaughton, 2020). A recent meta-analysis highlights the importance of their inclusion in organised physical activity (Howells et al., 2019). Interestingly, physical activity-focused interventions have been shown to improve not only motor skills, but also social outcomes, according to recent systematic reviews (Colombo-Dougovito & Block, 2019; Ruggeri, Dancel, Johnson & Sargent, 2019). This may be related to the fact that, according to the literature, there is an association between social and motor functioning in individuals with ASD (Ohara, Kanejima, Kitamura & Izawa, 2020). For instance, Lloyd, MacDonald and Lord (2013) claim that social deficits may act as a barrier to the development of motor skills, and motor deficits can act as a barrier to the development of social skills. Furthermore, empirical research on the topic supports the proposal that poor motor skills are associated with poor social skills and vice versa (MacDonald, Lord & Ulrich, 2013; Puspongoro et al., 2016), and advanced quantitative and neurodiagnostic methods demonstrate the relationship between motor function and social development (Wilson, Enticott & Rinehart, 2018). This reciprocal relationship is important because, as a consequence, although motor difficulties are not considered a core characteristic of ASD, recent investigations report that children with ASD have difficulties performing age-appropriate motor skills. In this regard, research has found percentages of motor difficulties

of 35% (Licari et al., 2020), 41% (Paquet, Olliac, Bouvard, Golse & Vavre-Douret, 2016), 77% (Liu & Breslin, 2013), and even 83% (Ruggeri et al., 2019) in ASD populations.

The World Health Organization (2013), as in the meta-analysis by Hollis et al. (2017), warns that children and adolescents should increase the amount of moderate-vigorous physical activity (MVPA) they perform because this is the type of intensity (comparable to walking fast or cycling) most directly associated with positive health effects. Specifically, the recommendation for children from 5 to 17 years old is to meet the goal of 60 min per day of MVPA (World Health Organization, 2013). In this regard, recent studies state that the amount of physical activity is similar in children with ASD and their Typically Developing (TD) peers until 5–7 years old (Thomas, Hinkley, Barnett, May & Rinehart, 2019), and they begin to show differences in middle childhood that become more prominent during adolescence (Healy, Aigner, Haegele & Patterson, 2019; Ratcliff, Hong & Hilton, 2018; Stanish et al., 2017). Likewise, a recent systematic review suggests that children and young people with ASD generally engage in less physical activity than their TD peers (Jones et al., 2017), which is probably due to the few opportunities they have to engage in such activities (Meyer et al., 2013). In any case, it is important to increase physical activity because a lack of MVPA is associated with the risk of heart disease, diabetes, and cancer (US Department of Health and Human Services, 2012). Hence, Liang, Li, Wong, Sum, and Sit (2020) highlight the need to design and implement effective interventions for children and adolescents with ASD to foment the accumulation of physical activity during and after school hours.

Different proposals that focus on meeting this need have started to emerge. In this regard, interventions and services aimed at promoting community participation by individuals with ASD through physical activity have proven effective, several of them specifically targeting motor and social skills (Colombo-Dougovito & Block, 2019; Ketcheson, Hauck & Ulrich, 2017; Ruggeri et al., 2019). For example, Rivera, Renziehausen and Garcia (2020) recently carried out a study to examine the effects of an eight-week judo programme on behavioural factors in children with ASD who did not present severe physical limitations or display violent behaviours. This programme was taught by three certified instructors and a tutor for the 33 participants. Each session lasted 45 min, began with a formal opening and description of the class, and closed with a few minutes of mindfulness. Their findings suggest an improvement in the participants' social skills. Similarly, Najafabadi et al. (2018) analysed the effect of the SPARK physical education programme. The 36 sessions were 40 min long, had three different parts, and were supervised by an expert psychologist and three PE coaches for 28 children. The authors concluded that this training can be seen as a therapeutic option for improving social skills in children with ASD who do not present any serious medical conditions. In addition, Zhao and Chen (2018) investigated the effects of a structured physical activity programme for young children with ASD who were about six years old. The sessions in the 12-week programme had four parts and used a reward system. During each session (60 min), the 25 participants were divided into groups of five, and each group was assigned a teacher. Their results show that the programme positively influences the social interaction and communication skills of children with ASD. Therefore, according to the literature, physical education and physical activity-led programmes may be considered an optimal opportunity for children with ASD to improve their social skills, in addition to giving them the chance to interact with peers in an out-of-school setting.

In this context, Service-Learning (SL) in Physical Education Teacher Education (PETE) programmes may be a potentially important mechanism to support the well-being of children with ASD and their families in ways that respond to and are appropriate for their particular circumstances and features. SL is a teaching methodology that seeks to develop academic and personal skills in the participating students while meeting a social need (Chiva-Bartoll, Moliner & Salvador-Garcia, 2020). The common denominator underpinning SL is a reciprocal process that simultaneously focuses on the interaction between the students'

learning experience and an unmet need in the community. A widely recognised definition to date is the one by [Bringle and Hatcher \(1995, 112\)](#):

A course-based, credit-bearing educational experience in which students (a) participate in an organized service activity that meets identified community needs and (b) reflect on the service activity in such a way as to gain further understanding of the course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility.

This methodology has been applied in the field of PETE and targeted at children with developmental disorders on a number of occasions ([Chiva-Bartoll et al., 2019](#)). These programmes are both flexible and grounded in an understanding of the social needs within a particular context. In addition, their specific aim is to meet both individual needs and community circumstances, given that preservice physical education teachers design a specific programme that focuses on the particular features of the children receiving the service. In any case, there has to be mutual agreement among the participants (students, community, educators) when identifying and defining the service to be provided.

Despite the benefits of SL programmes in the PETE arena for both service providers and receivers ([Chiva-Bartoll et al., 2019](#)), their application and investigation with children with ASD are still scarce. Research is needed in this regard to gain a better understanding of the programmes implemented and the services provided, and determine whether these programmes are achieving their objectives. Well-designed research based on programmes and services for children is needed in order to improve and generalize their design, execution, teamwork, service delivery, and effectiveness. Gathering research data will help to provide scientific-based criteria to promote and support the most effective programmes and service initiatives.

However, to the best of our knowledge, no study has explored the effects of a physical education SL programme for children with ASD from a holistic perspective. The results may contribute to a better understanding of these practices, which will be instrumental in designing future proposals for providing ASD children with proper services adapted to their specific characteristics. To fill this gap in the literature, the main aim of the present study was to examine the effects of a physical education SL programme in children with ASD. To address this issue, two different specific objectives were established: (1) to understand the impact of the programme from the viewpoints of PETE students and the families of children with ASD; and (2) to analyse the programme's effects on the motor domain of children with ASD (i.e., physical activity levels and development of basic motor skills).

2. Method

2.1. Design

This study used a mixed-methods approach ([Anguera, Blanco-Villa-señor, Losada, Sánchez-Algarra & Onwuegbuzie, 2018](#)) to address the primary objective. Specifically, we used a concurrent triangulation design ([Creswell, Plano, Gutmann & Hanson, 2003](#)). The research encompassed quantitative and qualitative data derived from a physical education SL programme for children with ASD carried out in the Valencian Region (Spain). For the first specific objective (O1), a qualitative approach was used to obtain data from two group interviews with parents of the children involved in the programme and a group interview and 52 reflective journals from the participating PETE students. The second specific objective (O2), using a quantitative approach and focusing on the motor domain effects, involved a quasi-experimental design with two non-equivalent groups (experimental and control), with pre-test and post-test measures, to compare how participation in the SL programme affected children with ASD in terms of their: (1) physical activity levels, to discover the effect of the programme on the

amount and intensity of physical activity carried out by the participants; and (2) motor skills development, to analyse its impact on the quality of movement.

This study design allowed us to gather qualitative and quantitative data to examine the phenomena at multiple levels, in order to combine the strengths of the two approaches and develop a more comprehensive understanding of the SL programme ([Creswell & Plano Clark, 2017](#); [Tashakkori & Teddlie, 1998](#)). In this regard, the mixed-methods design is one of the most widely used modalities in western educational research because the educational setting is complex to analyse due to the many factors affecting this scenario ([Johnson & Christensen, 2012](#)). Particularly, this approach is frequently used in studies examining educational programmes (i.e., [Augsberger, Zeitlin, Rao, Weisberg & Toraif, 2021](#); [Malvaso & Delfabbro, 2020](#); [Sawrikar, 2020](#)), and recent studies propose that mixed-methods research is a useful tool for the evaluation of educational interventions and should be considered by researchers undertaking such projects (i.e., [Punukollu, Burns & Marques, 2020](#)). Furthermore, mixed methods are also recommended for specific SL research, as reported in a recent systematic review on this topic ([Pérez-Ordás, Nuviola, Grao-Cruces & Fernández-Martínez, 2021](#)). In our study, this approach was useful because it combined the insights and data of the different agents involved (families, children with ASD, and PETE students). Overall, the different sets of data provided stronger evidence of the programme's effects through the convergence and corroboration of the findings. Thus, this information may be instrumental in guiding the development, execution, and evaluation of similar interventions. An overview of the research is shown in [Fig. 1](#).

2.2. Participants

The research team contacted schools and organizations that serve children with ASD throughout the Valencian Region to recruit participants for the physical education SL programme. They informed them about the research objectives and the criteria for participating in the study. Initially, all the families of the participating children wanted to take part in the physical education programme, but some of them could not do so due to time incompatibilities and/or other logistical issues. Therefore, they could decide whether to be included in the experimental group or the control group, so that everyone had the opportunity to take part in the programme. The children in the control group did not carry out any extracurricular activities that involved physical activity, as reported during regular interviews with their families.

For specific-O1, the sample was composed of 12 parents of children with ASD and 52 PETE students involved in the physical education SL programme. The interviewees were chosen using the expert sampling technique ([Patton, 2002](#)). The choice of this sampling technique was determined by the characteristics of the participants. Parameters such as loquacity, involvement in the programme, gender (parity), predisposition, and interest in participating in the study were considered.

With regard to specific-O2, the sample was composed of 25 children with ASD, 15 in the experimental group (4 girls, 11 boys; age: 10.13 ± 2.56 years; Body Mass: 38.20 ± 17.03 kg; Height: 138.29 ± 14.09 cm; BMI: 19.70 ± 6.42) and 10 in the control group (1 girl, 9 boys; age: 10.13 ± 3.09 years; Body Mass: 37.21 ± 16.00 kg; Height: 140.13 ± 17.18 cm; BMI: 18.17 ± 5.30). The samples were previously compared to verify that they were not significantly different (Age: $p = 0.995$; Body Mass: $p = 0.904$; Height: $p = 0.788$; BMI: $p = 0.604$). The inclusion criteria consisted of having a clinical diagnosis (by trained professionals) based on the diagnostic standards for ASD established in the DSM-IV-TR ([APA, 2000](#)) or DSM-V-TR ([APA, 2013](#)), as well as an IQ > 70, as in previous interventions with children with ASD ([Borgi et al., 2016](#)), and some degree of functionality in terms of communicating, understanding, and following instructions. We also selected and analysed the data of the children who participated in the whole programme, who took MABC-2 pre- and post-tests and wore accelerometers for the required time.

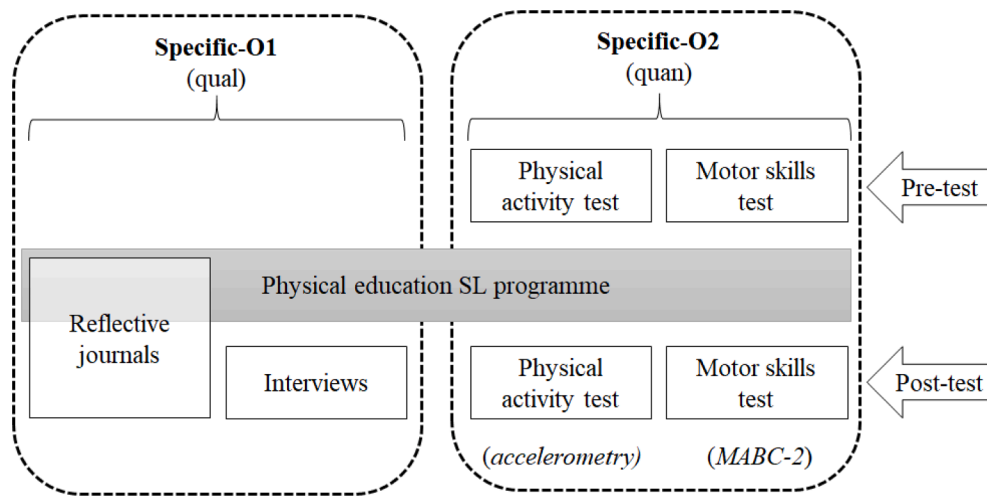


Fig. 1. Mixed-methods research design.

2.3. Physical education SL programme

The SL programme implemented had two purposes, one oriented towards the PETE students' training and the other towards the social service provided to children with ASD. On the one hand, in order to improve the PETE students' training, they implemented inclusive physical education sessions and adapted them specifically to children with ASD. Thus, they were able to reinforce the theoretical concepts and teaching skills learned in class. On the other hand, the social service objective was to serve children with ASD by providing a physical education programme aimed at promoting active lifestyles and social inclusion through motor skills-based games and activities.

In this context, the experimental group of children with ASD participated in the physical education SL programme between November and May. The programme was implemented in the sports facilities of the University that hosted the research, which provided a suitable location and equipment (e.g., smooth walls, spacious, bright, without exterior noise). Two one-hour sessions were held each week. All these sessions were led by the same PETE students and supervised by an expert psychologist and the university professors involved in the SL programme. The children with ASD were invited to bring siblings and/or friends to the sessions, and they also participated in the games and tasks so that the children with ASD would feel more comfortable. Between three and five typically-developing children attended some of the sessions. The implementation followed a series of guidelines established in the meta-analysis by Brock et al. (2017), as well as several teaching strategies that had been used in previous SL programmes (Chiva-Bartoll, Capella-Peris & Salvador-Garcia, 2020). The sessions relied mainly on a directive approach based on direct instructions, with modelling techniques, visual support, continuous feedback, and individualised instruction when needed. Moreover, the children with ASD were offered as many activities as possible, which allowed them to select their own participation level based on their abilities.

The participating children with ASD displayed a high degree of adherence to the programme, given that the average attendance was 91.2%. The design of the sessions was previously sent to the families so that they could help the children anticipate the tasks at home. All the sessions had a very simple structure that focused on providing the children with opportunities for social interaction and future practice of healthy, recreational, and educational motor activities. A typical session consisted of 5 to 10 min of simple warm-up activities, 45 min of activities or games focusing on motor skills and body expression, and a dynamic cool-down to finish the session. Each session was composed of both group dynamics based on social interaction (e.g., parachute games, teamwork, and dancing games), carried out mainly during the warm-up

and cool-down parts of the session, and analytical activities in groups of three or four children based on the age range (e.g., manipulative skills, balance, and gross coordination). Each session was supported by several PETE students, which made it possible for a children to staff ratio between 3 and 5, depending on the day and age group. PETE students took part in the PETE programme of the University that hosted the programme. Of the different alternatives offered within the subject 'Learning and motor development', they chose the SL option, which meant that they learned the curricular content while providing the service. All of them had previously participated in subjects on educational inclusion and attended a specific training seminar on adapting physical activities for children with ASD.

2.4. Instruments and procedure

2.4.1. Qualitative instruments related to the perspectives of the PETE students and the families involved

On the one hand, two group interviews were carried out, with six parents in each, to observe the perspective of the families served by the programme. On the other hand, a group interview with six students and 52 reflective journals were used to understand the point of view of the participating PETE students.

- *Group interviews.* A semi-structured interview format was used because it allows the interviewees to provide detailed information, but at the same time the interviewer still has good control over the data received. In addition, it ensures a degree of comparability across interviews while allowing different ideas to arise (Creswell, 2012). Interview questions were created to help us understand the meaning and effect of the physical education SL programme, such as the strengths of the programme and the challenges faced. The interviews consisted of 'ice breaker' questions, general and specific questions, and a conclusion question aimed at obtaining further observations from the interviewees. For instance, informants were first asked open questions, such as: 'What has this experience meant to you and your child?' Or 'What have your personal thoughts and feelings been during it?' The questions then became increasingly closed and more specific, such as: 'How has the programme affected your understanding of PETE programmes and educational inclusion in general?'
- *Reflective journals.* In order to explore the perspective of the PETE students, non-graded reflective journals, one of the most widely used strategies in SL, were used (Nolan, 2008; Schön, 2016). 'The act of writing facilitates deeper analysis of the experience by assessing and articulating it' (Pavlovich, 2007, 284). The assignment asked students to describe their personal experiences and explain what they

had gained from the SL experience. Particularly, the PETE students were asked to write about their experiences, focusing on two main topics, by answering several related questions: (1) learning and training (e.g., In your opinion, what teaching abilities have been put into practice?) and (2) personal feelings (e.g., How did you feel during the programme?).

2.4.2. Quantitative instruments related to the motor domain.

All the participants were assessed on the outcomes of physical activity levels and motor skills development at two different time points, before and after the physical education SL programme. The instruments used were:

- *Accelerometry*. Physical activity levels and frequency were assessed using triaxial accelerometers (Actigraph, xGT3X-BT, Pensacola, FL, USA), a small device (size: 4.6 cm × 3.3 cm × 1.5 cm; weight: 19 g) that measures physical activity on three planes at an epoch length of 10 s. The children wore it on their right hip on seven consecutive days. The families were given specific guidelines about how to use the accelerometer, so that it would not affect the children sensorially. Data were collected between October and the first week of June, before and after the intervention programme, respectively. The data obtained from the accelerometers were processed using Actilife software (version 6.13.3, Actigraph). The cut-off points were selected according to the criteria of [Freedson, Pober and Janz \(2005\)](#) (Sedentary: 0–149; Light: 150–499; Moderate: 500–3999; Vigorous: 4000–7599; Very Vigorous: 7600 and above). MVPA was calculated as the mean of the sum of MVPA, as in the study by [Ketcheson et al. \(2017\)](#).
- *MABC-2*. Motor competence was objectively assessed in three dimensions: Manual Dexterity (MD), Aiming & Catching (A&C), and Balance (Bal), through the Movement Assessment Battery for Children-2 (MABC-2), validated by [Henderson, Sugden, and Barnett \(2007\)](#) and meeting the standards for validity and reliability ([Schulz, Henderson, Sugden & Barnett, 2011](#); [Schoemaker, Niemeijer, Flapper & Smits-Engelsman, 2012](#)). This test contains a total of eight motor tasks for each of the three age ranges it establishes (4–6, 7–10, and 11–16). We used the specific range according to each child's age, considering the structural validity across the three age bands reported by [Schulz et al. \(2011\)](#).

2.5. Data analysis

2.5.1. Qualitative data analysis

The 412 pages obtained from the transcription of the reflective journals and group interviews were analysed using a multiphase approach based on an initial open-coding phase and a second axial-coding phase. Considering the potential of Computer Assisted Qualitative Data Analysis (CAQDAS) ([Odena, 2013](#)), NVivo software was used. First, the research team coded the information from both instruments, that is, the group interviews and reflective journals. This helped the researchers to go backwards and forwards between the connected datasets to make sense of the analysis in the second phase, axial coding, which focused on using the previously coded information to obtain and organize the emerging nuclei, moving between inductive and deductive reasoning ([Flick, 2014](#)). In this phase, the researchers established the different categories when they were theoretically saturated, analysing the information from both instruments together. Lastly, representative quotations were selected to create this report.

A number of procedures were adopted to ensure the trustworthiness of the findings ([Smith & Sparkes, 2016](#)): triangulation among three different members of the research team in each phase of the analysis, a member-checking process to ensure that researchers interpreted what participants meant, and a step-by-step description of the procedure carried out, in case other researchers would like to replicate the study.

After the data were analysed, a professional translated them into

English for publication. Codes are used to protect the interviewees' identities. The reflective journals are identified by the acronym RJ and the number of the PETE student assigned (1–52). For the group interviews, the acronym (GI) is followed by two numbers, one referring to the number of the GI and the other to the participant involved in each GI (1–6). The family GIs are numbered 1–2, and the PETE student GI is number 3.

2.5.2. Quantitative data analysis

We used descriptive analysis (mean and standard deviation) to characterize the sample. After performing the normality test, we described the accelerometer and MABC-2 data with the median and interquartile ranges to characterize the baseline (T1) and post-intervention (T2) results, as well as the T2-T1 results. We performed the Wilcoxon *T* test to compare the results before and after the intervention programme, at a significance level of $p \leq 0.05$. The characterization of the sample and the difference in the results were compared between groups using the Mann-Whitney *U* test ($p > 0.05$). We also calculated the effect size (Cohen's *d*), considering 0.2, 0.5, and 0.8 as small, medium, and large effect sizes, respectively ([Cohen, 1988](#)).

2.6. Ethical considerations

All the parents or legal guardians of the children signed an informed consent form during an information session prior to the start of the study. This study was approved by the University's Institutional Review Board, and all the researchers followed the ethical guidelines established in the [Declaration of Helsinki \(1964\)](#). To counteract ethical conflicts, the adults responsible for the children involved could decide whether they should be included in the experimental or control group, so that everyone had the option to attend the physical education SL programme. Furthermore, a similar programme was implemented again the following academic year without restricting participation.

3. Results

3.1. Qualitative findings related to the perspectives of the PETE students and families involved

A Venn Diagram ([Fig. 2](#)) shows the findings obtained from the qualitative data. Two types of categories emerged: on the one hand, those referring to the shared views of PETE students and families (e.g., 'Motor-related benefits for children', 'Social impact regarding inclusivity', and 'Teacher training quality'); on the other hand, unique categories that emerged from each particular perspective (e.g., 'Personal growth' from the PETE students and 'Desire for consolidation of the programme' from the families).

We will address the shared categories first, and then the single-group categories.

- Motor-related benefits for children

Regarding the motor-related benefits for the children with ASD reported by both the families and the PETE students, the content analysis shows a series of shared impressions. The PETE students clearly noticed an evolution in terms of the disposition of the children with ASD towards the assigned motor tasks.

'At first, many (children with ASD) were reluctant to participate, but every day we were gaining ground in that regard, and little by little they participated more actively'. GI.3.5

'I'm not really sure if their skills have improved, but it is clear that by the end of the programme, they showed everything they were capable of.' GI.3.2

In this regard, the families describe how their children seem to be

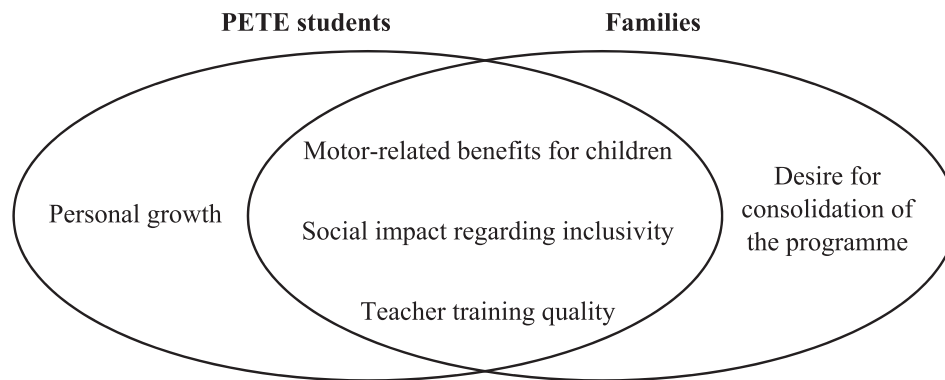


Fig. 2. Venn diagram of the categories that emerged.

much more comfortable in these sessions than in physical education at school. In the context of the programme, parents report the feeling that their children face physical activities with less fear and are willing to do many activities.

‘Here (referring to the sports facilities where the programme took place), once they (the children) saw what the programme was about, they began to feel motivated and much more willing.’ GI.1.1

‘Yes, I have had to hide the pictogram of the programme from mine (son). I made him one (pictogram) on purpose to anticipate the programme sessions, but he kept putting it on the pad constantly because he wanted to come every single day.’ GI.1.4

Families also agree that attending the SL programme helped their children to follow patterns and motor sequences that they did not know before. For instance, a mother points out that she felt surprised when her son asked her to play a new game he had learned in the SL programme.

‘I am totally convinced that they have learned some motor skills. For example, it was a milestone for me the day that Christian (not the child’s real name) asked me to play “rock-paper-scissors” at home. It may seem silly to you, but it almost made me cry. I thought he would never learn how to play that game.’ G2.5

Likewise, families highlight the fact that their children stopped feeling so unskilled thanks to the programme, as a motor skills-related benefit. Many parents strongly believe that regular physical education frustrates their children because they do not perform at the level of their classmates. However, they are convinced that the experience was different in the programme. Parents perceive that their children felt like any other child in the group during the SL sessions.

‘For a father who is used to seeing his son accumulate one frustration after another at school, it is priceless to see how the kid does not feel like the clumsiest one in the class for once.’ G1.6.

- Social impact regarding inclusivity

The social value of the SL programme carried out is another outcome that emerged. The social impact is shaped by different approaches. The PETE students refer to the need to continue to promote educational projects with a social/community vocation.

‘Participation in this service has made me understand the social/community aspect of education. Our objective as teachers is not only to transmit content to our students, but also to build a more inclusive society.’ RJ.5

‘Of all the educational experiences I have had throughout my academic career, this SL project has the clearest social and

transformative focus. We are not just learning content about educational inclusion, we are directly implementing it.’ GI.3.3

In addition, the parents point out that this specific programme affects one of the critical points related to their children’s social inclusion: play and interaction with their peers.

‘For our children, this experience is very important because one of the most critical aspects of their socialization is the relationship with other children through playing games. It is during school breaks when they are the most isolated. Everything they learn in this programme helps them cope at those times.’ GI.1.4

Moreover, parents also point out that, because no alternative extra-curricular physical activities for ASD children are offered in the region, SL programmes like this one make a lot of sense.

‘We think it is a good way to make the university reach everyone. It’s a good way to spend our tax money.’ GI.2.3

Therefore, through SL carried out at the university, the families involved in the programme feel that society takes them into account and makes them feel included.

- Teacher training quality

In relation to the quality of the teacher training, both the PETE students and the families receiving the service report positive views. On the one hand, the PETE students indicate that SL brings together theory and practice in a very operative way.

‘Having the opportunity to complement theoretical learning with this applied programme definitely improves the quality of our training.’ GI.3.6

In addition, they understand how their professional training is improved and complemented from a social perspective.

‘This approach allows us to develop skills and competencies related to teacher training, but combined with a social perspective.’ RJ.17

The parents, who feel very committed to teacher training due to their experience with their children, also welcome this type of programme because it reinforces specific training related to children with special educational needs.

‘This type of programme helps teachers to better understand our children’s needs. They (the teachers) will stop looking at them in fear and become better prepared than previous generations.’ GI.2.3

In addition, families are in favour of educational programmes that make PETE students face their training in real conditions with children with ASD.

‘This way they learn about our children from real experiences rather than just from handbooks, and that is very beneficial for their training.’ GI.1.6

- *Personal growth*

Personal growth is a category that emerges specifically from the PETE students’ perspective. It brings together all the visions of this group that refer to individual maturation and development of their identity.

‘The SL has not only helped me to better understand the teaching profession, but it has also allowed me to get to know myself better by requiring me to act in a real situation where my contribution was essential.’ RJ.12

‘I really feel that my vision of society and life after this experience has changed. Personally, SL has opened my eyes to better understand the type of person and teacher I want to be in the future.’ RJ.49

Therefore, we see that experiencing SL not only involves technical or purely instrumental learning, but it also affects the personal development of the participating students.

- *Desire for consolidation of the programme*

Finally, the desire for consolidation of the SL programme is the last category that emerged from the analysis, in this case by the families receiving the service.

‘All of us agree that we would like this programme to continue and become institutionalized in some way.’ GI.1.1

‘It does not seem fair to us that these initiatives are a matter of the good will of a few professors and their students. We think they should have more support and endorsement from the administration.’ GI.1.4

This category emerges as an appeal from the group of recipients of the service for the SL to be supported by educational policies and administrations.

3.2. *Quantitative findings related to effects on physical activity levels and basic motor skills of children with ASD*

The MVPA intensity of the children with ASD improved on weekdays and at weekends. In particular, we observed significant differences in the number of minutes of moderate physical activity performed on weekdays. However, no significant improvements were observed in the control group (Table 1).

The results of the MABC-2 test also improved on all the tests in the experimental group, whereas the results for the control group remained stable (Table 2).

4. Discussion

According to the results of the present study, the parents and PETE students involved in the physical education SL programme referred to effects related to five different categories: ‘Motor-related benefits for children’, ‘Social impact regarding inclusivity’, ‘Teacher training quality’, ‘Personal growth’, and ‘Desire for consolidation of the programme’. In addition, there was an objective improvement in physical activity levels and some motor skills in the children with ASD who received the service. The mixed-methods approach using methodological triangulation offers a great opportunity to analyse the effects of the physical education SL programme because the data obtained provide a comprehensive understanding of the programme carried out. Moreover, the qualitative categories that emerged complement the quantitative findings, providing stronger evidence for the results (Creswell et al., 2003). Therefore, the discussion of this category will be considered along with the quantitative results.

‘Motor-related benefits for children’ was the first category that emerged from the perspective of both the parents and the PETE students. These results refer to an appreciable predisposition and acceptance of motor tasks by the children with ASD, as well as the perception of not feeling unskilled. These qualitative outcomes are consistent with previous studies that analysed physical activity programmes for children with ASD. For example, Bo et al. (2019) found significant improvements in motor skills in all the participants in their pilot study. Similarly, Ketcheson et al. (2017), in another pilot study, found positive results of their intensive motor skills intervention on three motor outcomes, including locomotor skills, object control, and the total gross quotient.

In addition, the findings obtained from the qualitative part of our study are supported and complemented by the quantitative results based on accelerometry and the MABC-2 test measures. Statistically significant differences were found in physical activity levels and motor skills. Regarding accelerometry, moderate intensity physical activity by the children with ASD improved on weekdays and at weekends. The literature on the impact of physical education programmes for children with ASD on their physical activity levels presents conflicting results in this regard. Whereas some studies show significant improvements (Garcia et al., 2019), others do not present such clear increases (Ledford, Lane, Shepley & Kroll, 2016). These inconsistent viewpoints might be related to the age of the ASD participants (Pan et al., 2011); therefore, research is needed to further explore this topic. In any case, the improvement obtained is important because there is a need to increase the time children and adolescents spend on MVPA (Hollis et al., 2017).

Regarding motor skills, it is important to remember that children with ASD usually present difficulties or delays in fine motor skills, gross motor skills, or both (Ament et al., 2015; Kaur et al., 2018). Therefore, the participants’ improvement in this outcome thanks to the greater practice involved in the physical education SL programme may help to achieve better overall motor skills (Lopes, Santos, Pereira & Lopes, 2012). According to the results of the MABC-2 test, all its components improved after intervention. These findings are consistent with previous work analysing motor coordination and manipulation skills of children with ASD after participating in intervention programmes (Bremer,

Table 1
Accelerometry results for weekdays and weekends.

	Experimental group					Control group					Differences in ES (Intervention- control)
	Median		T2-T1	Z	Effect Size	Median		T2-T1	Z	Effect Size	
	Pre (IQ)	Post (IQ)				Pre (IQ)	Post (IQ)				
Week days	94.17 (98.98)	195.33 (336.17)	109.44 (103.42)***	-3.10	0.41	113.63 (154.88)	195.33 (336.17)	72.35 (174.63)	-1.58	0.31	0.26
Weekends	149.00 (175.88)	223.58 (182.06)	36.50 (170.50)	-0.67	0.42	90.75 (87.81)	117.75 (71.50)	32.75 (122.98)***	-0.05	0.34	0.02

*** p ≤ 0.05.

Table 2
MABC-2 test results for its three dimensions and the total score.

	Experimental group					Control group					
	Median					Median					
	Pre (IQ)	Post (IQ)	T2-T1	Z	Effect Size	Pre (IQ)	Post (IQ)	T2-T1	Z	Effect Size	Differences in ES (Intervention-control)
MD	1.00 (1.50)	2.00 (4.50)	1 (5.25)*	-2.41	0.30	3.00 (8.25)	1.50 (5.75)	-0.50 (2.00)	-0.77	0.21	0.34
A&C	1.00 (1.00)	1.50 (5.25)	0 (3.00)	-1.13	0.13	2.00 (6.25)	1.50 (4.25)	-0.5 (0)	-1.30	0.09	0.38
Bal	4.00 (5.00)	5.00 (8.00)	0.50 (5.25) *	-2.02	0.15	3.00 (9.25)	3.00 (9.00)	1.00 (2.25)	-0.30	0	1.22
Total	2.00 (8.00)	2.50 (7.75)	0.50 (3.75)	-0.50	0.06	3.00 (9.00)	2.50 (4.00)	-0.5 (0.25)	-1.36	0.07	0.38

IQ: Interquartile Range. *: $p \leq 0.05$.

Balogh & Lloyd, 2015; Healy, Nacario, Braithwaite & Hopper, 2018). In the present study, we found statistically significant improvements on the MD and Bal measures, probably because the majority of the tasks performed during the sessions focused on developing manipulative skills, balance, and gross coordination, whereas A&C was not always practised. It might be interesting, therefore, to include more A&C-related activities in future interventions.

Furthermore, improvements in the motor domain seem to positively affect the social domain of children with ASD (Ketcheson et al., 2017) because improvements in one area can have an impact on the other (Wilson et al., 2018). Movement provides opportunities to engage in social activities and develop social relationships (Leonard & Hill, 2014). Therefore, motor and social functioning, two areas that commonly affect individuals with ASD, may be improved through physical activity programmes (Guest, Balogh, Dogra & Lloyd, 2017; Ketcheson et al., 2017; Najafabadi et al., 2018), such as the physical education SL programme carried out in the present research.

This relationship is directly related to the second category that emerged from the PETE students' and parents' perspectives, 'Social impact regarding inclusivity'. Specifically, these qualitative results allude to the importance the interviewees give to the SL programme from two perspectives. First, it improves crucial elements for the development of children with ASD (play, social interaction, and motor development); and second, it makes the families themselves feel more socially supported. In this regard, previous studies highlight that families of the ASD population describe a general feeling of lack of acceptance within their communities (Blagrave & Colombo-Dougovito, 2019). By providing ASD children with needs-led, user-centred services and opportunities for activity, their families seem to be less likely to feel socially isolated (Marggraff & Constantino, 2018), which is an important effect of the physical education SL programme. In fact, social support may help children with ASD and their families to achieve a more satisfying lifestyle (Stacey, Froude, Trollor & Foley, 2018) and greater opportunities for social interaction and growth (MacDonald et al., 2013).

Both the families and the PETE students agreed on a third effect of the physical education SL programme related to the enhancement of 'Teacher training quality'. Regarding this category, the qualitative analysis offered nuances about the overlap between theory and practice and the development of professional training from a social perspective. This effect is somewhat expected after an SL intervention, and it has been consistently highlighted in research on PETE. Teacher education students acquire technical lessons typical of the physical education arena (i.e., adjusting spaces, materials, explanations, or groupings) (Cervantes & Meaney, 2013), and they improve their capacity to overcome difficulties *in situ* and adapt activities to students with special educational needs (Chiva-Bartoll, Capella-Peris et al., 2020). However, there is still a need to pursue this issue because families of children with ASD claim that proper staff training is not sufficient (Blagrave & Colombo-Dougovito, 2019). In fact, the families in our study explained that their children do not feel comfortable in physical education classes

at school, probably due to a lack of quality training for teachers. Thus, policy makers would do well to add and even prioritize training for teaching students with ASD and special educational needs in general because staff often lack adequate training and knowledge to meet the needs of this population (Dillenburger, McKerr, Jordan & Keenan, 2016). In any case, SL programmes such as the one in this study seem to be appropriate options to enhance preservice teacher training from an inclusive perspective.

As another effect of the physical education SL programme, the PETE students brought up the topic of their 'Personal growth'. They stressed that SL was far more than technical learning because it enhanced their personal development. Specifically, interviewees alluded to personal growth in terms of individual maturity and the development of their identity. This outcome is linked to a reformulation of personal values and beliefs about the PETE students' way of relating to others (Butin, 2003). Previous studies on SL in the teacher training field have specifically focused on trying to understand the effects on the comprehension of concepts such as diversity, inclusion, social justice, and multiculturalism (Amaro-Jiménez, 2012; Delano-Oriaran, 2014; Miller, 2012), fostering social aspects such as social commitment in university students (Domangue & Carson, 2008). Therefore, the SL programme used in the present study seems to be in line with previous analyses of experiential learning through SL in the physical education context (Whitley, Walsh, Hayden & Gould, 2017).

Finally, the last category families referred to was 'Desire for consolidation of the programme', and they overtly expressed their wish for SL to be supported by educational policies and administrations. In this regard, the families also claim that they often feel neglected, and so they regret that the SL programme had to end. In general, there is a lack of opportunities to engage in physical activity or sports programmes specifically designed for children with ASD (Blagrave & Colombo-Dougovito, 2019; Reinders, Branco, Wright, Fletcher & Bryden, 2019), and this concerns many parents (Nichols, Block, Bishop & McIntire, 2019). Therefore, providing an accessible programme for children with ASD that enhances their opportunities to be physically active, improves their motor skills, and promotes social inclusion and development seems to be an important service that families would love to maintain in the long term.

As expected, the physical activity programme helped children with ASD to improve their physical activity outcomes, as well as their motor and social skills (Bremer et al., 2015; Habib et al., 2018; Ketcheson et al., 2017). However, perhaps a more important observation relates to the understanding of the features of the SL programme that helped to make it effective, not only for children with ASD, but also for PETE students. It appears that the SL methodology helped to ensure that there were enough staff members (PETE students and university professors) to pay almost individualized attention to each child. In addition, the sessions always followed the same simple structure and used motor skill-based games and activities that mainly relied on a directive approach, in order to better address the features of children with ASD (Ruggeri et al.,

2019). Moreover, they were held in an appropriate location with suitable equipment. This experience was also enriching for PETE students as a way to better prepare and develop their future physical education sessions as teachers, ensuring the incorporation of an inclusive perspective thanks to the knowledge acquired through practice (Chiva-Bartoll, Moliner et al., 2020).

The strengths and advantages of the research presented here include the features of providing an in-depth, detailed, comprehensive, and objective examination of the variables analysed, and the possibility of making naturalistic generalizations (Tracy, 2010; Yin, 2009). However, there are a number of limitations that should be considered, including the sample size, which in turn limits the statistical analysis as well as the formal or categorical generalizability of the findings. In fact, this is a common issue in research that attempts to explore intervention programmes (Sandoval & Bell, 2004). However, studies with ASD populations usually rely on data gathered with a similar number of participants (Reinders et al., 2019). For example, a recent review by Liang et al. (2020) showed the characteristics of 21 studies, 60% of which included samples with ≤ 30 participants. However, the quasi-experimental design of the study attenuates this limitation. Finally, further research that includes data characterizing the families of children with ASD could help to better understand the results obtained, and follow-up measures could be useful to understand the effects of the programme in the long term.

5. Conclusions

SL programmes for children need to be analysed to obtain effective evidence and research-based criteria for future proposals. Based on a mixed-methods approach, this study reports the effects of a physical education SL programme provided to the participating children with ASD to promote their motor skills, active lifestyles, and social inclusion and improve the training of the PETE students involved. On the one hand, the qualitative findings help to understand the impact of the programme from the viewpoints of the PETE students and the families of the children with ASD. Five content categories emerged from the data collected. Three of them were shared by both groups, the families and the PETE students: 'Motor-related benefits for children', 'Social impact regarding inclusivity' and 'Teacher training quality'; whereas two emerged from the particular perspective of each group: 'Personal growth' from the PETE students and 'Desire for consolidation of the programme' from the families. On the other hand, regarding the motor domain of the children with ASD, the main findings showed that the skills of the children in the experimental group improved significantly, especially MD and Bal. This holistic investigative approach allows us to state that the SL programme implemented was beneficial for all the parties directly involved, successfully achieving the objectives established *a priori*. Therefore, it is necessary to provide physical activity programmes for children with ASD that enhance their opportunities to be physically active, improve their motor skills, and promote social inclusion.

In sum, this study has allowed us to identify some implications that may guide future SL interventions and evaluations in this field. Among them, we highlight that, on the one hand, the intervention should be implemented in a stable environment through simple and well-structured sessions, mainly based on modelling and visual techniques, as well as continuous feedback. An approximate length of six months, with regular weekly participation and high adherence rates, is recommended in order for the effects to be noticeable. Participating PETE students should be monitored by qualified educators and trained in educational inclusion and adapted physical activities. Regarding the children with ASD, the content of each session might be anticipated via their families. Likewise, inviting siblings and/or friends to the sessions may help children with ASD to feel more relaxed. In addition, mixed methods seems to be a good option to assess the complementary effects derived from the multidimensional factors affecting SL interventions.

Capturing the voices of the stakeholders and eliciting different effects (including those obtained from pre- and post-test standardized measures) can bring an important dimension to the evaluation and strengthen confidence in the findings by illustrating the experience from multiple perspectives and data sources. However, participating children should not be overloaded with excessive testing. In conclusion, although SL interventions will not completely eliminate the issue of the limited social and motor skills of children with ASD, the service provided seems to ameliorate these limitations while improving the specific training of PETEs.

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CRedit authorship contribution statement

Oscar Chiva-Bartoll: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Writing - original draft, Writing - review & editing. **María Maravé-Vivas:** Funding acquisition, Project administration, Resources, Supervision, Writing - review & editing. **Celina Salvador-García:** Conceptualization, Data curation, Methodology, Writing - original draft, Writing - review & editing. **Teresa Valverde-Esteve:** Data curation, Formal analysis, Software, Validation, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

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