SKIP-Cymru: Evaluating the Long-Term Impact of SKIP Teacher Professional Development on Children's Motor Competence

Abstract

Motor skill interventions addressing global developmental delays have shown to be effective but there is limited ecological validity and evidence of long-term effects in these studies. This naturalistic, cross-sectional study compared the MC of children (*n*=87) in classes of teachers previously trained in the SKIP-Cymru early years motor skill program compared to children (*n*=61) where teachers had no training in motor skill instruction. A secondary aim assessed teachers' ability to deliver SKIP-Cymru with fidelity 6 to 31 months after training. MC was assessed using the ball skills subscale of TGMD-3 and MABC2. Fidelity was assessed through a fidelity of implementation (FOI) evaluation completed during a lesson observation for teachers trained with SKIP-Cymru in the same week. Two, 2 Condition (SKIP-Cymru, Non-SKIP) X 2 Sex (Girls, Boys) ANOVAs revealed a significant main effect for Condition (p<.001;TGMD-3, MABC-2). The TGMD-3 showed main effect for Sex. Children taught by teachers trained in SKIP-Cymru had significantly better MC than those in the Non-SKIP schools, and boys outperformed girls in the TGMD-3. Teachers delivered SKIP-Cymru with FOI (between 68% and 87%). This study provides initial evidence to support more robust training of teachers to embed principles of SKIP Cymru in practice and impact child outcomes.

Keywords: fundamental motor skills, early childhood, fidelity of implementation, professional development

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Global Developmental Delays in Motor Competence

Research in Wales examining the play-based Foundation Phase curriculum identified a concerning gap in children's motor skill development (Wainwright et al., 2018). For several decades research has found that children from underserved and low socio-economic status (SES) environments have significant delays in fundamental motor skills (FMS), just at the time when they should be experiencing rapid development in these critical skills. FMS consist of object control (OC) skills such as throwing and catching and locomotor skills (LM) such as running and jumping (Goodway, Ozmun, & Gallahue, 2020) with these skills serving as the building blocks of future sports, recreational and physical activities (Clark & Metcalfe, 2002). The findings on FMS delay in Wales were in children across all demographic groups (John et al.,2019; 2024a). Since the initial finding of delays in Welsh children's FMS (Wainwright et al., 2018), research reports a continuing decline in FMS of pupils in Wales with studies showing an increase in the number of pupils below the 25th percentile (John et al., 2021, 2024a) and recent data showing 88% of 3-year-olds with poor motor skills (Wainwright et al., 2024). The findings in Wales reflect a growing body of literature that shows developmental delays in FMS across multiple geographic locations in countries as different as Indonesia (Famelia, 2018), the United Kingdom (Birch et al., 2016; Duncan et al., 2022; John et al., 2024a), Ireland (Behan et al., 2019; Bolger et al., 2018), Australia (Barnett et al., 2019; Okely et al., 2017), Brazil (Valentini et al., 2016), Belgium (Bardid et al., 2017; Brian et al., 2018a) and the USA (Robinson & Goodway, 2009; Brian et al., 2019).

The global developmental delays in FMS are further compounded by consistent sex differences in the motor skill development of OC skills. Boys generally outperform girls in both process (technique) and product (e.g., speed or distance) measures of OC skills (Goodway et al., 2010; Robinson & Goodway, 2009). More recently Zheng et al. (2022) and Martins et al. (2024) found boys outperformed girls on OC skills but there were significant differences in favour of girls in locomotor skills. Research by Garcia and colleagues (Garcia & Garcia, 2002) suggests that girls are more cooperative and supportive

in movement environments while boys are more competitive resulting in boys getting more practice trials than girls. Martins et al., (2024) highlight that there is a clear ontogenetic (environmental) aspect to raising children of different sex, positively influencing boy's MC over girls. It is clear that both boys and especially girls need early motor skill interventions to address these delays.

Critique of the Motor Skill Intervention Literature

Whilst global motor competence interventions have shown that with appropriate instruction and opportunities, delays in MC can be addressed with a high level of success (Brian & Taunton, 2018; Famelia, et al., 2018; Goodway, 2021; Lindsay et al., 2020), there are a number of weaknesses to this literature. The first issue is a lack of ecological validity of study designs and settings. Much of the research has used experts to deliver the interventions (Goodway & Branta, 2003; Lindsay et al., 2020), or undergraduate majors in exercise science (Robinson et al., 2011) presenting significant issues with translation of findings, ecological validity and the ability to scale-up interventions in natural contexts. A few studies in the literature have addressed this weakness by focusing on training teachers to implement FMS instruction in real world contexts (Brian et al., 2017a; Brian et al., 2017b; Campbell, 2024). One systematic and sustained approach to ecologically valid FMS interventions for young children is the "Successful Kinaesthetic Instruction for Pre-schoolers" (SKIP) motor skill intervention in the USA (Altunsoz & Goodway, 2016; Brian et al., 2017a, 2017b; Goodway & Branta, 2003; Robinson & Goodway, 2009) and Wales (SKIP-Cymru – Cymru is the Welsh word for Wales). Both SKIP and SKIP-Cymru have successfully trained teachers to deliver SKIP and bring about significant changes in FMS competence (John, 2021; John et al., 2022; Wainwright et al, 2019) in real world contexts.

A second critique of the FMS intervention literature is the lack of long-term follow-up on the teachers who have been trained in interventions like SKIP/SKIP-Cymru and the outcomes on the children they teach. It is not clear whether teachers trained in FMS interventions continue to apply this training after the research is completed. And if they do, are the teachers still able to deliver the intervention with fidelity to core principles. Nor is it clear whether the children taught by teachers who have been trained in evidence-based interventions like SKIP/SKIP-Cymru develop FMS competence

and have an advantage over their peers who are taught by early childhood teachers (ECT) without such training. Such research is needed and would provide evidence of the long-term value and return on investment of training teachers in evidence-based motors skill interventions.

A third concern of the ecologically valid motor intervention literature is that early childhood teachers do not possess the prior skills and knowledge to deliver motor skill interventions from their initial teacher training. Based upon the SKIP and SKIP-Cymru studies (Altunsoz & Goodway, 2016; Brian et al., 2017a, 2017b; Famelia, 2018; Goodway & Branta, 2003; John, 2021; John et al., 2022, 2024b; Robinson & Goodway, 2009; Wainwright et al, 2019), early childhood teachers (ECTs) need specific knowledge to deliver developmentally appropriate FMS interventions. This includes knowledge of FMS stages and the factors that impact FMS development (constraints), knowledge of differentiated instruction (an array of developmental tasks) and evidence-based instructional pedagogy (Goodway et al., 2020). Brian et al., (2018b) reported that ECTs in the USA had a concerning lack of knowledge about FMS and how to instruct them. The teachers also said they had low levels of perceived competence about teaching FMS, raising concerns about their motivation and ability to deliver effective FMS instruction for their children. This was also true in Wales where qualitative findings revealed a lack of teacher knowledge about FMS instruction and in particular OC skills (Wainwright et al., 2018). As the development of OC skills is more ontogenetic, teachers represent a key resource in the school environment to ensure timely motor development and the attainment of FMS competence. This concerning lack of knowledge highlights the need for professional development (PD) in this area (Randall & Griggs, 2021).

Other Approaches are Needed to the One Day Professional Development of Teachers

A typical approach to the PD of teachers has been the one-day workshop (Jess et al., 2017). However, the data on the impact of one-day PD on teaching behaviours is poor and translating PD into practice has long been recognised as a significant challenge in a variety of educational contexts (Harris et al.,2012; Fullan, 2012; Hargreaves & Fullan, 2015; Korthagen et al., 2001; Randall & Griggs, 2021).

What is clear from the teacher PD literature is that the knowledge and skills developed from one-day PD results in a "wash out" effect over time for teachers and thus has little impact on child outcomes (Patton & Parker, 2014). To address this wash out effect, Hargreaves and Fullan (2015) advocate a professional capital approach that combines: a) investment in teacher education (human capital), b) the creation of learning communities in schools (social capital), and c) drawing on the tacit knowledge of experience in a context (decisional capital) (Hargreaves & Fullan, 2015). They believe that such an approach will result in change in teachers' practice being embedded over time with cascading impact on child outcomes. However, there is no literature in motor skill interventions that uses such an approach.

SKIP-Cymru is the only motor skill intervention to date that has targeted a more comprehensive approach to teacher training in line with Hargreaves and Fullan's concept of professional capital. Originally, SKIP-Cymru studies implemented a one-day PD session in addition to on-going coaching or mentoring for the teachers during the intervention in response to concerns about wash-out effects (Brian et al., 2017a; Brian et al., 2017b; John, 2021). However, this research highlighted inconsistencies with the fidelity of implementation of SKIP-Cymru (John et al., 2024b) and the need to either train mentors for more consistency or to increase the depth of training for the ECTs so that they could embed the principles of SKIP-Cymru without the need for mentoring. Thus, drawing on the concept of professional capital, the SKIP-Cymru PD was further enhanced to involve more in-depth and accredited training. This involved investing in teachers' human capital through the training, creating a collaborative learning community (social capital) and drawing on teachers' experience in their own schools when applying learning (decisional capital). The new SKIP-Cymru PD aligned to professional capital and sought to address some of the many limitations of existing PD highlighted in the literature.

Evidence-based, Accredited SKIP-Cymru Training

The new accredited SKIP-Cymru module PD (level 4 accreditation is equivalent to first year undergraduate work) is studied over a term (10-12 weeks). Using a blended learning approach, the training combines online interactive learning of motor development theories, physical literacy and play

pedagogies with in-person practical workshops where the teachers apply the theory to practice. Between workshops teachers apply their learning back in their schools, reflect on their experiences and then return for a further two in-person practical workshops. To ensure the training is working, the accreditation requires two teacher assessments which are in the form of a practical delivery (filmed and uploaded to an online portal) and a reflective journal (applying motor development theory, physical literacy, and playful pedagogy in their classes). In-depth experiences and reflections of teachers on the revised SKIP-Cymru training have been collected and analysed as part of the wider research project but are not within the scope of this paper (Wainwright et al., 2022). To date, the effectiveness of this training has not been investigated.

This cross sectional and naturalistic study represents an initial investigation into whether ECTs who had been trained in the SKIP-Cymru Level 4 accredited training could deliver SKIP-Cymru with fidelity, and the potential impact on child outcomes. We believe that there would be significant differences in MC between children in the classes of ECTs who had previously (between 6 and 31 months) received SKIP-Cymru PD training compared to children who were in classes where teachers had not received SKIP-Cymru training. A secondary part to this research question was exploring potential sex differences in children's FMS competence in trained and untrained teacher's classes.

Method

Context and Participants

This study was conducted in Wales in a convenience sample of five primary schools involving eight classes. Four classroom teachers (classes 1.1; 1.2, 2.1; 3.1) in three schools had received no SKIP-Cymru training (Non-SKIP). Whilst four classroom teachers (classes 4.1, 4.2, 5.1, 5.2) in two schools had teachers trained in SKIP-Cymru. Among these primary schools, two were situated in small towns (2.0 enrolment 145 pupils; 3.0 enrolment 129 pupils), two in larger towns (4.0 enrolment 436 pupils; 5.0 enrolment 473 pupils) and the remaining school was rural (1.0 enrolment 151 pupils). Schools 2 and 4 were in underserved areas of with low SES with 17.8% and 32.7% free lunches (other

schools ranged from 4.8% to 8.5%). Schools 4 and 5 had 27.7% and 20.5% non-White British while other schools ranged from 4.9% to 12.1%. Attendance rates at the schools were high ranging from 88.9% to 93.5%.

Teachers for the study (*N*=8) were licensed primary school teachers who had received no training in motor development during their teacher training. However, all teachers were responsible for providing physical education for their children as there were no professional physical educators in Welsh primary schools. All the schools in the study were delivering the 'business as usual' curriculum requirements which consisted of one taught physical education session per class per week in a school hall or outdoor practical space. The difference between the SKIP-Cymru schools and the Non-SKIP schools was that the SKIP-Cymru teachers had previously received SKIP-Cymru training. None of the schools in this study had received additional PD for physical education. The only PD that the SKIP-Cymru teachers received was our training prior to the data collection. There were no additional physical activity programs running in any of the schools. The data were collected at the end of the academic year where the children had been in the teacher's classroom for the entire academic year.

Children in the study (*N*=148) were aged 5 to 6 years (*M*age = 73.67 months., *SD* = 5.40) with 84 girls and 64 boys. An overview of classes is presented in Table 1. A 2 Condition (SKIP-Cymru, Non-SKIP) X 2 Sex (boys, girls) ANOVA on age revealed no significant age differences by Condition ($p>.05$) or Sex ($p>.05$), and a non-significant Condition X Age interaction ($p>.05$). The mean age for the SKIP-Cymru group was 6.18 years and the Non-SKIP group was 6.08 years.

Insert Table 1 here

Instrumentation

MC was evaluated using both process and product measures. The process measure utilised the Test of Gross Motor Development third edition (TGMD-3; Ulrich 2020) using the OC (ball skills) subscale. The product assessment was the Movement Assessment Battery for Children - Second Edition (MABC-2; Henderson et al., 2007).

Test of Gross Motor Development-3

The TGMD-3 includes two subscales: locomotor and OC (ball) skills. This study only focussed on OC skills as it was these skills that were deficient in Welsh children (Wainwright, 2018). The standard protocol of the TGMD-3 (Ulrich, 2020) was implemented and included these following skills (number of points per skill in parentheses): striking a stationary ball (10); one-handed forehand strike of self-bounced ball (8); stationary dribble (6); catch (6); kick (8); overarm throw (8); and underhand throw (8) with a total subscale score of 56. The test was administered and digitally recorded in an inside gymnasium or outside space. OC raw scores were used rather than standard scores as the normative data for the TGMD-3 (Webster & Ulrich, 2017) were collected on a USA sample and thus not appropriate for a Welsh sample. Furthermore, the raw scores provided an assessment of each child's skill proficiency.

The data were coded by experienced members of the research team that had previous training and experience in coding motor skills. All coders achieved a 95% criterion on a “gold standard’ video compared to an expert coder prior to the start of the study. Thirty percent of the video underwent random checks for reliability by the research team. Overall interrater reliability for the double-blind sample was 92.5%.

Movement Assessment Battery for Children-2

The MABC-2 is divided into three age bands: band 1 (3–6 years), band 2 (7–10 years), and band 3 (11–16 years) with this study using age band 1. The test consists of three *subscales* with eight tasks (scoring methods in parentheses): *Manual Dexterity*: Posting coins (time); threading beads (time); drawing trail (errors); *Aim and Catch*: Catching a beanbag (number of catches); throwing a beanbag onto the mat (number of hits), and; *Balance*: One-legged balance (time); walking with heels raised (number of steps); jumping on mats (consecutive jumps). Children were individually assessed following the MABC-2 standard protocol in each of the three subscales, with each session lasting 20-30 minutes (Henderson et al., 2007). Interrater reliability was verified with 100% agreement between the lead researcher and another team member, an expert in physical education and motor development, who independently scored 20% of the participants. Raw scores were converted to age-and sex-adjusted

standard scores for the three subscale components, which were then combined into an overall standard score (1-19) and percentile. Unlike the TGMD-3, the MABC-2 was standardized on a UK population, so standard scores were appropriate for all three components and the total test score.

Fidelity of Implementation

A secondary purpose of the study was to examine if the teachers who had been trained in SKIP-Cymru were still able to deliver SKIP-Cymru with fidelity to the core principles and key elements. The Non-SKIP teachers were not evaluated as they had not been trained in SKIP-Cymru. Fidelity was assessed using a Fidelity of Implementation (FoI) tool on a single lesson observation due to time constraints. Evaluating a single lesson is a noted limitation of the study. All lessons observations were completed inside the school halls during the time designated for gross motor development in the same week on consecutive days. A scoring matrix was developed (see Table 2) aligned to the principles and key elements of SKIP-Cymru training and this was completed in the lesson observations (for greater detail of the fidelity of implementation of SKIP-Cymru see John et al., 2024b). The key elements for the FoI tool included score descriptions, and total possible scores (see Table 2). The FoI tool was scored 1 (partially present) or 2 (fully present) based on its presence, while 0 points were given if absent. For instance, if children engaged in the activity for 6 minutes or more, they received 2 points; for 5 to 6 minutes, they scored 1 point; and for less than 5 minutes, they received 0 points.

Insert Table 2 here

Procedures

Full ethical approval was gained (EC1109) for the research via the university ethics committee. Consent to perform the research was secured from the schools. First parental permission was secured from the parent or legal guardian of the child, then assent was secured from the children at school using developmentally appropriate methods. Pupil assent was an ongoing process throughout the study by observing body language and behaviour to ascertain whether children were happy to continue in the process. Teachers were consented at school. Both teachers and parents were able to take the consent

form home to consider their participation. All participants were able to withdraw at any point and have their data removed from the study.

All children were tested on the TGMD-3 and MABC-2 in a gymnasium or outside space at the school using standard protocols across a two-week period in July (summer term). FoI was assessed on SKIP-Cymru teachers only during one lesson (see above) in the same week.

Data Analysis

There were two major research questions. The first hypothesized that children whose ECT had been trained in SKIP-Cymru would have greater MC than children in Non-SKIP classrooms where the teachers were not trained in SKIP-Cymru. MC was defined broadly using: 1) OC raw scores of the TGMD-3, 2) total MABC-2 scores, and 3) the standard scores for each of the three sub-domains of the MABC-2 (manual dexterity, aim and catch, and balance). Two (OC skills of TGMD-3; MABC-2), 2 Condition (SKIP-Cymru, Non-SKIP) X 2 Sex (boys, girls) ANOVAs were conducted to examine if the children in the SKIP-Cymru classrooms had better OC raw scores or MABC-2 total scores than children taught by Non-SKIP teachers. As the MABC-2 total score was significant, then a follow-up analysis of the three sub-domains of the MABC-2 (manual dexterity, aim and catch, and balance) was conducted. As the three sub-domains were significantly correlated (r = .53-.89, p < .01) a 2 Condition (SKIP-Cymru, Non-SKIP) X 2 Sex (boys, girls) MANOVA was conducted on the three subscales of the MABC-2 with follow up univariate ANOVAs to examine significance on each subscale. Additionally, the two SKIP-Cymru schools had been trained at different times (6 months and 31 months) and we were interested to know if there was a difference between these schools for OC raw scores and MABC-2 total scores. Thus, two (OC raw scores, MABC-2), 2 School (school 4, 6-months training, school 5, 31-months training) X 2 Sex (boys, girls) ANOVAs were conducted to examine this question.

The second question examined the fidelity of implementation of SKIP-Cymru teachers who had been trained between 6 and 31 months prior to the data collection. Descriptive statistics were provided.

Results

Table 3 shows the descriptive statistics for MC for SKIP-Cymru and Non-SKIP conditions. Results are presented by the different measures of MC.

Insert Table 3 here

Differences in OC Raw Scores by SKIP-Cymru and Non-SKIP Conditions

A 2 Condition (SKIP-Cymru, Non-SKIP) X 2 Sex (boys, girls) ANOVA on OC raw scores reported significant main effects for Condition ($F[1,147] = 46.33$, $p<.001$, $\eta^2=.24$) and Sex ($F[1,147] = 34.06$, $p<.001$, $\eta^2=.19$). The SKIP-Cymru children ($M = 28.95$) had significantly better OC raw scores than Non-SKIP children ($M = 18.80$), and boys ($M = 29.37$) had better OC raw scores than girls ($M = 21.26$). There was a non-significant Condition X Sex interaction ($p>.05$).

As School 5 had been trained more recently (6 months ago) than School 4 (31 months ago) we ran a 2 School (School 4, School 5) X 2 Sex (boys, girls) ANOVA on OC raw scores. There were main effects for School ($F[1,87] = 5.07$, $p<.05$, $\eta^2=.06$) and Sex ($F[1,87] = 13.70$, $p<.001$, $\eta^2=.14$). School 4 children ($M = 31.31$, $SD=8.76$) had significantly better OC raw scores than School 5 children ($M = 24.77$, $SD=10.87$), and boys ($M = 29.37$, $SD=11.13$) had better OC raw scores than girls ($M = 21.26$, $SD=9.30$). There was a non-significant School X Sex interaction ($p>.05$).

Differences in MABC-2 scores by SKIP-Cymru and Non-SKIP Conditions

A 2 Condition (SKIP-Cymru, Non-SKIP) X 2 Sex (boys, girls) ANOVA on total MABC-2 SS reported a significant main effect for Condition ($F[1,144] = 58.38$, $p<.001$, $\eta^2=.29$) but not for Sex ($p>.05$). The SKIP-Cymru children ($M = 11.70$) had significantly greater MABC-2 SS than Non-SKIP children ($M = 7.62$) but boys and girls performed equally. There was a non-significant Condition X Sex interaction ($p>.05$).

As School 5 had been trained more recently on SKIP-Cymru (6 months ago) than School 4 (31 months ago) we ran a 2 School (School 4, School 5) X 2 Sex (boys, girls) ANOVA on MABC-2 total SS. There was a main effect for School ($F[1,84] = 13.95$, $p<.001$, $\eta^2=.15$) but not for Sex ($p>.05$) and School X Sex interaction ($p>.05$). School 5 children ($M = 13.00$, $SD=3.27$) had significantly better MABC-2 total SS than School 4 children ($M = 10.52$, $SD=2.94$).

Additionally, as there was a significant main effect for MABC-2 SSs, further analyses were run to determine in which of the MABC-2 subscales there might be differences. A multivariate, 2 Condition (SKIP-Cymru, Non- SKIP) X 2 Sex (boys, girls) MANOVA on the three subscales of the MABC-2 (manual dexterity SS, aiming and catching SS, balance SS) reported significant multivariate main effects for Condition (F[3,139] = 24.50, p<.001, η^2=.35) and Sex (F[3,139] = 3.14, p<.05 η^2=.06) but not the interaction (p>.05). Follow up univariate ANOVAs reported significant univariate main effects for Condition for manual dexterity (F[1,144] = 57.60, p<.001, η^2=.29), aiming and catching (F[1,144] = 45.99, p<.001, η^2=.25), and balance (F[1,144] = 13.12, p<.001, η^2=.09). The SKIP-Cymru children had significantly greater scores than Non-SKIP children in manual dexterity SS (M = 10.32 vs 6.30), aiming and catching SS (M = 12.24 vs 8.95) and balance (M = 11.65 vs 9.85). Follow up univariate ANOVAs for Sex reported non-significant main effects for manual dexterity (p>.05) and aiming and catching (p>.05) but significant Sex main effects for balance (F[1,144] = 5.52, p<.05, η^2=.04) with girls (M = 11.39) significantly better than boys (M = 10.24) at balance. The interaction was not significant.

Overall, children taught by teachers who had received SKIP-Cymru training had significantly better OC skills, manual dexterity, aiming and catching and balance than those children taught by teachers who had not been trained on SKIP-Cymru. Sex differences were present for OC skills with boys outperforming girls, but not for the Total MABC-2 SS. However, girls were significantly better at balance than boys.

Fidelity of Implementation.

Analysis of the FoI observation for SKIP-Cymru teachers showed that the teachers averaged a score of 75.25% fidelity (range 68% - 87%). The following are the fidelity scores for SKIP-Cymru classes: Class 4.1 = 76%, Class 4.2 = 70%, Class 5.1 = 87%, and Class 5.2 = 68%. School 5 trained 6 months ago had a mean fidelity score of 77.5% and School 4 trained 31 months ago had a score of 73%.

Discussion

This naturalistic study provided an initial investigation into whether ECTs who had been trained in the SKIP-Cymru Level 4 accredited training could deliver SKIP-Cymru with fidelity, and the potential impact on child outcomes. A secondary part to this research question was exploring potential sex differences in children's FMS competence in trained and untrained teacher's classes.

Children in SKIP-Cymru schools had better MC than Children in Non-SKIP schools

Our findings supported the hypothesis that children taught by teachers trained with the SKIP-Cymru PD 6-31 months ago had better MC than those taught by Non-SKIP teachers. MC was broadly examined using both the TGMD-3 which is a process measure of FMS competence and the MABC-2 which is a product measure of MC. The results for the TGMD ($p<.001$) and MABC-2 ($p<.001$) support the hypothesis that children's MC in classes where teachers were trained in SKIP-Cymru (6-31 months prior) had better MC than those children in classes where they had received no training in FMS instruction (Non-SKIP). We recognize that given the study design, we are not able to conclude that the differences in MC are solely due to the SKIP-Cymru training. However, these findings provide initial evidence that teachers trained in SKIP-Cymru could bring about changes in their children's MC. Future research needs to examine this issue with more robust study designs and particularly track children longitudinally.

These findings are encouraging when considering the demographics of the schools in the study. One of the SKIP-Cymru schools, School 4, was in an area of deprivation as identified by the British Government (underserved and low SES) with nearly a third of the children in receipt of free school meals (an indication of poverty in the UK) and also a much higher number of children identified with additional learning needs (ALN). Existing literature has highlighted that prevalence of delays in MC in underserved areas with low SES (Brian et al., 2019; Famelia, 2018; Goodway & Smith, 2005). The Non-SKIP schools were all in more affluent areas, with low levels of free school meals and only one pupil identified as having ALN. When considering the existing literature relating to delays in motor development, it could have been expected that the children in school 4, in an underserved area and low

SES would be more likely to have lower levels of MC. These initial findings suggest the importance of SKIP-Cymru training to improve the MC of children from all socio-economic areas.

The findings from the MABC-2 that children taught by SKIP-Cymru trained teachers performed better across all three subscales is promising. Few studies have assessed balance and manual dexterity, making these results particularly significant when considering their role in broader learning and development such as fine motor skills such as writing. Balance and stability are foundational for accessing learning opportunities in the classroom as a stable base is crucial for developing fine motor skills, while manual dexterity enables children to engage with various school activities, especially during early childhood when much of the curriculum involves handling small objects like beads, blocks, or scissors (Ayres, 2005). Maturity of the vestibular system which is supported through rich motor experiences is a vital aspect of balance and children with a disorganised vestibular system tire quickly and struggle to concentrate in school. (Ayres, 2005). The fact that SKIP-Cymru trained teachers are enhancing children's balance and manual dexterity in addition to OC skills highlights a key takeaway for educators and administrators, as it emphasises the role of high-quality movement in supporting children's overall learning and development.

We believe that this approach of SKIP-Cymru PD is unique with a strong theoretical and empirical foundations. SKIP-Cymru is theoretically developed based on dynamic systems theory and Newell’s constraints perspective (Newell, 1984;1986) and based on evidence of over 30 years of SKIP FMS intervention research (Altunsöz & Goodway, 2016; Brian et al., 2017a; 2017b; Goodway, Crowe & Ward 2003; Robinson & Goodway, 2009). All instruction in SKIP-Cymru starts from the child’s developmental level with the teacher being trained to identify the developmental stages of FMS (see Goodway, Ozmun, & Gallahue, 2020, pgs. 176-247) and differentiate instruction based on this stage. A core principle of SKIP-Cymru training is an understanding of the individual constraints a child brings to the instructional environment. The teacher is then trained to manipulate environmental constraints (balls, bats, targets, poly spots etc.) and design developmentally aligned motor skill tasks to meet the developmental level of each child (for greater descriptions of SKIP see Goodway et al., 2020, pgs. 279-

295). For example, if a child catches by hugging or scooping (stage 2/3) a larger ball might be used and tossed from a closer distance. Whereas a child who can hand catch (stage 4 or 5) might use a smaller ball from a further distance. These instructional modifications are both feasible and developmentally appropriate meeting the child where they are at developmentally. This is a core premise of SKIP-Cymru training. Prior research suggests that ECTs routinely carry out this type of analysis and instruction in other areas of learning but have never previously had the knowledge to do this in the motor domain (Brian et al., 2017a/b; Brian et al., 2018b). It is evident from these findings that once teachers are trained in SKIP-Cymru PD, they have the knowledge and skills to embed evidence-based FMS instruction into their practice as they do in other areas such as literacy and numeracy and as such impact their children's MC.

In spite of differences in when teachers were trained (ranging between 31 months [school 4] and 6 months [school 5]), collectively the children in SKIP-Cymru classes had better MC than children in Non-Skip classes. Interestingly, the physical education pedagogy literature reports that teacher PD typically "washes out" with the influence of the PD often having little to no impact even a few months after PD sessions (Richards, Templin, & Graber, 2014). Based upon one lesson observation, it appears that wash out did not occur for SKIP-Cymru teachers with both process and product measures of MC being better in children taught by SKIP-Cymru teachers than Non-SKIP schools. These findings are encouraging, and highlight the need for all early childhood teachers to be trained in evidence-based PD like SKIP-Cymru PD.

It is interesting that children in School 4 with teachers trained 31 months previously had better OC raw scores than children in School 5 with teachers trained 6 months previously. While we don't have data to understand this finding, it might be that teachers who had been trained 31 months previously had more time to refine their pedagogical skills and instruction of FMS and that is why their children had better OC skills than children in the classes of teachers trained 6 months previously. Future research needs to track teachers who have received training such as SKIP-Cymru longitudinally to examine how their skills and knowledge and effectiveness improve over time. The opposite was true

for the product oriented MABC-2 with teachers in schools trained 6 months prior having better MABC-2 SS than those in classes with teachers trained 31 months before. We do not have a clear understanding of why this might be, but it could be related to the fact that the TGMD-3 is process oriented and the MABC-2 is product oriented. Future research needs to examine this issue.

Sex Differences in Motor Competence Varied by Type of Motor Competence

It was interesting to note that the findings varied depending on the assessment tool used. The process-oriented TGMD-3 revealed sex differences in OC skills, with boys outperforming girls in both SKIP-Cymru and Non-SKIP-Cymru schools, consistent with decades of previous research showing boys' superiority in OC skills (Martins et al., 2024; Robinson & Goodway, 2009; Zheng et al., 2022). However, the MABC-2 SS showed no overall sex differences. This study focused solely on the OC portion of the TGMD, explaining the observed sex differences. While the MABC-2 was used comprehensively, subscale analysis revealed that although no sex differences were seen in manual dexterity and aim and catch, girls outperformed boys in balance. The balance subscale included tasks like one-legged balance, raised-heel walking, and consecutive jumps. While we are unclear of why girls were better at balance than boys, our findings are supported by previous research showing girls' superiority in balance and locomotor skills (Martins et al., 2024; Zheng et al., 2022). The boys' better performance in OC skills has also been shown across many studies (Barnett et al., 2016; Bolger et al., 2021) and reinforces the call for early intervention in OC skills for girls, especially as Zheng et al.'s (2022) review found boys’ advantage in OC skills increased with age. Despite interventions helping improve girls' OC skills, a gap still persists between the sexes (Wainwright et al., 2024), underscoring the importance of addressing MC early in life to develop OC skills in girls at the earliest possible opportunity.

Fidelity of Implementation of SKIP-Cymru 6-31 Months Post Training

A secondary purpose of the study was to examine if early childhood teachers who had been trained in SKIP-Cymru still used the principles of SKIP-Cymru when delivering physical development content in their classrooms. With much of the motor development intervention research utilising experts

to deliver the programmes (Lindsay et al., 2020; Robinson & Goodway, 2009), our PD focused on delivering SKIP-Cymru in naturalistic settings with sustained training of teachers, with the intention to impact the children within their own schools (John et al., 2022, 2024b; Wainwright et al., 2019). In previous SKIP training programmes, teachers were effective at translating a one-day PD training along with mentoring into practice and impacting pupil outcomes in the USA (Brian et al., 2017a, 2017b), Indonesia (Famelia, 2018) and Wales (John et al., 2022, 2024b) with the level of impact related to the fidelity of implementation. A concern of prior SKIP-Cymru studies was that quality of mentoring impacted fidelity of implementation of the teachers (John et al., 2024b). Additionally, it was hard to find mentors in naturalistic settings thus the revised SKIP-Cymru PD decided to implement a more extensive PD of teachers without the use of mentoring. By eliminating mentoring, a more in-depth PD accredited training was implemented and drew on the notion of professional capital in its inception (Hargreaves & Fullan, 2015). The mean fidelity of implementation on the one observed lesson was high (*M*=75.25%) with a range from 68% to 87%. A score of 68% was considered a high-fidelity score as existing literature suggests fidelity of between 40% and 60% is needed for positive intervention outcomes (Durlak & DuPre, 2008). The in-depth accredited training supports ECTs knowledge and understanding through online learning, practical workshops and assessments with feedback. As such this may have served to support the embedding of principles of SKIP-Cymru into practice over time, resulting in high levels of FOI.

These findings are encouraging, but it should be noted a major limitation of this study was only implementing one lesson observation of the SKIP-Cymru ECTs for fidelity data. However, in this one lesson teachers were able to demonstrate high levels of fidelity, which may explain the long-term impact of the teacher's delivery of the SKIP-Cymru program on their children's MC. * We were pleased to note that 6 to 31 months post SKIP-Cymru training, the teachers had embedded the principles of the accredited SKIP-Cymru module into their practice in line with the notion of professional capital (Hargreaves & Fullan, 2015).

Limitations

The study used a convenience sample of schools that were able to participate in the data collection and as such the demographics across the sample were varied with only schools in more affluent areas in the Non-SKIP-Cymru sample. The study did not collect data on activities that the children may have carried out at home, or as part of their community which may have impacted their motor development and future research should examine this issue. The sample size was small with only eight classes in total in the study. Time constraints for both the research team and the schools meant that only the OC skills from the TGMD-3 were tested although this decision aligned with prior research in Wales. Finally, as previously highlighted, we were only able to evaluate one lesson of fidelity per teacher due to time limitations of the research team and early childhood teacher. Future research needs to examine more than one lesson of fidelity and track both teacher's competency in delivering SKIP-Cymru over time. Furthermore, children's MC needs to be tracked longitudinally to determine if early intervention effects are sustained over time.

Conclusion

The findings from this study provide initial evidence that children taught by teachers trained in SKIP-Cymru PD had better MC compared to children in classes of teachers who had not been trained with SKIP-Cymru. While this was not a longitudinal study, this cross sectional, naturalistic study does suggest that teachers trained in SKIP-Cymru between 6 and 31 months prior to data collection still used the principles of SKIP-Cymru when delivering physical development content in their classrooms. We believe the increased knowledge and skills from the SKIP-Cymru PD not only transferred to the teachers practice but also impacted pupil outcomes in MC up to two years after training. This study has interesting implications for professional practice and policy. Governmental policies and those in charge of the PD of early childhood teachers need to ensure they are trained in evidence-based motor PD such as SKIP-Cymru in light of the wider implications for pupils learning and health outcomes associated with MC. Such an approach will address the widespread motor developmental delays found in the literature (Bardid et al., 2017; Barnett et al., 2019; Behan et al., 2019; Birch et al., 2016; Bolger et

al., 2018; Brian et al., 2019; Duncan et al., 2022; Famelia, 2018; John et al., 2024a; Okely et al., 2017; Robinson & Goodway, 2009; Valentini et al., 2016).

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Table 1

Demographic information by class

Condition	**Non-SKIP Schools**				**SKIP-Cymru Schools**			
School	**1**		**2**	**3**	**4**		**5**	
Class	**1.1**	**1.2**	**2.1**	**3.1**	**4.1**	**4.2**	**5.1**	**5.2**
Participants	15	11	17	18	24	21	28	14
Year	1 & 2	1 & Rcp.	1	1 & 2	1	1	1	Rcp.
Mean Age (Mos.)	74.31	64.23	74.42	75.82	77.02	75.63	75.04	65.36

Note: Rcp.=reception year in school.

Table 2

Fidelity Measures of SKIP-Cymru

Element	Score Description	Total Possible Score
Space is prepared when children arrive	0 = Not prepared 1 = Prepared, not made full use of space or equipment 2 = Good use of space, 'garden' developmentally appropriate	2
Warm up or cool down activity	0 = No warm-up or cool down, under 2 minutes 1 = Under 3 minutes 2 = 3+ minutes	2
Transition	0 = 3+ minutes 1 = Under 3 minutes 2 = Under 2 minutes	2

Pace of lesson (equal amount of time on each 'activity')	0 = Under 5 1 = 5+ minutes 2 = 6+ minutes	2
Pupil engagement	0 = No engagement 1 = Most of the class 2 = Majority of the class	2
Activity set up correctly	0 = Not set up correctly 2 = Set up correctly	6
Activity explained correctly	0 = Not explained correctly 2 = Explained correctly	6
Activity demonstrated correctly	0 = Not demonstrated correctly 2 = Demonstrated correctly	6
Demonstrated differentiation (modify task/equipment)	0 = Did not demonstrate 1 = Demonstrated on one occasion 2 = Consistency throughout	6
Children did the task correctly/developmentally	0 = Did not do task correctly 1 = Demonstrated on one occasion 2 = Consistency throughout	6
Children provided with corrective feedback	0 = Did not demonstrate 1 = Demonstrated on one occasion 2 = Consistency throughout	6

Table 3

Descriptive Statistics for Motor Competence Scores

Condition	Sex	MABC2 Total *M*	MABC2 Total *SD*	Man Dex *M*	Man Dex *SD*	Aim Catch *M*	Aim Catch *SD*	Bal *M*	Bal *SD*	OC Raw *M*	OC Raw *SD*
Non SKIP	Girl	8.03	2.71	6.53	2.63	8.97	2.91	10.76	3.53	14.15	6.75
	Boy	7.11	3.02	6.00	3.05	8.93	3.03	8.70	2.83	24.67	10.99
	Total	7.62	2.87	6.30	2.81	8.95	2.93	9.85	3.38	18.80	10.25
SKIP-Cymru	Girls	12.02	3.30	10.90	3.22	12.00	2.80	11.82	2.97	26.10	7.54
	Boys	11.26	3.36	9.51	3.21	12.57	2.92	11.43	2.89	32.81	10.05
	Total	11.70	3.32	10.32	3.27	12.24	2.85	11.65	2.93	28.95	9.26
Total	Girls	10.39	3.63	9.11	3.68	10.76	3.20	11.39	3.23	21.26	9.30
	Boys	9.45	3.80	7.98	3.58	10.98	3.46	10.24	3.15	29.37	11.13
	Total	9.99	3.73	8.63	3.67	10.86	3.30	10.90	3.24	24.77	10.87

Note: MABC-2 Total = Movement ABC-2 Total score, Man Dex = Manual Dexterity subscale standard score, Aim Catch = Aiming & Catching standard score, Bal = Balance standard score, OC Raw = Object Control raw score.