

EFFECTS OF VARIABLE AND FIXED PRACTICE ON THE DEVELOPMENT OF JUMPING ABILITY IN YOUNG CHILDREN

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The effects of variable and fixed practice regimes on the development fundamental skills are not fully understood. This study examined the effects of variable and fixed practice in jumping skills in children aged 5 to 6 years. Twenty four children were divided into two groups and each group received fixed or variable practice in jumping skills over a period of six weeks. Jumping skill was evaluated from video records using qualitative analysis procedures. Analysis was carried out before and immediately after the six week intervention and a retention test was conducted one week after the post test. The results indicated that the variable practice group significantly improved their jumping skill compared to pre-test scores but the fixed practice group showed no improvements. The results suggest that variable practice is more effective in improving skill levels in children.

KEY WORDS: leg spring stiffness, complex training, stretch-shortening cycle.

INTRODUCTION:

Jumping is a fundamental human movement that underpins successful performance in a wide range of sports and physical activities. The importance of practice in improving physical skills is widely recognised but the procedures for optimising practice for children at the fundamental phase of development are not well understood. Traditional approaches to learning and practice emphasise the importance of repetition but more recent approaches emphasise the importance of variability of practice. Dynamical Systems Theory (Thelen, 1995) and Schmidt's (1975) Schema Theory for learning of discrete motor skills both predict that variability of practice is required to ensure optimal learning of motor skills. However few studies exist that demonstrate this prediction in the development of fundamental motors skills in a practical physical education or coaching environment.

Recent studies have reported that many children are not developing competence in motor skills as expected (Holland, 1986; Ulrich, 1987; Kelly *et al.* 1989), and that children are not achieving mature patterns in fundamental motor skill patterns at the expected rate (Carre, 1979; Ulrich, 1987; Graham, 1987; McKenzie *et al.* 1998). It is known that physical education programmes have the potential to make a valuable contribution to the acquisition of fundamental motor skills (Kelly, 1989; Arnold, 1991; Buschner, 1994; Lee *et al.* 1995; Wickstrom, 1997; Rink, 1998) and the development of fundamental motor skills are a stated aim in the Physical Education curricula of many countries.

It is evident there is a need to establish effective physical education programmes that are designed to develop fundamental motor skills. If optimal development of fundamental motors skills is to be achieved, it is important that teachers and coaches are aware of the most effective ways of teaching and managing practice for children at the fundamental phase of development. This requires systematic evaluation of the effects of practice regimes used by teachers for developing fundamental skills in children. Therefore, the aim of this investigation is to evaluate the effects of variable and fixed practice on the development of the skill of jumping in children at the fundamental phase of development using qualitative analysis techniques.

METHOD:

The twenty four participants aged between 5 and 6 years took part in this investigation. The participants were divided into two groups of twelve subjects in each group. One group received a variable practice and the other group a fixed practice intervention. The study design used a pre-test followed by a six week intervention, a post-test and a retention test.

The study had obtained ethical approval from the University Research Ethics Committee. Written informed consent was obtained from all parents of children prior to their participation in the study.

Procedures: The participants were videotaped as they performed a horizontal jump from Standing in the pre, post and retention tests. The trials were recorded using a Panasonic AE450 Video camcorder securely mounted on a rigid tripod. The set up followed the observational positions recommended by Knudson and Morrison (2002). The camera location was carefully chosen to ensure that the participant's motion was orthogonal to the camera. Panning was not used and changes in camera angle were avoided to prevent distortion of the motion of the subject. A demonstration of the horizontal jump from standing was provided and participants were asked to perform this with the emphasis on jumping as far as possible. Each participant was asked to perform the jump three times. Additional trials were provided if it was deemed necessary to ensure an accurate and consistent performance. A six-week intervention was administered by one teacher for each group. The responsibilities for the instructor included leading the activities, demonstrations, providing feedback and working with participants requiring special attention. The specific activities were based on recommendations by Gallahue and Cleland (2003). All pupils were taught two 30 minute classes per week for 12 weeks. The 'Variable Practice Group' were instructed to practice all different type jumps, including horizontal jump, vertical jump, hopping and leaping. The 'Fixed Practice Group' only practised the vertical jump; they were not coached on, or did not get the opportunity to practice the horizontal jump after the pre test. This group performed the horizontal jump at the post test and again at the retention test. A post test was conducted immediately after the intervention ceased. The retention test was carried out one week after the post test.

The video records of all jump trials were inspected visually using slow motion and frame by frame analysis. All trials were analysed by the same investigator. The movement sequences were qualitatively evaluated using a scoring system based on the component approach developmental sequences of Robertson and Halverson (1984). This scoring system provided a score for the motion of leg, trunk and arm components in each phase of the jump (i.e. take-off and flight & landing phase). The participants were scored from 1 – 4 for each component (i.e. leg, trunk and arm) and for each phase depending on the quality of the skill performed. The score was obtained by comparing the participant's performance with a checklist and a picture sequence of each stage of development and textual descriptors. The total score of the jump was obtained by summing together all the individual scores for each component at each phase. The maximum total score obtainable, therefore, was 24 and the minimum total score was 6. An intra-observer reliability test was conducted for the scoring system. This involved scoring all subjects pre-test sequences and rescored them five weeks later.

Statistical Analysis: The intra-observer reliability results were analysed using a limits of agreement test, Bland and Altman (1995). Statistical analysis of the pre- post retention score was conducted using the SPSS software package (SPSS for Windows, Release 11.0.1). A GLM ANOVA with repeated measures was used to determine significant differences in performances between pre, post and retention test scores. The GLM ANOVA had two, within subject factors, namely Time with three levels (pre, post and retention) and Trial with two levels.

RESULTS:

The results of the intra-observer reliability analysis indicated that mean difference between test-retest scores across all subjects was 0.07 point (on the 24 point scale). The 95% confidence interval was 0.82. These data show good agreement between test and retest scores and suggest that in more than 95% of occasions, the retest score were within 1 point of the original rating. Figure 1 shows the mean scores for pre- post and retention tests of the fixed and variable practice groups. These data indicated significant improvements in quality

of performance of the horizontal jump from standing in the variable practice group but not in the fixed practice group.

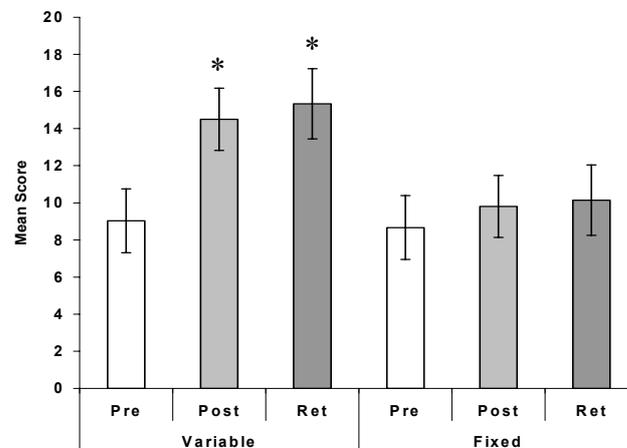


Figure 1: Mean Scores (\pm 95% Confidence Interval) of the variable practice and fixed practice groups at the pre, post and retention tests. * Denotes significant difference between the pre and post test and the pre and retention test for the variable practice group. $P \leq 0.05$

DISCUSSION:

The results shown in Figure 1 illustrate the learning achieved by the participants for each practice schedule. There is clear evidence from these data that the variable practice group achieved a significant improvement in their movement quality from pre to post test and this improvement was maintained in the retention test. The results of the retention test suggest that the improvement in movement quality was relatively permanent and can therefore be considered as a learning effect. A comparison of the mean total scores obtained by both groups at the pre test was conducted to verify that the learning effect was a result of the intervention. The mean total score for the variable practice group was 9 and the mean total score for the fixed practice group was 8.7. This shows there was no meaningful difference in movement quality between the two groups at the start of the study. Therefore, the improvement in performance of the variable practice group was most likely caused by the nature of the intervention.

The post test results showed the mean total score of the variable practice group was 14.5. This represents a 61% increase between pre and post tests. There was no significant difference in the mean total score recorded by the fixed practice group between the pre and post test (9.8). While these data may indicate that variable practice is a more effective mode than fixed practice, it must be remembered that the fixed practice group did not perform the criterion jump whereas the variable practice group would have performed some horizontal jumps as part of their practice schedule. Despite this, the differences in horizontal jump scores between the groups were very large in relation to the small amount of horizontal jump practice that the variable practice group completed. The results of this study therefore, provide strong support the variability of practice hypothesis and are consistent with other studies with children (Kerr & Booth, 1978). This study further supports the work of others that have demonstrated the efficacy of variable practice, (Lee *et al.* 1985, Shea & Khol, 1990; Shoenfelt *et al.* 2002).

CONCLUSION:

This study assessed the effects of variable and fixed practice on the development of fundamental motor skills. The results show that variable practice produces more effective skill learning compared with fixed practice in a jumping skill in children aged 5 to 6 years. It is

recommended that children will learn to jump more skilfully if they are encouraged to engage in a varied range of jumping tasks rather by repeating the same skill.

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