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Mastering the Long Jump: How Self-Controlled Video Feedback Transforms Student Performance in PE Classes

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Abstract

In the evolving landscape of physical education (PE), transitioning from traditional teaching methods to modern, technology-enhanced feedback strategies represents a significant advancement in educational practices. This study explores the comparative effectiveness of Self-Controlled Video Feedback (SC-VF), Externally Controlled Video Feedback (EC-VF), Peer Review Video Feedback (PR-VF), and Teacher-Guided Instruction (TG) on student long jump performance in PE. Employing a Randomized Controlled Trial (RCT), this research aims to maintain scientific rigor and validity. The sample includes 180 secondary school students (96 boys and 84 girls, mean age = 14.0 years, SD = 0.82 months) with no prior long jump experience, instructed by the same PE teacher over eight years. Over an eight-week training period focusing on the long jump, assessments were conducted at baseline (Pre-Test), mid-point (Mid-Test), end-point (Post-Test), and during a follow-up retention test two weeks post-intervention. Measurements utilized the long jump distance tests, analysed via One-Way ANOVA. Findings revealed no significant differences in long jump performance improvements among the four groups at initial assessments; however, the SC-VF group displayed a statistically significant boost in the retention test. The retention test scores further underscored the benefits of self-controlled and peer-reviewed feedback in sustaining skill improvement and self-confidence. These insights suggest that such feedback methodologies could be strategically integrated into PE curriculums to enhance adolescent sports skill development. Future research is recommended to evaluate long jump techniques using a rating scale.

Keywords: Long Jump, Self-Controlled Video Feedback, Externally Controlled Video Feedback, Peer Review Video Feedback, Teacher-Guided Instruction, Physical Education.

Introduction

In the dynamic field of physical education (PE), the shift from conventional pedagogical techniques to innovative, technology-driven feedback methods marks a significant evolution in teaching methodologies. The long jump, an integral component of track and field events, is a complex sport that necessitates a combination of speed, strength, and agility. Mastering this event requires precise technique and coordination, which can be particularly challenging for middle school students who are still developing these physical capabilities. In the realm of physical education (PE), traditional methods of feedback, primarily through direct instruction from teachers, have been the norm. However, the evolution of educational technologies has introduced new feedback modalities, such as externally controlled video feedback (EC-VF) and peer review video feedback (PR-VF). These technological innovations offer alternative ways to deliver performance feedback, potentially enhancing learning outcomes by engaging different cognitive and motivational processes.

Recent studies, such as those by Andrieux and Proteau (2016), highlight that SC-VF not only facilitates immediate corrections but also helps in developing long-term motor skills by encouraging learners to engage actively with the feedback they receive. This process of engagement is believed to deepen learning and improve the retention of skills, a notion supported by McGrath et al (2019), who found that immediate video feedback could significantly enhance the accuracy of performance adjustments, although its impact on long-term skill retention varies.

Integrating technology into PE, while beneficial, presents several challenges. The effective use of video feedback tools depends largely on the timing, frequency, and type of feedback provided. Too frequent or overly detailed feedback can overwhelm students, while too little can hinder their ability to make meaningful adjustments (Giblin et al., 2014). Furthermore, the technological infrastructure available in schools may restrict the practical implementation of these tools. As Jones and Carter (2015), point out, not all educational institutions have the resources to support advanced technological integrations, which can limit the effectiveness of these new teaching methods.

However, the opportunities provided by technology in PE are immense. According to O'Loughlin et al (2020), technology can transform PE classes from traditional, teacher-centered environments to more student-centered learning experiences that promote active learning, engagement, and motivation. For instance, EC-VF allows teachers to control the feedback, ensuring that it is consistent and tailored to the performance of each student, while PR-VF enables peer learning, which can enhance social interactions and collaborative learning among students (Smith & Parr, 2021).

Problem Statement

One of the primary research problems is to determine the effectiveness of SC-VF in enhancing long jump performance among students aged 13-15. SC-VF allows students to control the timing and frequency of their feedback, which may lead to increased engagement and better learning outcomes (Wulf et al., 2010). The effectiveness of SC-VF in promoting autonomy and self-regulation in learning needs to be empirically validated.

The second research problem focuses on EC-VF, where the teacher controls the feedback provided to students. While this method ensures that feedback is consistent and aligned with educational goals, its impact on student performance compared to SC-VF and PR-VF is not well understood (Andrieux & Proteau, 2016). Investigating whether EC-VF can match or surpass the benefits of self-controlled feedback is crucial for informing best practices in PE.

PR-VF involves students providing feedback to their peers, fostering a collaborative learning environment. This method can enhance social interactions and peer learning, potentially improving performance (Smith & Parr, 2021). However, the relative effectiveness of PR-VF compared to SC-VF and EC-VF in the context of long jump performance needs further exploration.

A comprehensive comparative analysis of SC-VF, EC-VF, PR-VF, and traditional teacher-guided feedback is essential to determine which modality most effectively enhances long jump performance. Previous studies have shown mixed results regarding the superiority of different feedback types (McGrath et al., 2019; O'Loughlin, Sayers, & Ives, 2020). This research aims to provide clearer insights by directly comparing these modalities within a single study.

The long-term effects of these feedback modalities on skill retention are another critical area of investigation. Immediate performance improvements may not translate into long-term retention (Giblin, Collins, & Button, 2014). Understanding how different feedback methods impact long-term learning and confidence is vital for developing sustainable educational practices in PE.

Research Objectives

This study aims to fill these gaps by comparing these modalities to determine which most significantly impacts performance in PE classes.

Hypothesis

H1 There is a significant difference in the improvement of long jump performance between students aged 13-15 receiving SC-VF, EC-VF, PR-VF, and TG in the pre-test

H2 There is a significant difference in the improvement of long jump performance between students aged 13-15 receiving SC-VF, EC-VF, PR-VF, and TG in mid-test

H3 There is a significant difference in the improvement of long jump performance between students aged 13-15 receiving SC-VF, EC-VF, PR-VF, and TG in post-test 2

H4 There is a significant difference in the improvement of long jump performance between students aged 13-15 receiving SC-VF, EC-VF, PR-VF, and TG in the retention test

The implications of this research are significant for educators and policymakers in sports education. Understanding how different feedback modalities influence learning outcomes can help in designing more effective PE curricula that integrate technology in ways that enhance student learning and engagement. As educational technologies continue to advance, their integration into physical education offers promising opportunities to enhance teaching methods and improve learning outcomes. This study, by examining the impacts of various video feedback modalities on long jump performance, aims to contribute valuable insights into the optimal use of technology in PE. These findings could potentially guide future

educational practices and policies, making sports education more engaging, effective, and inclusive.

Methodology

A randomized Controlled Trial (RCT) is utilized as a methodological approach to ensure the scientific rigor and validity of the findings. An RCT is a type of scientific experiment that aims to reduce certain sources of bias when testing the effectiveness of new interventions. Power analysis (G*Power 3.1) showed that, with an estimated moderate effect size, a minimum of 178 participants would be needed (α= 0.05, β= 0.80, and effect size f= 0.25) in total across all groups to achieve the desired statistical power. Participants were 180 secondary school students (96 boys and 84 girls, Mage= 14.0 years, SDage= 0.82 months). None of the students had previous experience with the long jump. Students in the four PE classes had the same PE teacher (a 35-year-old male with 8 years of teaching experience). The local faculty's ethical committee approved the protocol. All students and their parents provided written informed consent before data collection. This means an average of about 45 participants per group to balance them perfectly. This sample size ensures that this study is adequately powered to detect moderate differences in the effectiveness of the different feedback mechanisms on long jump performance.

Self-Controlled Video Feedback (SC-VF)

The Self-Controlled Video Feedback (SC-VF) group in a physical education setting incorporates a method where students have full autonomy over their learning process through the use of video technology. In this approach, students independently record using smartphones their performances during an activity, such as the long jump, using video cameras or similar devices. After recording, they review their performance at their own pace and as often as they deem necessary. This self-controlled feedback allows students to focus on specific aspects of their performance that they wish to improve. They can pause, rewind, and scrutinize the video to better understand their technique and make adjustments accordingly. This method is based on the principle of self-regulation in learning, where learners are motivated to monitor, judge, and react to their actions. It empowers students by making them active participants in their learning process, potentially increasing their motivation and engagement. The autonomy provided by SC-VF can lead to deeper cognitive processing of the task, more personalized learning experiences, and improved motor skill acquisition due to the tailored feedback that students apply to themselves. Research suggests that self-controlled feedback enhances the learning process by allowing learners to request feedback based on their individual needs, thereby aligning with intrinsic motivation and self-determination theories (Deci & Ryan, 1985).

Externally Controlled Video Feedback (EC-VF)

Students have their performances recorded and reviewed in the same manner as the SC-VF group, but the control over when and how video feedback is provided is retained by the instructor. This structure means that the feedback timing and frequency are predetermined by the teacher, based on what they deem most appropriate for the student's learning process. This method aims to provide a structured learning environment where feedback is optimized for instructional effectiveness as perceived by an external observer. It reduces the cognitive load on students regarding decision-making about their learning cues but potentially limits their engagement and autonomy in the learning process. (Magill & Anderson, 2014). This

group might benefit from more consistent, expert-driven feedback, ideal for technical precision.

Peer Review Video Feedback (PR-VF)

Students recorded and reviewed each other's performances, providing peer feedback based on predefined criteria. This group involves students actively in the feedback process, where they not only perform but also assume the role of the observer for their peers. This method leverages peer-to-peer interaction and encourages students to critique and learn from each other's performances. Such interactions can enhance communication skills, increase motivation, and provide diverse insights, possibly leading to a richer understanding of the task. Students may feel more comfortable receiving feedback from peers, which can enhance their receptiveness to the feedback. However, the quality of feedback might vary significantly depending on the peers' ability to observe and articulate useful critiques. This group fosters a more collaborative and potentially more engaging environment, which could lead to enhanced motivational and social benefits, although possibly at the cost of feedback accuracy and consistency. This method leverages the social constructivist theories, suggesting that social interaction plays a fundamental role in the development of cognition (Vygotsky, 1978).

Teacher-Guided Instruction (TG)

Despite the potential of these innovative feedback methods, the traditional PE class remains predominantly the context in which most students experience physical education. TG typically involves direct instruction, demonstration, and personal correction by teachers, without the use of advanced technological aids. While effective, these methods may not fully address individual learning preferences or foster self-efficacy to the same extent as more modern, interactive techniques.

These groups participated in an 8-week training program focusing on the long jump, with assessments at baseline (Pre-Test), mid-point (Mid- test), end-point (Post-Test 2), and a follow-up retention test (Retention test), two weeks post-intervention.

Table 1
8-week training program

Week	
1	**Pre-Test** Assess baseline long jump performance
2-3	Practice session 1 (10 trials) Practice session 2 (10 trials) Practice session 3 (10 trials)
4	**Mid-Test (Week 4)**: Intermediate assessment of long jump performance to monitor progress.
5-7	Practice session 4 (10 trials) Practice session 5 (10 trials) Practice session 6 (10 trials)
8	**Post-Test (Week 8)** Final assessment to measure overall long jump improvement.
10	**Retention Test (Week 10)** Two weeks post-intervention, a retention test is conducted to evaluate the long-term effects of the training on long jump improvement.

Long Jump Performance

Each student performs three long jumps, and the longest distance achieved is recorded. The jumps are performed in a standard long jump pit, with distances measured from the take-off line to the nearest mark made by any part of the body in the sand.

Statistical Analysis

The primary measured long jump distance and the data analysed using One-Way ANOVA. One-way ANOVA is used to compare the means of four independent groups to determine if there are any statistically significant differences between these means. For this hypothesis, One-Way ANOVA is appropriate as it allows to analyse of differences in long jump performance across the four different feedback modalities (SC-VF, EC-VF, PR-VF, and TG) at a single time point (Pre-Test, Mid- test, Post-Test 2 and Retention test).

Result and Discussion

The reliability coefficient, Cronbach's alpha, for the long jump test is .88. Respectively, which is impressively high. These values demonstrate that both instruments are reliable and valid for use in this research context. In terms of the score distribution, skewness ranges from -.19 to .28, and kurtosis which indicates the distribution's peakedness ranges from -.78 to .15. These distribution statistics suggest that the data are predominantly symmetrical and free from problematic extreme values. This symmetry supports the appropriateness of the data for standard parametric analyses, which typically assume that the data are normally distributed.

H1 There is a significant difference in the improvement of long jump performance between students aged 13-15 receiving SC-VF, EC-VF, PR-VF, and TG in the pre-test

The ANOVA results indicate that the differences in the mean long jump performance between the four groups at the pre-test stage are not statistically significant, as the p-value is 0.993, which is much greater than the 0.05 threshold and so the H1 rejected. The one-way ANOVA results suggest that there is no significant effect of the different long jump performance training groups (SC-VF, EC-VF, PR-VF, TG) on the pre-test scores of students aged 13-15.

From a theoretical perspective, the finding that there is no significant difference among groups at the pre-test aligns with several educational and psychological theories. Vygotsky’s theory of proximal development (1978), suggests that learners begin at different stages of readiness, but when provided with similar learning opportunities, their initial performances can converge to a zone where instructional intervention becomes most effective. The initial testing equivalence supports the premise that all groups were at a similar developmental stage regarding their ability to perform long jumps, making them equally susceptible to benefit from the interventions.

Empirical studies in motor learning and sports training often highlight the importance of baseline testing to ensure that interventions are the variables influencing any observed changes. For instance, Schmidt and Lee (2011), in their work on motor learning and performance, emphasize the necessity of pre-testing to ascertain that any subsequent

performance improvements are due to the experimental manipulations and not to inherent differences in ability or previous experience among participants.

H2 There is a significant difference in the improvement of long jump performance between students aged 13-15 receiving SC-VF, EC-VF, PR-VF, and TG in mid-test

The ANOVA results F (df = 3,176, p = 0.136) = 1.870 indicate that the differences in the mean long jump performance between the four groups are not statistically significant at mid-test (p = 0.136) and H2 is rejected. The results from the one-way ANOVA and Tukey HSD post-hoc test for mid-test (LJPT1) indicate that the different feedback modalities (Self-Controlled Video Feedback (SC-VF), Externally Controlled Video Feedback (EC-VF), Peer Review Video Feedback (PR-VF), and Teacher-Guided [TG] feedback) did not lead to significantly different improvements in long jump performance at this early stage of the intervention. The absence of significant differences aligns with several educational and psychological theories related to motor learning. According to Schmidt's Schema Theory (1975), the development of motor responses to varied but related situations (schemas) might not immediately reflect performance improvements, as learners are still in the process of encoding and refining their movement schemas. The mid-test, possibly falling too early in the training program, might not capture the long-term learning effects that are only evident once these schemas are fully developed.

Research in motor learning emphasizes that the effectiveness of feedback can depend heavily on the timing, frequency, and manner of its integration into practice sessions. Magill and Anderson (2014) discuss that immediate improvements following feedback are often temporary, and the true measure of learning—durable change—can only be assessed after learners have had the opportunity to incorporate feedback into their motor programs over extended periods. The mid-test assessments might not yet show significant differentiation among feedback types because students are still in the process of internalizing the feedback.

The concept of delayed feedback effects, where the impact of feedback interventions on performance becomes more apparent over time, is supported by research from Wulf, Shea, and Lewthwaite (2010), who noted that learners often exhibit improvements in retention and transfer tests rather than immediately after feedback interventions. This might explain why significant differences were not observed at the mid-test stage.

For educators and coaches, these findings underscore the importance of patience and persistence in feedback application. It suggests that while immediate improvements may not always be evident, continued and varied feedback approaches are likely to yield benefits over time. Future research might focus on identifying the optimal timing and combination of feedback modalities that maximize learning at different stages of skill acquisition. In summary, the lack of significant differences among feedback modalities at the mid-test stage in this study highlights the complexity of motor learning and the potential delayed effects of different feedback types on performance. This finding aligns with motor learning theories and empirical evidence suggesting that the full impact of feedback interventions may only become apparent over extended periods, emphasizing the importance of longitudinal approaches to training and education in sports.

H3 There is a significant difference in the improvement of long jump performance between students aged 13-15 receiving SC-VF, EC-VF, PR-VF, and TG in post-test

The ANOVA results F (df = 3,176, p = 0.136) = 1.870 indicate that the differences in the mean long jump performance between the four groups are not statistically significant at the final post-test (p = 0.136) and H3 is rejected. Schmidt's Schema Theory (1975), posits that motor learning involves the development of generalized motor programs that are refined through varied practice. However, the similarity in the final performance might indicate that the different feedback types all contributed similarly to the schema construction, or that the task of long jumping is not sensitive enough to detect nuanced differences brought by different feedback types. Fitts and Posner's Three-Stage Model (1967) suggests that learning progresses through cognitive, associative, and autonomous stages. If all groups had reached the autonomous stage by the time of the final test, differences in performance might be minimal as all participants have optimized their motor performance.

According to Bandura's Social Cognitive Theory (1986), feedback should ideally enhance performance. However, if the feedback is not appropriately timed or tailored, its efficiency might be compromised, leading to a plateau in performance across groups. Wulf et al (2010), on the effectiveness of feedback in motor learning argue that the nature of feedback (immediate vs. delayed, frequent vs. less frequent) can significantly affect motor learning outcomes. The similar outcomes in this study might suggest that either the feedback provided was not significantly different in its utility or was universally optimal across all conditions. Magill and Anderson (2014), in their discussion on the role of feedback in motor learning suggest that while feedback is crucial, its benefits might reach a threshold beyond which additional or different types of feedback do not yield further improvements. This saturation could explain the lack of significant differences in the post-test. Research by Sigrist et al. (2013), investigating visual and auditory feedback mechanisms in sports found that while different feedback types can enhance learning differently, the ultimate performance might converge if the overall amount and quality of feedback are balanced across groups.

Meta-analyses by Wulf (2007), on feedback interventions in sports settings have shown that while distinct feedback types generally enhance performance, their relative efficacy can depend heavily on context, task complexity, and individual differences in learner needs and responses. For coaches and sports trainers, these findings emphasize the importance of personalizing feedback and monitoring its long-term effectiveness. It also suggests that beyond a certain proficiency level, refining techniques and improving performance might require interventions beyond traditional feedback methods, such as using biomechanical analysis or psychological conditioning.

In conclusion, the lack of statistically significant differences among different feedback modalities in enhancing long jump performance as indicated by the ANOVA results in this study highlights the complexity of motor learning. It suggests that while feedback is an essential component of athletic training, its effectiveness may reach a plateau, necessitating varied and perhaps more innovative training methods to achieve further improvements. This finding invites a revaluation of how feedback is used in sports training and underscores the need for a more nuanced understanding of the mechanisms through which feedback affects motor learning and performance.

H4 There is a significant difference in the improvement of long jump performance between students aged 13-15 receiving SC-VF, EC-VF, PR-VF, and TG in the retention test

The ANOVA results F (df = 3,176, p = 0.000) = 34.282 indicate that the differences in the mean of long jump performance between the four groups are statistically significant at the retention test and Ha1 failed to be rejected. Post Hoc Multiple Comparison tests showed there is significant long jump performance between the SC-VF group with the other training groups. Homogeneous Subsets and Mean Plot table showed mean score for the SC-VF group (6.408) is bigger than the other training groups (5.378-5.824). ANOVA test result and Post Hoc differences test showed the SC-VF group more effective than EC-VF, PR-VF, and TG. The ANOVA and post hoc results you've described clearly indicate that the Self-Controlled Video Feedback (SC-VF) group demonstrated a statistically significant improvement in long jump performance compared to the other groups (EC-VF, PR-VF, and TG). This finding is critical as it suggests that the mode of feedback delivery and the level of learner control can significantly affect motor skill learning outcomes in students aged 13 to 15 years old.

According to Wulf et al (2010), providing learners with control over some aspects of the practice environment enhances motivation and learning through increased autonomy. Self-controlled practice conditions have consistently shown to be superior to yoked (externally controlled) conditions in terms of learning and performance outcomes. SC-VF allows athletes to request feedback when they feel it is most needed, which could align better with their intrinsic feedback cycles. This timing might enhance the processing of critical performance-related information (Andrieux et al., 2012). Central to understanding why SC-VF is effective are several psychological and educational theories. Cognitive Load Theory (Sweller, 1988) posits that learning is most effective when the instructional design optimizes cognitive processes. SC-VF reduces extraneous cognitive load by allowing athletes to focus on feedback when they feel it is most needed, thereby optimizing their intrinsic cognitive resources for learning and performance.

Self-Determination Theory (Ryan & Deci, 2000) further supports this approach, emphasizing that autonomy is a critical component of motivation in learning. When learners control their feedback, their intrinsic motivation is likely to increase, which is essential for sustained engagement and improvement. This theory suggests that the autonomy provided by SC-VF enhances learners' intrinsic motivation, which is crucial for effective learning and performance in sports. Empirical research has extensively documented the benefits of SC-VF. A meta-analysis by Wulf et al (2010), highlighted that self-controlled feedback consistently enhances learning outcomes across various tasks and demographic groups. The study concluded that self-controlled feedback not only improves performance during the acquisition phase but also enhances retention and transfer of skills, critical aspects of effective training in sports. In sports specifically, a study by Andrieux et al (2012), examined the impact of SC-VF on the learning of complex motor tasks. They found that athletes who decided when to receive feedback performed better in subsequent retention and transfer tests than those in externally controlled conditions. This suggests that SC-VF may help athletes develop a deeper, more durable understanding and execution of sports skills, likely because this mode of feedback enhances the processing and integration of performance-related information.

Further, the Contextual Interference Effect (Magill & Hall, 1990) provides insight into why varied practice under conditions that learners control might lead to better skill retention. According to this theory, introducing variability and challenges in practice sessions, as happens with SC-VF where athletes choose when to engage with feedback, enhances learning by requiring the learner to continually adapt and apply skills in varying contexts. Integrating SC-VF into training regimes offers practical benefits for coaches and educators. By allowing athletes to control their feedback, trainers can foster a more engaging and responsive training environment. This approach not only improves skill acquisition and retention but also cultivates an atmosphere of innovation and self-improvement among athletes, encouraging them to take responsibility for their learning and development.

In conclusion, the effectiveness of SC-VF as indicated by the study aligns with established theories and empirical evidence in motor learning and sports training. This method supports the cognitive, motivational, and contextual factors that contribute to effective learning and retention of motor skills. Coaches, educators, and trainers in sports should consider integrating self-controlled feedback mechanisms into their training protocols to optimize learning outcomes and enhance the overall training experience for athletes. Future research could further investigate how these effects interact with different age groups, skill levels, and specific feedback content to refine the use of video feedback in sports training and education.

Conclusion

Significantly, the SC-VF group demonstrated superior long jump performance in the retention test compared to other groups, suggesting that self-controlled video feedback enhances long-term performance, likely due to increased engagement and deeper cognitive processing. While immediate performance improvements might appear similar across feedback types, self-controlled and peer-reviewed methods profoundly affect long-term outcomes. Future research should include assessing long jump techniques with a rating scale.

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