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**EXTENDED  
ABSTRACT**

# Effects of Task Difficulty Manipulation and Feedback Frequency on Dart Accuracy in Young Adults

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## I. INTRODUCTION

Adapting task difficulty to the learner's ability is a key principle in motor learning. The Challenge Point Framework suggests that optimal learning occurs when task demands match skill level, with progressive difficulty shown to enhance skill acquisition and transfer more effectively than constant practice [1]. Previous research has shown that manipulating task difficulty is effective across a range of populations, such as children and college students, especially in tasks requiring precision. Additionally, feedback frequency is a critical factor, as excessive feedback can lead to dependency, whereas appropriately spaced feedback enhances learning and retention [2][3]. This study aims to examine how the manipulation of task difficulty and the variation in feedback frequency affect dart-throwing performance in young adults, using dart throwing as a representative precision-based motor task. Despite this, few studies have examined the combined effects of task difficulty and feedback frequency in accuracy-based tasks. Therefore, this study investigates the effects of manipulating task difficulty and feedback frequency on dart-throwing accuracy in young adults, to inform best practices for motor learning interventions.

## II. METHODS

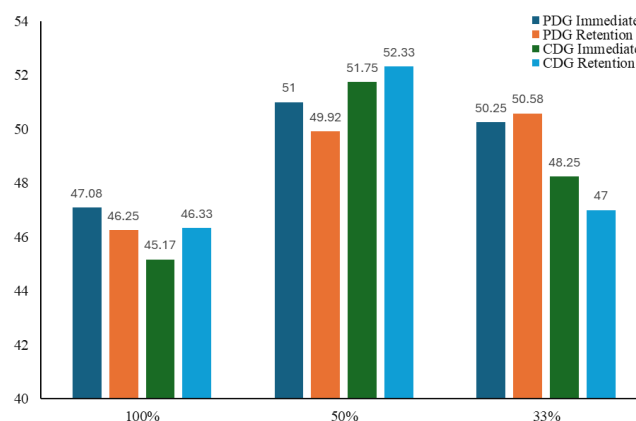
This study employed a randomized controlled design and was conducted at the Motor Learning Laboratory, Universiti Teknologi MARA. A total of 72 young adults were randomly assigned to one of six experimental groups receiving verbal external focus feedback under either constant difficulty (CDG) or progressive difficulty (PDG) conditions. Within each difficulty group, feedback was delivered at one of three frequencies: 100%, 50%, or 33%. Group allocation was balanced according to participants' baseline scores to ensure comparability in initial skill level. Throwing accuracy was assessed using a custom-designed dartboard modelled after an archery-style scoring system, ranging from 0 to 10 points. Each participant completed a pre-test consisting of nine dart throws, followed by 48 acquisition trials divided into six blocks of eight throws (6 blocks × 8 throws). Feedback was administered according to the specific frequency assigned to each group. Performance was further evaluated through a post-test of nine throws conducted immediately after the acquisition phase, and a delayed retention test administered 24 hours later, to assess learning retention under varied task difficulty and feedback frequency conditions.

## III. RESULTS

### A. Comparison Between Manipulating Task Difficulty and Feedback Frequency on Dart Throwing Accuracy

Participants receiving 50% feedback in the Constant Difficulty Group (CDG) showed the best immediate and long-term retention with a  $mean + SD$  ( $51.75 \pm 5.73$ ),  $p$  value = 0.04, while excessive feedback caused dependency, and minimal feedback led to confusion. This supports using moderate feedback frequency to balance guidance and independent error correction in motor skill learning.

Although gradual task difficulty did not show clear improvements in this study, the Progressive Difficulty Group (PDG) achieved better delayed retention overall. This suggests that gradual increases in difficulty may support long-term learning effects. The PDG practiced at three distances, while the CDG trained at one, highlighting how varying complexity might benefit skill consolidation in precision tasks.



\* $p < 0.05$

Fig. 1 Effects of manipulating task difficulty and feedback frequency on dart-throwing accuracy.

## IV. CONCLUSIONS

Moderate external-focus feedback frequency enhances dart-throwing accuracy and retention among young adults, while gradual task difficulty may support long-term skill

learning. These findings highlight the importance of balancing feedback and task complexity to optimize motor performance. Coaches and trainers should carefully adjust these elements to improve precision-based sports training. Providing feedback too frequently (100%) may cause learners to depend on it, limiting their ability to detect and correct errors independently [4]. This supports findings that moderate feedback (50%) is optimal. Past studies suggest reduced feedback helps develop information-processing skills [3][5]. Gradual task difficulty also improved accuracy and consistency over time [6]. Retention trials show learners perform better when not over-reliant on constant feedback, explaining why 50% feedback frequency groups performed best overall. Although literature often highlights the advantages of progressive difficulty for promoting motor learning independence [1][7], the current findings suggest that under certain conditions, such as tasks with moderate complexity and high feedback frequency, a constant difficulty environment may better support skill stabilization and immediate performance gains

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