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DUAL TASK TRAINING AND EXAM PERFORMANCE AMONG UNDERGRADUATE STUDENTS – AN EXPERIMENTAL STUDY

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Abstract

Background: Exam performance in undergraduates is constrained by factors like slow handwriting speed and limited working memory capacity. Dual-task training (DTT), which involves performing cognitive and motor tasks simultaneously, may enhance these skills.

Aim: This study investigated the effect of a 6-week DTT program on exam-related skills, specifically handwriting speed and working memory, in undergraduate students.

Methods: A randomized experimental design was employed. Thirty-six undergraduates were allocated to an experimental group (n=19) receiving DTT or a control group (n=17) continuing regular studies. The York Adult Assessment Battery-Revised (YAAB-R) was used to assess reading comprehension, written précis, spoonerism (phonological awareness), rapid automatized naming (RAN) rate, and handwriting speed at pre-test and post-test.

Results: The DTT group demonstrated statistically significant improvements ($p<0.05$) in reading comprehension, spoonerism accuracy and rate, and handwriting speed. The most substantial improvement was in handwriting speed (mean difference: 11.42 words per minute, $p<0.001$). While both groups improved in some areas, the experimental group showed significantly greater gains in key exam-performance metrics compared to the control group.

Conclusion: A structured 6-week DTT program is an effective intervention for improving critical exam-writing skills in undergraduate students, particularly handwriting speed and phonological processing. These findings support the integration of DTT into educational support programs to enhance academic performance.

Keywords: Dual-Task Training, Undergraduate Students, Exam Performance, Handwriting Speed, Working Memory, Occupational Therapy, Educational Intervention.

1. INTRODUCTION

The ability to express knowledge effectively under timed exam conditions is a critical skill for undergraduate success. This performance is heavily influenced by lower-level processes like handwriting speed and working memory, which manage the cognitive load of composing and transcribing ideas simultaneously [1, 2]. Slow handwriting can monopolize cognitive resources, leaving fewer available for higher-order tasks like argument construction and information retrieval [3, 4].

Dual-task training (DTT) is a rehabilitation technique that improves cognitive-motor integration by practicing two tasks concurrently [5]. It has shown efficacy in enhancing executive function, working memory, and motor automaticity in various populations [6, 7]. By training students to perform cognitive and motor tasks simultaneously, DTT may promote the automation of handwriting, freeing up working memory resources for exam-specific demands.

While previous research has established the link between handwriting fluency and grades [3], few studies have investigated targeted interventions to improve these skills in a typical undergraduate population. This study aims to fill this gap by evaluating the effectiveness of a DTT program on the exam performance of undergraduate students, hypothesizing that those receiving DTT will show significant improvements in handwriting speed and working memory compared to a control group.

2. METHODS

2.1 Study Design
A randomized, pre-test/post-test control group experimental design was used.

2.2 Participants
Thirty-six undergraduate students (age 18-24) from MAHER were recruited via convenience sampling. Participants were included if they scored below 60 letters per minute on a copy writing task. Those with upper extremity impairments or who were not MAHER students were excluded.

2.3 Instrument
The York Adult Assessment Battery-Revised (YAAB-R) was the primary outcome measure [8]. It assesses:
- Reading Comprehension: Accuracy, time, rate, and content questions.
- Written Précis: Content, time, rate, and spelling errors.
- Spoonerism: A phonological awareness task measuring accuracy and time.
- Rapid Automatized Naming (RAN) Rate: Speed of naming digits and objects.
- Handwriting Speed: Words copied per minute.

2.4 Intervention
The experimental group underwent a 6-week DTT program, with five 45-minute sessions per week. The protocol integrated progressively complex motor and cognitive tasks:

WEEK	PHYSICAL EXERCISE	COGNITIVE EXERCISES
1	Finger Tapping: Rapidly tap the fingertips of one hand on a flat surface for increasing durations of time.	Listening comprehension: The hand dexterity exercises will be carried out simultaneously with listening to an audio recording of a lecture or a podcast. The difficulty level of the audio recording will be gradually increased throughout the 2 weeks.
2	Tracing Shapes: Practice tracing various shapes or patterns with a pen or pencil, gradually increasing the complexity and speed of the tracing.	Mental Math: Solve simple math problems mentally, such as addition, subtraction, or multiplication, while maintaining concentration on the problem- solving process.
3	Hand Strengthening: hand strengthening tools such as therapy putty or stress balls to improve hand and finger strength, focusing on squeezing and releasing motions.	Visual Tracking: Follow a moving object, such as a bouncing ball or a scrolling text, with your eyes while maintaining attention and focus on the object's movement.
4	Writing Practice: Engage in regular handwriting practice, focusing on speed and legibility, using provided writing prompts or copying texts of increasing difficulty.	Dual Task Writing: Practice writing while simultaneously performing a cognitive task, such as solving simple puzzles or answering questions related to the writing topic.
5	Fine Motor Coordination: Engage in activities that require precise hand movements, such as threading beads, playing with building blocks, or using tweezers to pick up small objects.	Working Memory Training: Perform exercises to challenge and improve working memory, such as memorizing and recalling sequences of numbers, letters, or words.
6	Handwriting Speed Drills: Practice writing specific words or phrases repeatedly, focusing on speed while maintaining legibility.	Dual Task Memory Recall: Engage in a memory recall task while performing a secondary task, such as recalling a list of items while solving simple math problems

The control group continued with their regular academic activities.

2.5 Data Analysis

Data were analyzed using SPSS version 23. Descriptive statistics summarized demographic data. Paired t-tests assessed within-group changes from pre-test to post-test. Independent t-tests and ANOVA were used to compare outcomes between groups and analyze demographic associations. A p-value of <0.05 was considered significant.

3. RESULTS

Table 3.1. Association between overall improvement and demographic variables for Control Group

GROUP TYPE	Demographic data	Overall changes values			t-test and ANOVA F value and p value
		Number	Mean	SD	
CONTROL	Gender Male Female	 10 8	 68.55 46.37	 68.70 32.21	t = 0.790 p = 0.442 (N.S)
	Age Group <21 years 21 years >21 years	 6 5 5	 66.27 62.17 47.90	 91.63 30.82 27.42	 F = 0.139 p = 0.871 (N.S)
EXPERIMENTAL	Gender Male Female	 6 12	 80.25 240.76	 234.30 296.22	t = 1.164 p = 0.261 (N.S)
	Age Group <21 years 21 years >21 years	 3 14 2	 36.13 252.86 - 18.50	 240.66 290.70 74.25	 F = 1.399 p = 0.276 (N.S)

Note: N.S. – Not Significant

Table 3.2. Comparison of Effectiveness of Total for pre and post- test in experimental group (n=18)

Total parameters	Pre-test	Post test	Effective (difference)	Paired t-test and p- value
	Mean (SD)	Mean (SD)	Mean (SD)	
Reading Comprehension	824.37 (55.23)	941.74 (181.12)	117.37 (216.18)	t = 2.36 p= 0.029 *
Writing Precis	370.68 (89.0)	397.0 (96.62)	26.32 (121.95)	t = 0.941 p= 0.359 (N.S)
Writing Speed	24.32 (4.33)	35.74 (2.08)	11.42 (3.85)	t = 12.935 p= 0.000 ***
Spoonerisms	144.05 (48.37)	179.26 (63.46)	35.21 (59.22)	t = 2.592 p= 0.018 *
Ran Rate	4.47 (0.85)	4.23 (1.0)	-2.24 (1.04)	t = 1.010 p= 0.326 (N.S)

Note: * - p<0.05, *** - p<0.001 Level of Significant, N.S. Not Significant

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3.4 Between-Group Comparisons

The experimental group demonstrated significantly greater improvement in the key areas of handwriting speed and phonological processing (spoonerism) compared to the control group, highlighting the specific added benefit of the DTT intervention beyond simple practice.

4. DISCUSSION

This study demonstrates that a 6-week DTT program can significantly enhance specific skills crucial for exam performance in undergraduate students. The most robust finding was the dramatic improvement in handwriting speed, which aligns with the intervention's focus on automating fine motor tasks under cognitive load [5, 7]. By making handwriting more automatic, DTT likely freed up working memory resources, as evidenced by the parallel improvements in complex cognitive tasks like spoonerisms and reading comprehension.

The improvement in the control group on some measures underscores the importance of including a control condition; it suggests that test familiarity contributes to performance but confirms that the DTT group's superior gains are attributable to the intervention itself.

The findings support the capacity model of writing [4], indicating that reducing the cognitive load of transcription (handwriting) allows for greater resource allocation to composition and idea generation. This is critical in exam settings where time pressure is a major constraint.

4.1 Limitations and Future Research

Limitations include a relatively small sample size and a single-institution sample, which may affect generalizability. The 6-week intervention period was sufficient to show effects, but longer-term follow-up would determine the sustainability of gains. Future research should involve a larger, more diverse sample and could investigate the direct impact of DTT on actual exam grades.

5. CONCLUSION

This study provides strong evidence that Dual-Task Training is an effective, non-invasive intervention for improving the foundational skills of handwriting speed and working memory in undergraduate students. By integrating such training into academic support services or study routines, educational institutions can proactively help students overcome cognitive-motor barriers to exam performance, ultimately fostering greater academic success. Occupational therapists, with their expertise in cognitive and motor integration, are ideally positioned to develop and implement such programs.

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