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EVALUATING PSYCHOMOTOR SKILLS OF THE SÜLEYMAN DEMIREL UNIVERSITY FACULTY OF DENTISTRY STUDENTS BY 9-HOLE PEG TEST

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ABSTRACT

Aim: To measure and evaluate the effects of the curriculum applied in the Faculty of Dentistry on the psychomotor skills of the students.
Design: The study was carried on 416 volunteer students. Participants were put to the "9-hole peg test" (9-HPT). The results were classified by considering the students' grades (1-5), gender (male and female), and the test hand (dominant/non-dominant) variables.
Methods: Although there is an improvement in the 9-HPT completion time among the dominant (DH) and non-dominant hands (NDH) of the participants in the second and third grades, it is not statistically significant.
Results: In this study, psychomotor proficiency development, considered a basic competence in the dentistry profession, was measured by the "9-HPT". The results are significant in measuring, comparing, and developing this competence by different educational methods.

Keywords: Dentistry, Dental Education, Psychomotor Skills

1. INTRODUCTION

Psychomotor skills as a term cover motor skills, manual dexterity, and spatial perception. These skills significantly impact performing daily life activities, professional achievement, and leisure time activities engagement Wang et al. (2011), Volman et al. (2006). Several manual dexterity tests can assess them, often used to quantify, and predict subjects' fine motor abilities or disabilities. The most

generalized uses of these tests are physical and occupational therapy, vocational evaluation, and pre-employment screening. Vocationally it is used to determine the ability and aptitude for specific works demanding manual dexterity. Block engraving, tremometer test, two hand coordination machine, O'Connor Tweezer Dexterity Test, Minnesota Manual Dexterity Test, the Box and Block Test, and Purdue Pegboard Test exemplify the most used tests, among others, to assess manual dexterity in dentistry. However, there is no consensus about which has the highest psychometric soundness Lugassy et al. (2018)

Clinical success depends not only on the scientific knowledge of the practitioner (intern/clinician), but it also demands some clinical abilities. Skill or ability is called performance in any activity resulting from long-term practice. The ability to detect psychomotor or motor skills requires sensory knowledge and muscle response compatible with the defined subject for performance. Thus, it does not contain only regular movements but is also controlled by regular sensory information flow and is provided by the extra detection or proprioception, where transactions are continuously adjusted Andrés et al. (2004).

The tests for the evaluation of future performances are increasingly rising to hire employees and choosing university students. High school grade point average (GPA), skill tests, psychometric tests, interviews, and dexterity tests are examined to predict students' future achievements. One of the most discussed topics among the parameters used to choose the dentistry students is essential dexterity. Many tests, such as perceptual-motor skills, chalk carving, paper, and pencil, were used by Wilson and Suddick to associate their hand skills with practical success in dentistry faculties5. In any case, most of the work is very well correlated with academic and preclinical laboratory skills, while a few are prepared to assess the relationship between mastery and clinical success. The factors that lead the researchers to work have emerged because the students selected by the school performance and achievements have failed at the beginning of clinical and laboratory practical training Sandow et al. (2002), Schofield and Merwin (1966).

Dentistry is a medical profession that requires excellent motor skills, hand-eye coordination, and spatial perception. Moreover, there is a need for perceptual learning through the mirror for indirect visualization. Nevertheless, admission to dentistry faculties around the world is generally based on academic and scientific factors. Studies have shown that the correlation between dental candidates' high school grade point average (GPA) and their performances in preclinical practice classes are weak. Thus, a large percentage of students cannot successfully fulfil the requirements of preclinical courses. Chambers has tried to identify a screening tool that can more accurately predict the future performances of students in preclinical practice courses Chambers (2012).

Many European countries consider high school GPA and the matriculation results for the admittance of dentistry schools. In Sweden, at the Karolinska Institute, the adoption procedure since 1993 has been evaluating the candidate’s motivation through interviews and written assignments. Some studies have shown that there is a correlation between written assignments and intellectual abilities Chambers (2012). The repetition of clinical procedures is necessary to provide clinical proficiency in dentistry programs. The number of laboratory courses is increased to encourage good practice to learn from experience Boone (1980). Knowledge of dental anatomy and morphology is mandatory in modern dentistry applications. Dentists should develop motor skills (dexterity) and artistic abilities to restore the lost tooth structure with different materials. These factors constitute the basis of the profession of dentistry, regardless of the branch Kellesarian (2018).

In many dentistry curricula, the first assessment of the potential for psychomotor skills development may not be possible until the students pass the preclinical courses. Early evaluation of psychomotor competencies is vital for them to increase their clinical achievements. For this reason, a proper and valid dexterity test to define the potential for dentistry students to learn their psychomotor skills and dexterity skills will be an essential step for educators. However, the applied test methods for evaluating psychomotor skills such as chalk carving, wax forming, or tweezer tests were reported as invalid because of suspected validity, the difficulty, and the cost of their implementation Azevedo et al. (2015). Some studies have investigated the indirect vision skills of students using perceptual testing as perceived potential sensors from psychology. Disputes about the results of these studies have been reported. Although the indirect vision skills measured by the psychology tests have been examined, very few skill tests that measure the precision motor skills of the occupational therapy area were carried out in the indirect vision conditions Lugassy et al. (2018).

In general, psychomotor competence denotes the knowledge and ability of motor dexterity, hand-eye coordination, and spatial sensing and is implicitly bound up with dentistry training as a profession. Despite much research, there is no single method to determine the manual dexterity of dentistry students to date Azevedo et al. (2015) This study aims to evaluate the psychomotor skills of dentistry students from all grades by the Gansky et al. (2004)-Hole Peg Test. The null hypothesis is that: the current curriculum does not affect and improve the psychomotor skills of dentistry students, and gender does not affect psychomotor skills.

2. MATERIALS AND METHODS

2.1. PARTICIPANTS

A total of four hundred and sixteen first to fifth-year dental students at the Faculty of Dentistry, Süleyman Demirel University, were interviewed for participation in the study during the academic year 2018-2019. The study was conducted in the first month of the fall semester to evaluate the first-year students' amateur status. The students were informed about the study and were guaranteed that they would not be advantaged/disadvantaged by accepting/refusing to participate. The Ethics Committee of Süleyman Demirel University Faculty of Medicine approved the study, and each participant signed a written consent form according to the World Medical Association's Helsinki Declaration (2018:189).

The following volunteers were excluded:

- Students who were repeating years and with previous college degrees because of the possibility of having acquired specific skills previously,
- Students who had an injury or disease severe enough to limit the dexterity of both hands,
- Students aged over 25 to homogenize the sample were excluded.

A total of 416 participants (91.6% of 467 volunteers) were included in the study (247 Female - 58.65% / 169 Male - 41.35%). The distribution of participants was as follows: 99 first grade students (63 F / 36 M) (mean age: 19.23), 68 second grade students (42 F / 26 M) (mean age: 20,51), 73 third grade students (40 F / 33 M) (mean age: 21.63), 91 fourth grade students (53 F / 38 M) (mean age: 22.32) and 85 fifth (final) grade students (49 F / 36 M) (mean age: 23.91).

2.2. MEASUREMENT

The 9-Hole Peg Test (9-HPT) is a brief, simple, standardized, timed measure of upper extremity function and dexterity Grice et al. (2003). 9-HPT material comprises a shallow dish next to the 9-hole pegboard with nine wooden/plastic pegs (Baseline Evaluation Instruments, USA, Lot: 055965) Figure 1. The pegboard is placed before the subject at midline, with the container holding the pegs oriented towards the participant's hand being tested. Subjects are seated on a height-appropriate chair to ensure that the tabletop is at mid-chest level. The test task requires the subject to take the pegs from a container, one by one, and place them into the holes on the board as quickly as possible. And then, they must remove the pegs from the holes and replace them in the container one by one. The time taken to complete the test activity in seconds is recorded as the score Figure 2. The trials begin with the dominant hand. Two consecutive trials with the dominant hand are immediately followed by two consecutive trials with the non-dominant hand. The mean of two consecutive trials is recorded as the score. Grice et al. (2003)

Figure1

Figure 1 9-HPT test kit

Figure2

Figure 2 9-HPT test

2.3. STATISTICAL ANALYSIS

IBM SPSS V23 was used to analyse the data. Shapiro-Wilk's test was used to assess normality. The students' 9-HPT completing times with both hands were recorded and used as primary data. The grades of students (1st -5th), their gender (male and female), and their hands (dominant / non-dominant) during the test variables were taken into consideration for statistical analyses. (Multivariate analyses, $p \leq 0.05$) (SPSS statistical programmer).

3. RESULTS

This study shows that the class variable is statistically significant on both the dominant and non-dominant hand 9-HPT scores. When the dominant hand 9-HPT data were examined, mean scores were obtained as 20.74 sec. for the 1st-grade participants, 19.09 sec. for the 2nd-grade, and 18.55 sec. for the 3rd-grade, 17.51 sec. for the 4th-grade, and 15.46 sec. (best score) for the 5th-grade participants. On the dominant hand, except for the difference among the 2nd and 3rd-grade participants', the 9-HPT score differences among the other grades are statistically significant. When the non-dominant hand 9-HPT data were examined, mean scores were obtained as 22.84 sec. for the 1st-grade participants, 21.11 sec. for the 2nd-grade, and 20.34 sec. for the 3rd-grade, 18.54 sec. for the 4th-grade, and 16.38 sec. (best score) for the 5th-grade participants. There is a statistical difference between the mean values of all grades, and the highest mean score was obtained in the 1st-grades, while the lowest mean score was obtained in the 5th-grades.

When the 9-HPT scores were analysed according to the gender variable, the difference among the dominant hand scores of the female and male participants was statistically significant ($p=0.011$). While the mean 9-HPT score for female participants of this study was 18.03, it was 18.68 for male participants.

The higher education entrance exam scores (admission ranking for dentistry) were added to the model as a covariate variable. The results show that it did not significantly affect the participants' 9-HPT scores of the dominant and non-dominant hands ($p=0.052$, and $p=0.069$, respectively).

The 9-HPT performance time with dominant and non-dominant hands according to grade and gender are given in Table 1 and shown in Figure 3.

Table1

Table 1 Descriptive statistics of the 9-HPT performance time of the participants with dominant and non-dominant hands according to gender and grade

Grade	Dominant Hand in Seconds (Mean±SD)			Non-dominant Hand in Seconds (Mean±SD)		
	Female	Male	Total	Female	Male	Total
1st	19.96 ± 2.27 (n=63)	22.04 ± 2.87 (n=36)	20.74 ± 2.7 (n=99)	22.13 ± 2.21 (n=63)	24.03 ± 2.94 (n=36)	22.84 ± 2.66 (n=99)
2nd	18.7 ± 1.61 (n=42)	19.72 ± 1.92 (n=26)	19.09 ± 1.79 (n=68)	20.97 ± 1.71 (n=42)	21.35 ± 2.11 (n=26)	21.11 ± 1.87 (n=68)
3rd	18.2 ± 1.54 (n=40)	18.98 ± 1.5 (n=33)	18.55 ± 1.56 (n=73)	20.05 ± 1.84 (n=40)	20.69 ± 1.53 (n=33)	20.34 ± 1.73 (n=73)

4th	17.43 ± 0.87	17.61 ± 0.97	17.51 ± 0.91	18.42 ± 1.01	18.71 ± 0.93	18.54 ± 0.98
	(n=53)	(n=38)	(n=91)	(n=53)	(n=38)	(n=91)
5th	15.46 ± 0.7	15.45 ± 0.81	15.46 ± 0.75	16.29 ± 0.84	16.49 ± 0.84	16.38 ± 0.84
	(n=49)	(n=36)	(n=85)	(n=49)	(n=36)	(n=85)
Total	18.03 ± 2.19	18.68 ±	18.3 ± 2.5	19.65 ± 2.66	20.16 ±	19.86 ±
Average	(n=247)	(n=169)	(n=416)	(n=247)	(n=169)	(n=416)

Figure3

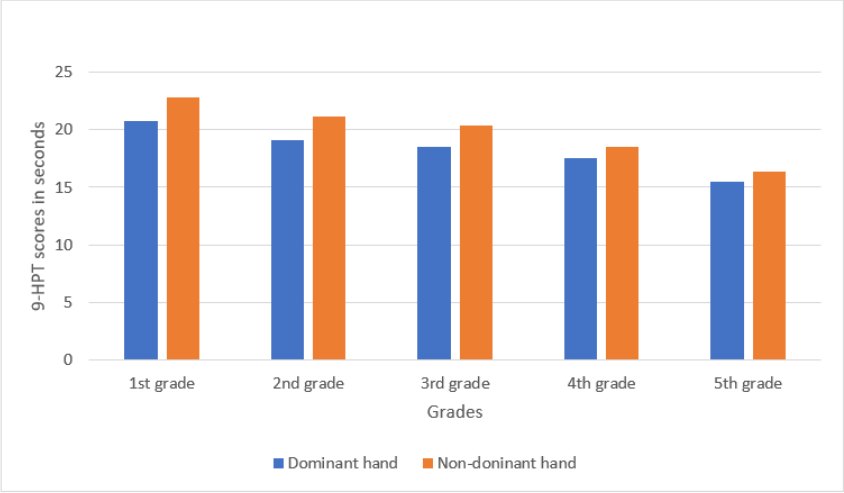

Figure 3 Psychomotor skills proficiency development of the dentistry students due to 9-HPT scores

The statistical analyses show that the grade variable has a statistically significant effect on dominant and non-dominant hand scores ($p<0.001$). The participants statistically achieved more successful test results with each passing year for the mean dominant hand scores (except for the 2nd and 3rd grades) and the mean non-dominant hand scores for all grades. Table 2

The gender variable also exhibited a statistical effect on the 9-HPT scores of the students. Results showed that female participants performed better than male participants in general ($p=0.011$) and for each grade ($p=0.022$). Table 2

Table2

Table 2 The statistical analyses of grade and gender variables on the dominant / non-dominant hand 9-HPT

		Sum of squares	df	Mean of squares	F	p
Grade	Dominant hand	577.5	4	144.4	57.6	**0**
	Non-dominant hand	644.9	4	161.2	56.5	**0**
Gender	Dominant hand	16.2	1	16.2	6.5	**0.011**
	Non-dominant hand	7.7	1	7.7	2.7	0.102
Grade*Gender	Dominant hand	29.1	4	7.3	2.9	**0.022**
	Non-dominant hand	27.2	4	6.8	2.4	0.051

4. DISCUSSION

One of the fundamental problems of dentistry education is determining whether educators can assess the reflectivity and hand skills of the students Gillet et al. (2002). The Perceptual Ability Test (PAT) for admission to the faculty of dentistry was a robust cognitive determinant for the spatial abilities of the candidates of the faculty of dentistry; however, a verified psychomotor test is not available. Computer-aided simulation training is beneficial to both a vehicle and a preclinical dentistry curriculum to improve preclinical practical training performances. Developing haptic technologies have the potential to develop the simulation experience. Recently, woven technologies have emerged to provide an environment to test the hand skills needed to perform dentistry procedures Urbankova et al. (2013).

The course of dental anatomy refers to theoretical and psychomotor training. The interactive class model offers a variety of benefits compared to the traditional course model in dental anatomy. First, it encourages a student-centered environment and allows students to take responsibility for their learning. In this model, the faculty member will act as a facilitator for student learning rather than giving them information directly. Secondly, combining digital resources provides students with unlimited access to instructional materials. Besides, these resources lead to an active teaching process by promoting the interaction and independence of the learning experience. Thirdly, it offers essential content online, and it provides more efficient use of time face-to-face outside of the classroom. Exercises will help improve psychomotor learning, including visual skills (acquisition of visual discrimination) and motor skills (re-creating normal dental morphology) Kellesarian (2018)

The weak correlation between the tests used by Gillet and his colleagues confirms the difficulty in finding a reliable test that can predict the likelihood that the student might be a good dentist16. Uncontrolled variables such as the student's interests or personality may affect the outcome18. Furthermore, it is unclear what kind of manual skills a dentist needs and the balance between manual and intellectual skills Spratley (1990). As a result of the study of Gillet and his friends and the data in the literature, the combination of academic and personal factors can be promising to predict success in the Faculty of Dentistry. However, these results show an open relationship between the cognitive level measured by the writing tests and the manual capabilities of dentistry students Gillet et al. (2002) The dental anatomy course significantly contributes to the psychomotor proficiency development of the students Eroglu et al. (2021).

The admission requirements and examinations of the faculties of dentistry in Turkey are determined and carried out by the Higher Education Council (http://www.yok.gov.tr/). After a written examination, students who have completed their high school education can enrol in the Faculty of Dentistry. There are no interviews or psychomotor skills tests applied to enrol in the Faculty of Dentistry. The selection tests for admittance to the Faculty of Dentistry are exclusively theoretical and comprise the subjects studied during high school. In the first three years of the dentistry training (five years in total), practical courses for the acquisition of psychomotor skills are included. A published study on the outputs of these applied courses as a measurable psychomotor skill has not been found in the literature research.

Our study aims to expose psychomotor skills with measurable data in dentistry students. This study can be used to assess the practical course gains of dentistry students and regulate the curriculum.

5. CONCLUSIONS

This study aims to assess the potential impact of dentistry education on psychomotor competence and dexterity, depending on grade, gender, and the dominant and non-dominant hand variables via the 9-hole peg manual dexterity test.

Dentistry is mainly a clinical profession, and dexterity expresses a wide range of skills for a dentist. The results of this study reveal that the 9-hole peg manual dexterity test can be used to assess the psychomotor competencies of dentistry students (at least some, if not all) due to its reliability, objectivity, and ease of applicability. This study shows that the current curriculum of the Süleyman Demirel University Faculty of Dentistry significantly contributes to improving psychomotor skills beginning from the first semester, and gender variable statistically affects these skills in favour of females.

CONFLICT OF INTERESTS

None.

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