

Access this article online

Quick Response Code:



Website:

https://journals.lww.com/jehp/

DOI:

10.4103/jehp.jehp\_1656\_24

# Relationship between dentistry students' psychomotor skills, and fixed prosthodontics performance, their self-estimate and self-efficacy

Maryam Amini-Pozveh, Zahra Amini Pozveh<sup>1</sup>, Athar Omid<sup>2</sup>

## Abstract:

**BACKGROUND:** This study aimed to investigate the relationship between dental students' performance in premolar preparation for porcelain fused to metal (PFM) crowns and their psychomotor skills. Additionally, the study explored the relationship between students' baseline psychomotor skills, self-estimate, and self-efficacy.

**MATERIAL AND METHODS:** Fifty fourth-year dental students enrolled in the fixed prosthodontics course were included in this study. Psychomotor skills were assessed using the Gibson Spiral Maze test before training. Students were then instructed on PFM crown preparation for premolars. Following instruction, students rated their self-estimate performance using a visual analog scale (VAS; 0–10). After completing the tooth preparation, students rated their self-efficacy using the same scale. Tooth preparations were evaluated by an expert professor using a standardized checklist (0–10). Pearson correlation analysis was used to assess relationships between psychomotor skills, preparation scores, self-estimate, and self-efficacy.

**RESULTS:** The mean tooth preparation score was  $6.96 \pm 1.44$ , and the mean error count in the psychomotor test was  $8.54 \pm 4.97$ . No significant correlation was found between preparation scores and self-efficacy ( $P = 0.10$ ) or self-estimate ( $P = 0.18$ ). However, a significant negative correlation was observed between errors in the Gibson Maze test and preparation scores ( $P < 0.001$ ), self-estimate ( $P = 0.02$ ), and self-efficacy ( $P = 0.006$ ).

**CONCLUSION:** The findings suggest that improving psychomotor skills, particularly hand–eye coordination, can enhance students' self-efficacy and the quality of clinical performance. Incorporating psychomotor skill training into dental curricula may benefit students' clinical competence and confidence.

## Keywords:

Dental student, psychomotor, self-efficacy

## Introduction

Dental education requires a combination of theoretical knowledge and practical skills<sup>[1]</sup>, with psychomotor abilities playing a critical role in clinical performance. Hand–eye coordination and manual dexterity are essential for performing precise dental procedures,<sup>[2]</sup> such as tooth preparation for porcelain fused to metal (PFM) crowns.

These skills are particularly important in fixed prosthodontics, where accuracy and precision are paramount.

Psychomotor skills encompass a range of abilities, including perceptual differentiation and complex motor responses. Chaiken *et al.*<sup>[3]</sup> defined psychomotor ability as the capacity to integrate sensory input (visual, auditory, tactile) with motor output (manual, vocal, or visual). In dental education, psychomotor

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 License (CC BY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

For reprints contact: WKHLRPMedknow\_reprints@wolterskluwer.com

**How to cite this article:** Amini-Pozveh M, Pozveh ZA, Omid A. Relationship between dentistry students' psychomotor skills, and fixed prosthodontics performance, their self-estimate and self-efficacy. J Edu Health Promot 2026;15:87.

Department of  
Prosthodontics Dentistry,  
Dental Materials Research  
Center, Dental Research  
Institute, School of  
Dentistry, Isfahan  
University of Medical  
Sciences, Isfahan, Iran,  
<sup>1</sup>Department of Community  
and Family Medicine,  
Isfahan University of  
Medical Sciences,  
Isfahan, Iran, <sup>2</sup>Department  
of Medical Education,  
Medical Education  
Research Center, Isfahan  
University of Medical  
Sciences, Isfahan, Iran

## Address for correspondence:

Dr. Maryam Amini-Pozveh,  
Department of  
Prosthodontics, Dental  
Research Institute, Isfahan  
University of Medical  
Sciences, Isfahan, Iran.  
E-mail: m.amini8412@  
gmail.com

Received: 15-09-2024

Accepted: 24-03-2025

Published: 27-02-2026

skills are often assessed to predict clinical performance and future success.

The term self-efficacy refers to the feeling of well-being that results from the feeling of gaining a skill or achieving an achievement<sup>[4]</sup>. If students couldn't perform received education, they would have an unpleasant feeling of dissatisfaction.

Tooth preparation for PFM crowns requires precise control of high-speed handpieces and careful attention to finish line dimensions. This procedure demands advanced hand-eye coordination, making it challenging for novice students. Self-efficacy, defined as an individual's belief in their ability to perform a task, is closely linked to psychomotor performance. Low self-efficacy can lead to dissatisfaction and anxiety, particularly when students struggle to meet clinical expectations.

While previous studies have explored the relationship between psychomotor skills and dental students' overall performance,<sup>[5-10]</sup> few have focused on specific procedures such as fixed prosthodontics. Additionally, the impact of psychomotor skills on self-estimate and self-efficacy remains underexplored. This study aimed to address these gaps by examining the relationship between psychomotor skills, performance in premolar preparation for PFM crowns, and students' self-perceptions.

The null hypothesis posited no relationship between psychomotor skills, tooth preparation performance, self-estimate, and self-efficacy.

## Materials and Methods

### Study design and setting

This cross-sectional study was conducted at Isfahan University of Medical Sciences in 2021.

### Study participants and sampling

The study population included 50 fourth-year dental students who had a basic fixed prosthodontics course with the same professor. The inclusion criteria were the willingness to participate in the study and attend the training sessions. As well, students who did not participate in the examination, had a mobility limit, and had a known psychiatric disorder were excluded from the study. In addition, the written informed consent form was obtained from all participants. Sampling was done through census method and all dental students who met the study conditions were included in the study. Further 50 sampling was not possible due to the limited number of students [Figure 1].

### Data collection tools and technique

1. **Psychomotor skills assessment:** The Gibson Spiral Maze test<sup>[11,12]</sup> was used to evaluate hand-eye

coordination. Students were instructed to complete the maze as quickly and accurately as possible. Errors (line/shape contacts) were recorded.

2. **Training:** Students received a lecture and demonstration on premolar preparation for PFM crowns.
3. **Self-estimate and self-efficacy:** Before and after tooth preparation, students rated their confidence and perceived performance using a visual analog scale (VAS; 0–10).
4. **Performance evaluation:** An expert professor scored each preparation using a standardized checklist (0–10).

### Ethical consideration

The approval ethics is accepted by the ethical committee by code IR.ARI.MUI.REC.1400.052. In this study, written consent was obtained from the students agreeing to participate in the study and they were assured that their information would be kept confidential by the researcher and that the data obtained would be presented in the form of an article.

### Statistical analysis method

Statistical analysis was done with the SPSS 23 version and the Pearson's correlation test was used for analysis among variables. Chi-square, independent *t*-test, and Pearson's correlation tests were used to analyze the data.

## Results

Fifty students (24 male, 26 female) participated. The mean preparation score was  $6.96 \pm 1.44$ , and the mean psychomotor error count was  $8.54 \pm 4.97$ . Self-estimate and self-efficacy scores were  $7.77 \pm 1.07$  and  $7.65 \pm 1.25$ , respectively. No significant gender differences were observed ( $P > 0.05$ ). A significant negative correlation was found between psychomotor errors and preparation scores ( $r = -0.56$ ,  $P < 0.001$ ), self-estimate ( $r = -0.38$ ,  $P = 0.02$ ), and self-efficacy ( $r = -0.38$ ,  $P = 0.006$ ). The variations and their correlations are mentioned in Tables 1 and 2.

## Discussion

In this study, we found a significant relationship between students' psychomotor skills and their performance in tooth preparation, as well as between their psychomotor skills and their sense of self-estimate and self-efficacy.

Currently, our curriculum lacks specific components dedicated to assessing or improving students' psychomotor skills and hand-eye coordination. This raises the question of how significantly these skills influence clinical performance, particularly in tasks like tooth preparation, which heavily rely on psychomotor abilities. Despite receiving uniform instruction, we

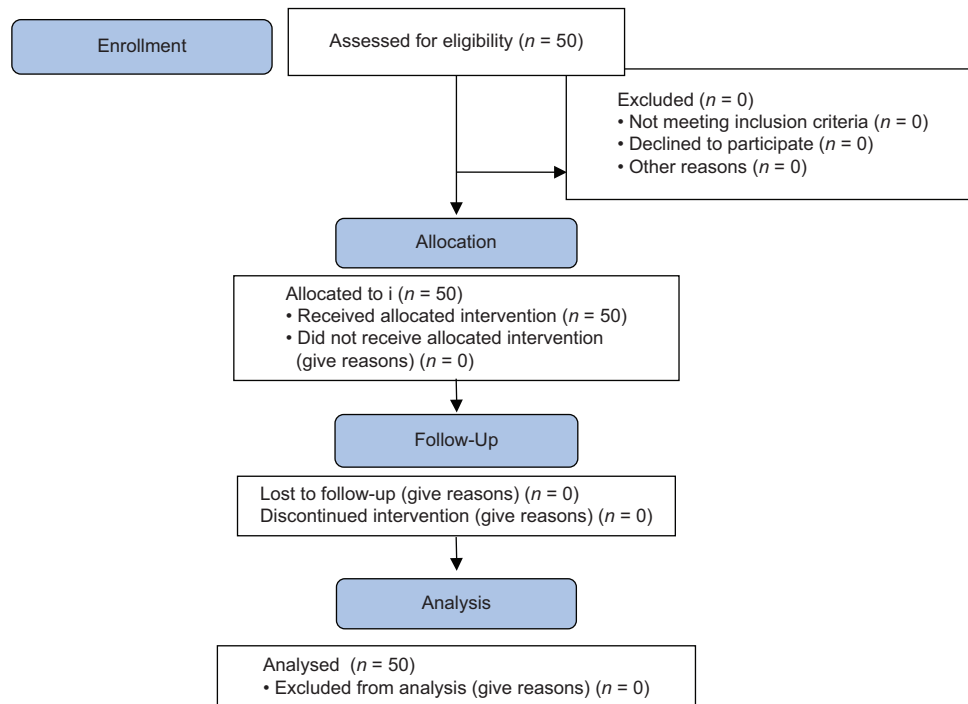


Figure 1: CONSORT Flow Diagram

**Table 1: The mean and standard deviation of premolar score, self-estimate, self-efficacy, and error count psychomotor regarding sex**

| Variable                | Group       |               | Total      | P     |
|-------------------------|-------------|---------------|------------|-------|
|                         | Male (n=24) | Female (n=26) |            |       |
| Premolar score          | 6.91±1.586  | 7±1.327       | 6.96±1.442 | 0.841 |
| Self- estimate          | 7.67±1.028  | 7.86±1.127    | 7.77±1.074 | 0.519 |
| Self-efficacy           | 7.35±1.088  | 7.92±1.347    | 7.65±1.250 | 0.109 |
| Error count psychomotor | 9.79±6.192  | 7.38±3.213    | 8.54±4.974 | 0.087 |

Independent t test was used

observed that some students struggled to execute the procedures as effectively as their peers, leading to frustration and anxiety about their inability to perform adequately.

Psychomotor ability encompasses various sub-skills,<sup>[13]</sup> but this study focused on fine motor skills, which are critical in fixed prosthodontics. Students must precisely control high-speed handpieces to create a narrow finish line, requiring exceptional hand-eye coordination.

Ranney *et al.*<sup>[15]</sup> demonstrated that the academic average of the dental admission test is a better predictor of success than the perceptual ability test. However, dental educators who advocate for including manual dexterity or perceptual ability assessments in admissions decisions can find sufficient evidence to support this approach. Numerous studies have evaluated psychomotor skills and hand-eye coordination in dental students,<sup>[5-10]</sup> with mixed findings.

Ellakany *et al.*<sup>[14]</sup> highlighted that self-assessment scores positively influenced the development of dental students' skills during training and impacted their overall preclinical performance. They emphasized the need for student-centered activities to enhance preclinical training in fixed prosthodontics. Similarly, Neves *et al.*<sup>[9]</sup> in a review of 38 articles, concluded that assessing hand skills during admissions is essential and can predict future professional success. However, Ballard *et al.*<sup>[8]</sup> found that hand skills, when used as an admission criterion, did not reliably predict success. Vahed *et al.*<sup>[15]</sup> also reported that their psychomotor test, involving the carving of specific shapes, failed to predict success among dental technology students.

While some studies emphasize the importance of psychomotor skills in dental education, others challenge their predictive value. Most research has examined psychomotor skills broadly, but a more detailed evaluation is necessary. In this study, we focused on a specific task: premolar preparation for PFM crowns.

The Gibson Spiral Maze test<sup>[11]</sup> was used to assess psychomotor skills. This test, which involves navigating a spiral maze with internal shapes, was chosen because it mimics the hand-eye coordination required for tooth preparation. This test was used in previous study for assessment of psychomotor skills<sup>[12]</sup> Premolar preparation for PFM crowns was selected as the focus of this study due to its high precision requirements, particularly in maintaining the finish line width, and its frequent application in clinical practice.<sup>[16]</sup>

**Table 2: Correlation between studied variables**

| Variables               | Premolar score | Canin score    | Self-estimate  | Self-efficacy  | Error count psychomotor | Form completion time |
|-------------------------|----------------|----------------|----------------|----------------|-------------------------|----------------------|
| Premolar score          | 1              | 0.394 (0.005)* | 0.191 (0.193)  | 0.235 (0.10)   | -0.56 (<0.001)          | 0.286 (0.044)        |
| Canin score             | 0.394 (0.005)  | 1              | 0.474 (<0.001) | 0.457 (<0.001) | -0.262 (0.066)          | 0.188 (0.192)        |
| Self-estimate           | 0.191 (0.183)  | 0.174 (<0.001) | 1              | 0.470 (<0.001) | -0.326 (0.021)          | -0.009 (0.95)        |
| Self-efficacy           | 0.235 (0.10)   | 0.457 (<0.001) | 0.47 (<0.001)  | 1              | -0.381 (0.006)          | 0.380 (0.006)        |
| Error count psychomotor | 0.56 (<0.001)  | -0.262 (0.066) | -0.326 (0.021) | -0.381 (0.006) | 1                       | -0.383 (0.006)       |
| Form completion time    | 0.286 (0.044)  | 0.188 (0.192)  | -0.009 (0.95)  | 0.380 (0.006)  | -0.383 (0.006)          | 1                    |

\*Correlation (*P*)

Ensuring that students feel confident and positive about their abilities is a critical aspect of instruction. However, we found no prior studies examining the relationship between psychomotor skills and self-estimate or self-efficacy in dental students. These factors can significantly influence students' emotional well-being and performance.

To measure self-estimate and self-efficacy, we used VAS, a widely accepted tool for assessing subjective variables. In this study, a linear scale ranging from 0 (dissatisfaction) to 10 (complete satisfaction) was used. Roh *et al.*<sup>[17]</sup> found a correlation between psychomotor skills and performance satisfaction among nursing students, supporting our findings that psychomotor skills are linked to self-estimate and self-efficacy. To foster these positive feelings in students, targeted exercises to improve psychomotor skills should be introduced before they begin tooth preparation courses.

Psychomotor skills are a critical component of medical education.<sup>[18]</sup> In previous courses, we observed that students often struggled to understand why they could not replicate the demonstrated procedures accurately. This study clarified that psychomotor skills are directly related to tooth preparation performance. Dental students are at high risk of stress, which can lead to depression and other negative emotions.<sup>[19,20]</sup> Improved psychomotor skills not only enhance technical performance but also contribute to a greater sense of self-efficacy and satisfaction.

This study has two main limitations. First, the requirement for uniform educational conditions limited participation to 50 students. Second, psychomotor skills are multifaceted, and evaluating them comprehensively with a single tool is challenging. Despite these limitations, the findings indicate a significant relationship between psychomotor skills, tooth preparation performance, self-estimate, and self-efficacy. However, the small sample size limits the generalizability of the results, and further research is needed to validate these findings.

## Conclusion

Improving psychomotor skills through targeted training can enhance dental students' clinical performance and

self-efficacy. Incorporating psychomotor assessments and exercises into dental curricula may improve educational outcomes and patient care quality.

## Acknowledgements

The authors of the article would like to acknowledge and thank the financial and scientific support of the Vice Chancellor for Research and Technology, Isfahan University of Medical Sciences, for conducting this research project with number 2400165.

## Author's contributions

MA: Study design, data interpretation, manuscript preparation. ZA: Data analysis, manuscript review. AO: Data collection, manuscript preparation.

## Financial support and sponsorship

Nil.

## Conflicts of interest

The authors declare no conflict of interest.

## References

1. Vahed A, McKenna S, Singh S. Linking the 'know-that' and 'know-how' knowledge through games: A quest to evolve the future for science and engineering education. *Higher Educ* 2016;71:781-90.
2. Lugassy D, Levanon Y, Pilo R, Shelly A, Rosen G, Meirowitz A, *et al.* Predicting the clinical performance of dental students with a manual dexterity test. *PLoS One* 2018;13:e0193980.
3. Chaiken SR, Kyllonen PC, Tirre WC. Organization and components of psychomotor ability. *Cogn Psychol* 2000;40:198-226.
4. Maddux JE, Gosselin JT. *Self-efficacy*. The Guilford Press; 2012.
5. Ranney RR, Wilson MB, Bennett RB. Evaluation of applicants to predoctoral dental education programs: Review of the literature. *J Dent Educ* 2005;69:1095-106.
6. Kellesarian SV. Flipping the dental anatomy classroom. *Dent J (Basel)* 2018;6:23.
7. Liang L, Ha V, Lin A, Chutinan S, Ohya H. Association of student performance between dental anatomy waxing and preclinical operative dentistry. *J Dent Sci* 2024;19:645-7.
8. Ballard RW, Hagan JL, Cheramie T. Relationship between hand-skill exercises and other admissions criteria and students' performance in dental school. *J Dent Educ* 2015;79:557-62.
9. Neves TDC, Garcia PPNS. Use of manual dexterity tests in dental education. *J Adv Med Med Res* 2018;27:1-7.
10. Ziada HM, Ditmyer MM, Abubakr NH. Reflections of

- psychomotor skill development in preclinical simulation: A qualitative analysis. *Eur J Dent Educ* 2022;26:157-65
11. Gibson HB. The spiral maze: A psychomotor test with implications for the study of delinquency. *Br J Psychol* 1964;55:219-25.
  12. Harris CJ, Herbert M, Steele RJC. Psychomotor skills of surgical trainees compared with those of different medical specialists. *J Br Surg* 1994;81:382-3.
  13. Simpson EJ. Educational objectives in the psychomotor domain. *Behav Object Curric Dev Sel Readings Bibliogr* 1971;60:1-35.
  14. Ellakany P, El Tantawi M, Al-Eraky DM, Aly NM, Al-Eraky MM. Self-assessment and peer-assessment of the psychomotor skills in preclinical prosthodontics: A prospective study. *Eur J Dent Educ* 2023;27:601-9.
  15. Vahed A, Naidoo S, Singh D. A preliminary inquiry on the association between pre-admission assessments and academic performance of first year dental technology students' within a South African university of technology. *S Afr Dent J* 2021;76:187-93.
  16. Phang ZY, Quek SH, Teoh KH, Tan KB, Tan K. A retrospective study on the success, survival, and incidence of complications of post-retained restorations in premolars supporting fixed dental prostheses with a mean of 7 years in function. *Int J Prosthodont* 2020;33:176-83.
  17. Roh YS, Issenberg SB. Association of cardiopulmonary resuscitation psychomotor skills with knowledge and self-efficacy in nursing students. *Int J Nurs Pract* 2014;20:674-9.
  18. Rohilla R, Gupta PK, Narula H, Sharma AK, Mehta V, Rao S, *et al.* Assessment of cognitive and psychomotor domains regarding biomedical waste management and hand hygiene among various categories of healthcare professionals at a tertiary care center in Northern India. *J Educ Health Promot* 2021;10:186.
  19. Pavani NPM, Anirudh G, Kothia NR, Shaik PS, Priya KK, Yaddanapalli SC. Depression, suicidal ideation, and suicidal behaviors among dental students of Neo-state capital region in India. *J Educ Health Promot* 2021;10:432.
  20. Behera S, Paluri SSSL, Mishra A. Mental health status of students pursuing professional training. *J Educ Health Promot* 2021;10:399-6.