The Power of the Pen in the Digital Age: A Study on the Note-Taking Preferences of Medical School Students

Dijital Çağda Kalemin Gücü: Tıp Fakültesi Öğrencilerinin Not Alma Tercihleri Üzerine Bir Araştırma

Araştırma Research

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DOI: 10.17942/sted.1832706

Geliş/Received: 01.12.2025
Kabul/Accepted: 01.06.2026

Abstract

Objective: This study investigates the note-taking frequency and tool preferences of medical school students, as well as their relationship with sociodemographic variables, perceived academic achievement, and perceptions of handwriting deterioration.

Method: This cross-sectional study included 407 medical students from the first, second, and third academic years at Gazi University Faculty of Medicine. A sociodemographic form developed by the researchers based on the literature and consisting of closed-ended questions was used to collect data on note-taking habits, tool preferences, perceived academic achievement, and perceived handwriting deterioration. Chi-square tests, non-parametric comparisons, and binary logistic regression models were used for statistical analyses.

Results: The majority of students (62.7%) reported using a note-taking strategy and stated a preference for pen and paper (82.7%) over digital tools. Note-taking was significantly associated with the female gender and higher perceived academic achievement ($p<0.001$). Logistic regression analysis revealed that male students were 3.17 (95% CI=2.004–5.014) times more likely not to take notes, and the likelihood of not taking notes increased with the academic year (Year 2 vs Year 1: OR=3.29; Year 3 vs Year 1: OR=4.45). Furthermore, the perception of deterioration in handwriting was found to be significantly higher among students who took notes ($p=0.013$).

Conclusion: Despite the increasing prevalence of digital tools, pen and paper remain the dominant note-taking method. Note-taking was significantly associated with perceived academic achievement for the medical students in this study, and note-taking habits were associated with gender, academic year, perception of achievement, and handwriting quality. Further research with longitudinal and multi-center study designs is needed to investigate the long-term cognitive and educational impact of note-taking strategies.

Keywords: academic success; handwriting; learning strategies; medical education; note-taking

Özet

Amaç: Çalışmamız, tıp fakültesi öğrencilerinin not alma sıklıkları ile not alma aracı tercihlerini, ayrıca bunların sosyodemografik değişkenler, algılanan akademik başarı ve el yazısı bozulması algıları ile ilişkisini araştırmayı amaçlamıştır.

Yöntem: Bu kesitsel çalışma, Gazi Üniversitesi Tıp Fakültesi birinci, ikinci ve üçüncü sınıfta eğitim gören 407 tıp fakültesi öğrencisini kapsamıştır. Not alma alışkanlıkları, not alma aracı tercihi, algılanan akademik başarı ve algılanan el yazısı bozulması ile ilgili verileri toplamak için araştırmacılar tarafından literatüre dayalı olarak geliştirilen, kapalı uçlu sorulardan oluşan bir sosyodemografik form kullanılmıştır. İstatistiksel analizlerde ki-kare testleri, non-parametrik karşılaştırmalar ve ikili lojistik regresyon modelleri kullanılmıştır.

Bulgular: Öğrencilerin çoğunluğu (%62,7) not alma stratejisi kullandığını söylemiş ve dijital araçlara göre kalem ve kâğıdı (%82,7) tercih ettiğini belirtmiştir. Not alma, kadın cinsiyet ve algılanan akademik başarının yüksekliği ile anlamlı bir şekilde ilişkiliydi ($p<0,001$). Lojistik regresyon analizi, erkek öğrencilerin not almama olasılığının 3,17 (95% CI=2,004–5,014) kat daha fazla olduğunu ve not almama olasılığının akademik yıl ile arttığını ortaya koydu (2. sınıf vs 1.: OR=3,29; 3. sınıf vs 1.: OR=4,45). Ayrıca, el yazısındaki bozulma algısı, not alan öğrenciler arasında anlamlı bir şekilde daha yüksekti ($p=0,013$).

Sonuç: Dijital araçların giderek yaygınlaşmasına rağmen, kalem ve kâğıt hala baskın not alma yöntemi olmaya devam etmektedir. Not alma, bu çalışmadaki tıp fakültesi öğrencileri için algılanan akademik başarı ile anlamlı bir şekilde ilişkiliydi. Öğrencilerin not alma alışkanlıklarının cinsiyet, akademik yıl, başarı algısı ve el yazısı kalitesiyle ilişkili olduğu bulunmuştur. Not alma stratejisinin uzun vadeli bilişsel ve eğitimsel etkilerini araştırmak için uzunlamasına ve çok merkezli çalışma tasarımlara sahip daha fazla araştırma yapılması gerekmektedir.

Anahtar Sözcükler: akademik başarı; el yazısı; not alma; öğrenme stratejileri; tıp eğitimi

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Introduction

Note-taking has two primary functions: the first is the encoding function, which involves recording information as notes to commit it to memory, and the second is the external storage function, where notes serve as a memory repository that can be accessed at any time (1,2). The process of note-taking involves multidimensional cognitive activities, such as paying attention, selecting necessary information, paraphrasing, and recalling (3,4), and is the most frequently used study activity by students (5). Note-taking is a necessary strategy due to the limited capacity of short-term memory, also known as working memory, and the limitations of the human information processing system (6), which make it impossible to retain and process all information (7).

Notes can be recorded using both analog and digital tools. While analog notes can be written on surfaces such as paper, printed texts, post-it notes, whiteboards, and flip charts, digital note-taking requires the use of electronic devices activated by keyboard, digital ink, or voice (2,8-11). A study by Mueller and Oppenheimer (12) concluded that taking notes by hand is superior to taking notes on a laptop. However, Urry et al. (13) did not observe a significant impact of the note-taking method on learning performance. In general, the process of taking and reviewing notes appears to be positively correlated with students' academic achievement. However, it should be noted that some students do not prefer to take notes, and there are several factors, such as the pace of the lecture, that can constrain note-taking and reviewing (3,14).

Whether students' academic achievement improves with specific note-taking habits seems to depend on the type of course and the inclination of the students to review their notes (15). Furthermore, according to Morehead et al. (2019), the effectiveness of note-taking habits for academic success can vary depending on the lecturer's style and the course material. They provide an example showing that digital note-taking may be more efficient in situations where lecturers speak quickly or when lecture slides lack visuals (16). Another study has also demonstrated the superiority of taking notes by hand (17).

Although various studies have examined the relationship between note-taking habits and perceived academic achievement among undergraduate students, holistic studies that simultaneously consider the perception of handwriting deterioration and note-taking behavior, as well as sociodemographic variables such as perceived success and gender, are limited. There is no published report on the simultaneous evaluation of these variables in medical school students. This gap in the literature underscores the importance of the present study.

The objective of this study is to examine the note-taking frequencies and the methods used by medical school students. In accordance with this objective, the study endeavours to address the following research questions:

1. What is the distribution of note-taking habits and preferred tools (handwriting/digital) among medical school students?
2. Is there a relationship between students' note-taking habits and variables such as gender, academic year, perceived academic success, and the perception of handwriting deterioration?

Material and Methods

Study Design and Setting

This cross-sectional study was conducted with first, second, and third-year students at Gazi University Faculty of Medicine in a single session at the beginning of the 2023-2024 academic year.

Data Collection

The students were collectively informed about the study in their classrooms, and an Informed Consent Form was obtained from students who wished to participate. A Sociodemographic Form consisting of closed-ended questions and some numerical data fields was developed by the researchers to collect data. The form included variables such as the participants' age, gender, academic year, dominant hand used for writing, note-taking status during lectures (yes/no), self-perception of success (yes/no), perception of handwriting deterioration (yes/no), presence of hand tremors (yes/no), and presence of a neurological/psychiatric disorder (yes/no).

For participants who took notes, additional information was recorded, including the number

of years they have been taking notes, the most frequently used note-taking tool (pen-paper, tablet and digital pen, phone, computer), the average number of pages of notes per day, and the type of handwriting (cursive, print, or both). No prior pilot study was conducted for the content validity or reliability of the form; the questions were adapted from studies measuring similar variables in the literature and were prepared based on the research team's field experience. Students who submitted incomplete forms were excluded from the study (six students, 1.4%). The research team attempted to reach all students in every academic year. A total of 407 students were contacted, and their data were included in the study (407/1008).

Ethical Approval

The study was approved by the Dean's Office of Gazi University and the Gazi University Rectorate's Ethics Committee (Research Code No: 2023 - 691).

Statistical Analysis

Data analysis was conducted using IBM SPSS Statistics 25.0 (SPSS Inc., Chicago, IL, USA) software. Continuous variables have been presented as mean and standard deviation (mean±SD), and categorical variables as frequency (n) and percentage (%). The chi-square test was used to compare categorical variables. In cases where more than 20% of the expected frequencies were below 5 in tables of 3x2 or larger, the chi-square test based on the Monte Carlo simulation method was employed. The normality of data distribution was assessed with the Shapiro-Wilk and Kolmogorov-Smirnov tests. In case of non-normal distribution, the non-parametric Kruskal-Wallis H test was employed to compare more than two groups. Pairwise comparisons between groups were made using the Mann-Whitney U test. Binary logistic regression analysis was performed to identify factors underlying note-taking behavior. The students' note-taking status ("Note-taking status"; Yes=0, No=1) was taken as the dependent variable, and the independent variables included gender (Female=0, Male=1), academic year (Year 1 as reference; Year 2 and Year 3 as comparison groups), the student's self-perceived success (Yes=0, No=1), and the perception of handwriting deterioration (Yes=0, No=1) (only years 2 and 3 were included for this variable). All variables were defined as categorical, and the first category was selected as the reference category. The logistic regression analysis was conducted using the Enter method. The overall significance of the model was evaluated with the Omnibus Test of Model Coefficients, and the model fit was tested using the Hosmer-Lemeshow test. The Cox & Snell R2 and Nagelkerke R2 coefficients were reported for the amount of explained variance. A statistical significance level of $p<0.05$ was accepted, and all analyses were conducted with a 95% confidence interval (CI).

Results

A total of 407 students, including 236 females (58.0%) and 171 males (42.0%), consented to participate in the study. The mean age of the participants was 19.54±2.06 years. In addition, 151 participants (37.1%) were in Year 1, 102 (25.1%) in Year 2, and 154 (37.8%) in Year 3. A total of 255 students (62.7%) reported taking notes during lectures, while 152 (37.3%) reported not taking notes (Table 1).

As shown in Table 1, there was no statistically significant variation in gender distribution across academic years, nor was there any significant difference regarding the dominant hand used. Note-taking in Year 1 was significantly higher compared to that in Year 2 and Year 3 ($p<0.001$). The proportion of students who perceived themselves as successful was significantly higher in Year 1 than in the other years. However, there was no significant difference between Years 2 and 3 ($p<0.001$). When asked whether their handwriting had changed compared to previous years, there was no significant difference in the number of students who perceived deterioration and those who did not in either Year 2 or Year 3. Furthermore, there was no significant difference in the reporting of hand tremors across academic years. When all years were considered, the number of students with and without a neurological or psychiatric disorder were also similar.

In our analysis of handwriting deterioration based on note-taking status, the perception of handwriting deterioration was significantly higher among students who took notes

Table 1. Sociodemographic parameters and note-taking habits											
		Year									
		Year 1		Year 2		Year 3		Total		x^2	p
		n	%	n	%	n	%	n	%		
Gender	**Female**	83	35.2	67	28.4	86	36.4	236	100.0	3.307	0.188
	Male	68	39.8	35	20.5	68	39.8	171	100.0		
Dominant hand	**Right**	138	37.6	94	25.6	135	36.8	367	100.0	1.801	0.406
	Left	13	32.5	8	20.0	19	47.5	40	100.0		
Note-taking status	**Takes notes**	122	47.8	58	22.7	75	29.4	255	100.0	35.512	**<0.001**
	Does not take notes	29	19.1	44	28.9	79	52.0	152	100.0		
Do you consider yourself successful?	**Yes**	132	48.0	51	18.5	92	33.5	275	100.0	45.820	**<0.001**
	No	19	14.4	51	38.6	62	47.0	132	100.0		
Do you think your handwriting has deteriorated? †	**Yes**	-	-	53	41.1	76	58.9	129	100.0	0.167	0.683
	No	-	-	49	38.6	78	61.4	127	100.0		
Do you have hand tremors?	**Yes**	23	28.4	27	33.3	31	38.3	81	100.0	4.832	0.089
	No	128	39.3	75	23.0	123	37.7	326	100.0		
Note-taking tool	**Pen and paper**	102	48.3	41	19.4	68	32.2	211	100.0	9.264	**0.010**
	Tablet and digital pen	20	43.5	17	38.6	7	15.9	44	100.0		
What type of handwriting do you use?*	**Cursive**	1	9.1	4	36.4	6	54.5	11	100.0	1.490	0.125
	Print	128	37.6	83	24.4	129	37.9	340	100.0		
	Both	22	39.3	15	26.8	19	33.9	56	100.0		
Do you have a neurological or psychiatric illness?*	**Yes**	4	23.5	3	17.6	10	58.8	17	100.0	3.305	0.064
	No	147	37.7	99	25.4	144	36.9	390	100.0		
*Monte-Carlo test		†Only year 2 and year 3 students were included in the evaluation									

(p=0.013) (Table 2). Self-perceived success was significantly higher among those who took notes compared to those who did not (p<0.001), and note-taking was significantly more frequent among females than males (p<0.001). Hand tremors were not associated with note-taking status (Table 2).

As shown in Table 3, the average number of pages of notes taken daily differed significantly

Table 2. Evaluation of some parameters according to note-taking status

		Note-taking status							
		I take notes		I do not take notes		Total		x^2	p
		n	%	n	%	n	%		
Do you think your handwriting has deteriorated?*	**Yes**	77	68.4	52	31.6	129	100.0	6.236	**0.013**
	No	56	57.1	71	42.9	127	100.0		
Do you consider yourself successful?	**Yes**	184	68.9	83	31.1	267	100.0	14.574	**<0.001**
	No	60	48.8	63	51.2	123	100.0		
Gender	**Female**	161	71.6	64	28.4	225	100.0	18.357	**<0.001**
	Male	83	50.3	82	49.7	165	100.0		
Do you have hand tremors?	**Yes**	44	59.5	30	40.5	74	100.0	0.376	0.540
	No	200	63.3	116	36.7	316	100.0		
*** Only year 2 and year 3 students were included in the evaluation**									

Table 3. Daily page counts of notes by academic year

		On average, how many pages of notes do you take per day?		
		Median (min-max)	x^2	p
Years	**Year 1**	4.0 (1.0-20.0)	5.313	**0.021**
	Year 2	3.0 (1.0-10.0)		
	Year 3	2.0 (1.0-12.0)		

across academic years among students who took notes. A notable difference was observed in the daily number of note pages between Year 1 and Year 3, as well as between Year 2 and Year 3 students (p=0.021).

The results of the omnibus test of model coefficients in the logistic regression model indicated that the independent variables made a statistically significant contribution to the model (χ^2=77.422, p<0.001). The p value for the Hosmer-Lemeshow test was greater than 0.05 (χ2=9.940, p=0.269), indicating that the model had a good fit to the data. The Nagelkerke R2 value, a measure of the model's explanatory power, was 0.236, which meant that the independent variables explained approximately 23.6% of the variance in note-taking behavior. The overall prediction accuracy of the model was 67.8%.

The results of logistic regression analysis (Table 4) revealed that all independent variables included in the model had a significant effect on students' note-taking behavior (p<0.05). Male students were 3.17 times more likely not to take notes compared to female students (B=1.154, p<0.001, OR=3.170, 95% CI [2.004–5.014]). The likelihood of students not taking notes increased with their academic year. Students in Year 2 were 3.29 times more likely not to take notes compared to the Year 1 students (B=1.190, p<0.001, OR=3.286, 95% CI [1.756–6.150]), while students in Year 3 were 4.45 times more likely not to take notes than the Year 1 students (B=1.493, p<0.001, OR=4.453, 95% CI [2.560–7.744]). Students who did not describe themselves as successful were 1.96 times less likely to take notes than those who perceived themselves as such (B = 0.672, p = 0.006, OR = 1.957, 95% CI [1.209–3.169]). In a sub-analysis including only Year 2 and 3 students, the predictive power of the academic year variable on note-taking behavior was not statistically significant (B=0.328, p=0.201, OR=1.388, 95% CI [0.839–2.297]).

Table 4. Logistic regression analysis of note-taking status with some parameters								
Variable	**B**	**S.H.**	**Wald**	**df**	**p**	**Exp(B)**	**95% CI Lower**	**95% CI Upper**
Gender (Male)	1.154	0.234	24.312	1	**<0.001**	3.170	2.004	5.014
Year(1) (Year 2)	1.190	0.320	13.846	1	**<0.001**	3.286	1.756	6.150
Year(2) (Year 3)	1.493	0.282	27.978	1	**<0.001**	4.453	2.560	7.744
Do you consider yourself successful? (No)	0.672	0.246	7.467	1	**0.006**	1.957	1.209	3.169
Do you think your handwriting has deteriorated? (No)*	0.328	0.257	1.633	1	0.201	1.388	0.839	2.297
Constant	-2.577	0.307	70.311	1	**<0.001**	0.076	–	–
CI: Confidence Interval	*Only year 2 and year 3 students were included in the evaluation							

Discussion

This study examined the note-taking habits of students at Gazi University Faculty of Medicine, and compared the findings to that for other disciplines.

In a study conducted by Salame and Thompson (18), the majority of the participating students shared the view that note-taking is an important strategy for achieving academic success, as well as supporting effective studying and learning. The most notable findings of our study are that 62.7% of medical students actively took notes in lectures, and perceived themselves to be more successful than those who did not take notes ($p<0.001$). Due to the cross-sectional design of our study, the direction of this relationship cannot be determined; it is possible that having a high perception of academic achievement encourages note-taking behavior, just as it is also possible that regular note-taking leads students to perceive themselves as more successful. Longitudinal studies are needed to elucidate this possible bidirectional relationship. Furthermore, students who did not describe themselves as successful were 1.96 times more likely to not take notes than those who did. This result aligns with existing literature supporting the encoding and external storage functions of note-taking for academic achievement and learning (3,14,16).

Among the students who took notes, the use of pen and paper (82.7%) was significantly more prevalent compared to digital tools (17.3%). In a study involving students from arts, social sciences, technology, and engineering disciplines, 94% of the respondents reported taking notes in class, while 69% stated they took their notes digitally (19). In a study conducted on medical students, the preferred note-taking method was with iPad/tablet for 58 students (85.2%), pen and paper for four students (5.8%), and a combination of both for six students (8.8%) (20). In contrast, notebook-based note-taking was most common (86%) among language students who reported taking notes (96%), followed by laptop note-taking (46%) (21). This discrepancy may be related not only to technological trends but also to faculty-specific learning cultures, information load, examination structures, faculty culture, curriculum design, and teaching strategies. In information-dense disciplines like medicine, where conceptual understanding is critical, the advantage of handwritten notes in restructuring information and activating deep processing (12) may be the underlying cognitive reason for the preference observed in our study. On the other hand, in quantitative and technical fields, digital note-taking may be preferred for its speed in typing and drawing. Nevertheless, the careful and purposeful use of digital tools can be integrated into all educational settings. Educators providing faculty-based note-taking guidance that considers these differences could also enhance students' learning efficiency. However, one study showed that the presence of laptops in the classroom, even when used solely for note-taking, could have a negative impact on academic achievement (22). In another

study, students who wrote their notes by hand experienced fewer mental distractions, which could lead to better recall of course material (17). The greater use of pen and paper among Year 1 students in our study, coupled with a higher self-perception of success, is consistent with the aforementioned literature.

We found that the note-taking behavior of medical students showed significant changes with the academic year. The Year 1 students took an average of four pages of notes, compared to three and two pages for Year 2 and Year 3 students respectively ($p=0.021$). Furthermore, students in Year 2 were 3.29 times more likely not to take notes compared to Year 1 students, while students in Year 3 were 4.45 times more likely not to take notes than Year 1 students. Although the cross-sectional nature of this study does not definitively establish causality, these results suggest that students' skills in filtering and selecting information may develop over time, enabling them to record less but more concise information. This trend is meaningful in the context of Cognitive Load Theory (23) and the regulation of learning strategies. It can be argued that as students' learning experience increases, they tend to adopt more strategic note-taking approaches.

A large-sample study investigating the association between gender and note-taking among undergraduate students revealed that females recorded more information in their notes and demonstrated better performance on measures of handwriting speed, working memory, language comprehension, and conscientiousness than males (24). In our study as well, the majority of the students who took notes were female, although there was no significant difference in self-perceived success. Additionally, we found that male students were 3.17 times more likely not to take notes compared to female students. We also observed a significantly higher prevalence of students in Years 2 and 3 who took notes and perceived their handwriting to have deteriorated. Factors such as the intensive use of handwriting and the speed required for note-taking in lectures may have contributed to this perception. Further research using more objective data is needed to explain this finding.

Limitations

This study has several limitations. First, due to the cross-sectional nature of the study, it was not possible to establish a cause-and-effect relationship; in particular, the direction of the association between perceived academic success and note-taking remains undetermined. Whether higher self-perceived success encourages note-taking, or whether the act of note-taking enhances the perception of being successful, cannot be inferred from the present design. Second, the students' perception of success was evaluated based on self-report and was not verified with objective academic indicators; therefore, the possibility of discrepancies with actual academic performance should be considered. In addition, since the data was collected from a single medical faculty, the generalizability of the results is limited. Furthermore, although the questions in the sociodemographic form were adapted from the literature and prepared based on the research team's experience, a prior validity and reliability analysis was not conducted, which precluded assessment of the psychometric properties of the measurement tool. Finally, our multivariate model explains approximately 23.6% of the variance in note-taking behavior; this indicates that other variables not included in our model, such as study motivation, learning styles, attention span, course load, the instructor's presentation style, and previous educational experiences, may have an effect on note-taking behavior.

Future Research

Future research could employ a longitudinal design to examine the changes in students' note-taking habits over the years, and the impact of these changes on academic success and handwriting deterioration using objective data. Additionally, comparative studies involving students from different faculties would provide a deeper understanding of discipline-specific learning strategies.

Conclusion

In this study, we aimed to evaluate the note-taking habits and preferences of medical students at our faculty, along with their perceived academic success and perceptions of handwriting deterioration.

- Despite the widespread availability of digital technologies, the participating students preferred traditional pen-and-paper methods for note-taking.
- In addition, note-taking habits were significantly associated with perceived academic achievement, and thus remain an important learning strategy within the demanding context of medical education. Furthermore, note-taking behavior was significantly influenced by factors like gender, academic year, and perceived academic success.
- Female students and those who perceived themselves as more successful were more likely to take notes; however, the cross-sectional design does not allow us to determine the direction of this association, while the tendency to take notes decreased in higher academic years. This pattern may reflect a shift from detailed record-keeping to more selective and strategic information processing as students advance through medical training.
- The perception of handwriting deterioration among note-takers may reflect the intensity and frequency of handwritten work during medical education rather than an actual decline in handwriting ability.
- Ultimately, in an era where digital note-taking tools are becoming increasingly prevalent, encouraging a balanced integration of analog and digital methods may enhance learning efficiency. Future longitudinal and multi-center studies should investigate how these habits evolve over time, and how different note-taking approaches influence learning outcomes, handwriting quality, and academic performance in medical education.

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