

Impact of instructor-provided notes on the learning and exam performance of medical students in an organ system-based medical curriculum

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Purpose: The present study aimed to explore the impact of instructor-provided notes on the learning and exam performance of medical students

Patients and methods: The participants involved in this study were the first year medical students who enrolled in the auditory system course in the second semester of the academic years 2012–2016 (N=380, 170 males and 210 females). The medical students were divided into two groups: teaching without guided note-taking approach and teaching with guided note-taking approach. To measure the note-taking process of students, quantity and quality of notes were recorded and scored. At the end of the course, the questionnaire was administered to all students in the experimental group in order to cover student's satisfaction with the instructor-provided notes. Chi-squared tests using SPSS software were performed on categorical variables for comparison of exam score between classes with/without guided note-taking approach. A $P < 0.05$ was considered as statistically significant.

Results: When compared, more females (75%) than males were included in the note-taking process. Females wrote more information in greater detail than males. In the control group, only 58 students from 193 students attempted to take notes, but in the experimental group, all of the students were encouraged to complete guided notes and take notes. When students were provided with guided notes, the structure of their notes reflected more outline, examples, verbatim and words than the control group. The students connected the main idea with their details in the spaces of the guided notes. The course final exam performance for the class with the guided note-taking approach was statistically significantly higher than that for the class without a guided note-taking approach ($\chi^2 = 10.542$; $P = 0.023$). Nearly all of the students agreed to receive instructor-provided notes before class.

Conclusions: Findings of the present study indicated that when students are provided with guided notes, their note-taking process develops; consequently improving students' learning and exam performance.

Keywords: instructor-provided notes, note taking, anatomy, learning, curriculum, education

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Introduction

The ever-increasing need of medical students for basic sciences with clinical information requires appropriate medical curricular revision.¹ Therefore, several universities have developed their curricula for integration of the basic sciences with clinical medicine.²

Because of the importance of teaching to both undergraduate and postgraduate students, anatomy has historically been a cornerstone in the medical curriculum.

Therefore, teaching of anatomy has undergone the greatest fluctuation of any of the basic sciences.³ In recent years, gross anatomy has been integrated into newer teaching and learning approaches such as problem-based learning and system-based curriculum.³

For most anatomy instructors, lectures remain a dominant method of teaching and learning. During a lecture, the student takes notes, but student-authored notes are often incomplete.⁴ Previous research has indicated that two main functions of note taking for students are encoding (process of listening to a lecture, understanding the lecture ideas and writing down the main information in their own words) and as external storage device. Several studies have shown that effective note-taking techniques can improve student learning.^{5,6} During the lecture, students attempt to create notes they can easily use and understand. Therefore, note taking needs a teaching system that helps students to redesign the contents the teacher provides.^{7,8}

Although one of the most effective learning skills is note taking, this skill is often incomplete. In the literature, only a few studies have reported medical student learning through instructor-provided notes.⁹ The present study aimed to explore the impact of instructor-provided notes on note taking, learning and exam performance of medical students.

Patients and methods

Ethics statement

All the experimental procedures were done after Shahroud University of Medical Sciences ethics research committees' approval. Control for a Hawthorne effect in the present study was performed by giving equal time and attention to both teaching with and without guided note-taking approaches. The Hawthorne effect occurs when students are aware that they are being used to experiment and modify or improve an aspect of their behavior. To control this, the anatomy teachers of the School of Medicine were selected for this study and used for teaching the classes. Therefore, the suspicion that the teachers were using students for an experiment was reduced.

The characteristics of the curriculum of Shahroud University of Medical Sciences

The medical curriculum consisted of three phases: preclinical (basic sciences) and clinical sciences, and clinical experience.^{10,11} The integrated preclinical phase consisted of five courses (12 organ systems), including anatomy, physiology, biochemistry, immunology and genetics as a horizontal model. At the end of the fifth term, the medical students were ready to take the national basic science exams (Figure 1).

Anatomical sciences was taught in four parts during the curriculum, which included anatomy, histology, embryology, and radiology (Figure 1).

Participants

The participants involved in this study were the first year medical students who enrolled in the auditory system course in the second semester of the academic years 2012–2016 (N=380, 170 males and 210 females).

Lecture setting

During the second semester of the first year, the medical students enrolled in the auditory system. There were four main topics in the auditory system that needed to be taught. The content consisted of the anatomy of the external ear (auricle, external acoustic meatus), middle ear (the boundaries of the tympanic cavity, auditory ossicles), internal ear (the bony membranous labyrinth), innervation and the arterial supply of the auditory system. Also, the microscopic anatomy of external, middle and internal ear was discussed. Development of ear and clinical correlations were incorporated into the curriculum as embryology. Furthermore, the learning and teaching of lectures improved with computed

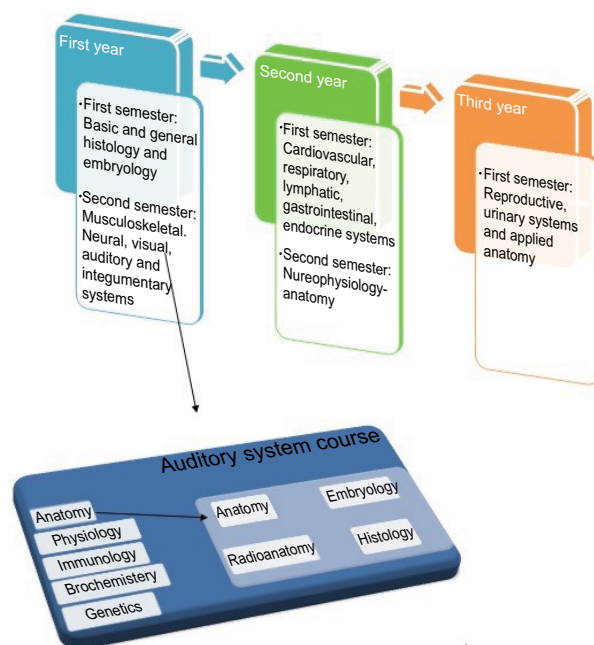


Figure 1 Medical education curriculum of Shahroud University of Medical Sciences. Preclinical (basic sciences) phase of organ systems consists of five courses, including the anatomy, physiology, biochemistry, immunology and genetics of 12 body systems. The anatomical sciences education of the auditory system includes all three branches of anatomy: gross anatomy, embryology and histology and all were integrated with radiology.

tomography (CT) and magnetic resonance imaging (MRI) images as radio anatomy. The course was conducted as computer-assisted lectures with a clinical case presentation at first. After the class, students were supplied with power point slides of the course.

Study design

To investigate the impact of instructor-provided notes on the note-taking process, learning and exam performance, medical students were divided into two groups: 1) teaching without a guided note-taking approach; and 2) teaching with a guided note-taking approach (Figure 2).

Teaching without a guided note-taking approach in 2012–2016

In the group, 193 participants (as a control group) were taught without guided note-taking throughout the course. The control group was taught by a conventional lecture format and each lesson was started by explaining the general principles of the auditory system with examples of clinical problems. However, students were not provided with guided notes and took their own notes (Figure 2).

Teaching with a guided note-taking approach in 2012–2016

Preparation of guided-notes

At first, summaries of contents and outlines of the auditory system were extracted from textbooks of anatomy, histology and embryology as instructor-provided notes (guided

notes). The guided notes were created as a structured tree map model that identified and summarized the main points of class discussions. Accuracy of main points, details, sequence and clarity of guided notes was checked in each semester. The experimental group of students (n=187) was taught by the same lecture format as the control group. The notes were designed with appropriate space, clear cues and an interactive window. The medical students were given guided notes while attending the auditory system course on each day.

Lessons of the auditory system were started with a demonstration, and students were asked to use guided notes and allowed to write down their notes.

Assessment of students' note-taking process

To measure the note-taking process of students, the quantity (total words and total information units) and quality (efficiency or density, completeness, test answerability, level of information and organizational features of notes) were recorded and scored (Table 1).¹² Therefore, we employed a system of measures, namely, the title, numbering, outline, examples, verbatim, diagrams, symbols, abbreviations and words in notes to identify three factors: quantity and organization (total words, outline, abbreviations, symbols), representational simplicity (diagrams, lists) and elaborateness (verbatim) (Table 1).

Questionnaire and interview questions

At the end of the course, the questionnaire was administered to all students in the experimental group in order to cover the

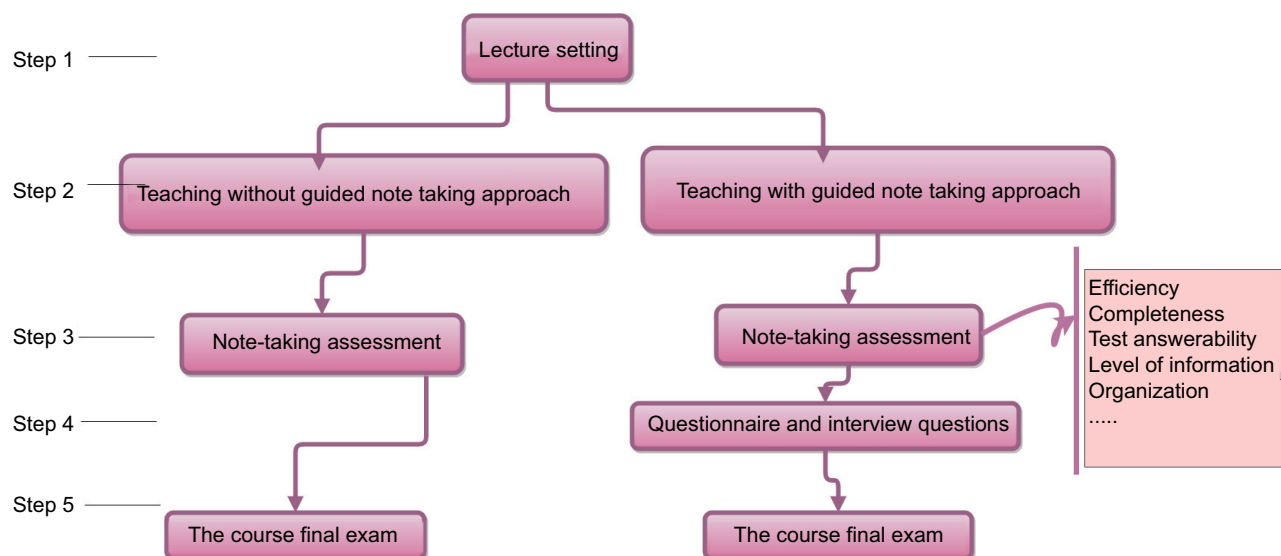


Figure 2 Study design: after lecture setting, the students were divided into two groups: an experimental group (teaching with a guided note-taking approach) and a control group (teaching without a guided note-taking approach).

satisfaction of students with the instructor-provided notes. The questions focused on whether the guided notes helped students learn in the lectures and asked students whether they were satisfied with the guided notes. Also, the strengths and weaknesses of the guided notes were asked about. The validity and reliability were examined by administering the questionnaire on two separate occasions by the same interviewer and was administered twice to compare the answers from the questionnaires.

The course final exam

The final exam of the auditory system (31 questions) included four types of questions: fill-in-the-blank, multiple choice, true/false and image-based questions (Table 2). Overall, 45.16%, 25.80%, 16.12% and 12.90% of exam questions related to anatomy, histology, radiology and embryology, respectively, were asked. According to the final exam, the students' scores were divided into five groups: (G1) scores 13–16, (G2) scores 17–20, (G3) scores 21–24, (G4) scores 25–28 and (G5) scores 29–31.

Statistics

The data regarding students' note-taking procedures and the final exam performance were collected and arranged as

Table 1 Assessment of student's note-taking process (several variables of the note-taking process such as title and abbreviations were examined)

Variable	Item checked
Title	Provision of lecture title
Numbering	Numbers of letters indicating a list
Outline	Use of hierarchical outlining
Examples	Provision of signaled examples
Verbatim	Evidence of transcription, completeness
Diagrams	Provision of sketches, figures, maps
Symbols	Provision of arrows, boxes, etc
Abbreviations	Provision of abbreviated words
Words	All units, not numbers, symbols or diagrams

Table 2 Final exam questions in full integration of gross anatomy, radiology, histology and embryology of the auditory system course at preclinical (basic sciences) phase. The exams consisted of several types of questions such as multiple choice, fill-in-the-blank, true or false and figures

	Multiple choice questions	Fill-in-the-blank	True or false	Figure	Count	Percent
Anatomy	8	3	3	0	14	45.16
Radio anatomy	0	0	0	5	5	16.12
Histology	4	2	2	0	8	25.80
Embryology	1	1	1	0	4	12.90
Count	13	6	6	5	31	100
Percent	41.93	19.35	19.35	16.12	100	

numbers and percentages. All responses to the questionnaire were stratified separately. Chi-squared tests using SPSS software were performed on categorical variables to compare the exam score between classes with/without a guided note-taking approach. A $P < 0.05$ was considered as statistically significant.

Results

Participants

When compared, more females (75%) than males were included in the note-taking process. Females wrote more information in greater detail than males.

Lecture setting

The Shahroud University of Medical Sciences curricula was designed with intergradations of clinical and basic science. The integration of radiology with anatomy improved clinical application of anatomy and radiological interpretation.

Assessment of note-taking quality

In the control group, only 58 students from 193 students attempted to take notes, but in the experimental group all of the students were encouraged to complete guided notes and take notes. When students were provided with guided notes, the structure of their notes reflected higher outline, example, verbatim and word than the control group. The students connected the main idea with their details in the spaces of the guided notes. During the lecture, the students discussed the material and compared their notes (Table 3).

With tree map guided notes, students experienced alternative and nonlinear note-taking procedures.

Figure 3 illustrates an example of instructor-provided notes (A) and those notes with student comments added (B). The student wrote the comments on the side with different color, which would definitely help them understand. They connected supporting materials to the appropriate main point by using the abbreviation. Students connected

the main contents and clinical relevance of cases of course with their review; as anatomy comprised the major portion of the course, comments related to this field were more than other fields (Figure 3).

The course final exam

When instructors provided students with the lecturer's guided notes, students' test scores improved

When a chi-squared test was used to compare the final exam score between the two groups, the performance of the

class with a guided note-taking approach was statistically significantly higher than that of the class without a guided note-taking approach ($\chi^2=10.542$; $P=0.023$) (Table 4).

Questionnaire and interview questions

According to the students who responded, the instructor-provided notes helped them understand the course content (90%). The response rate was 75.60% and the majority of students (96%) were in favor of receiving the instructor-

Table 3 Findings of the students' note-taking assessment (data were arranged as numbers and percentages)

	Title	Numbering	Outline	Examples	Verbatim	Diagrams	Symbols	Abbreviations	Words
With guided notes (187)	100	30	187	110	135	30	43	43	140
Percentage without guided notes (58)	58	4	10	6	15	7	8	6	4
Percentage with guided notes (187)	100	16.04	100	58.82	72.19	16.4	22.99	22.99	74.86
Percentage without guided notes (58)	58	4	10	6	15	7	8	6	4
Percentage with guided notes (187)	100	6.89	17.24	10.34	25.86	12.06	13.79	10.34	6.89

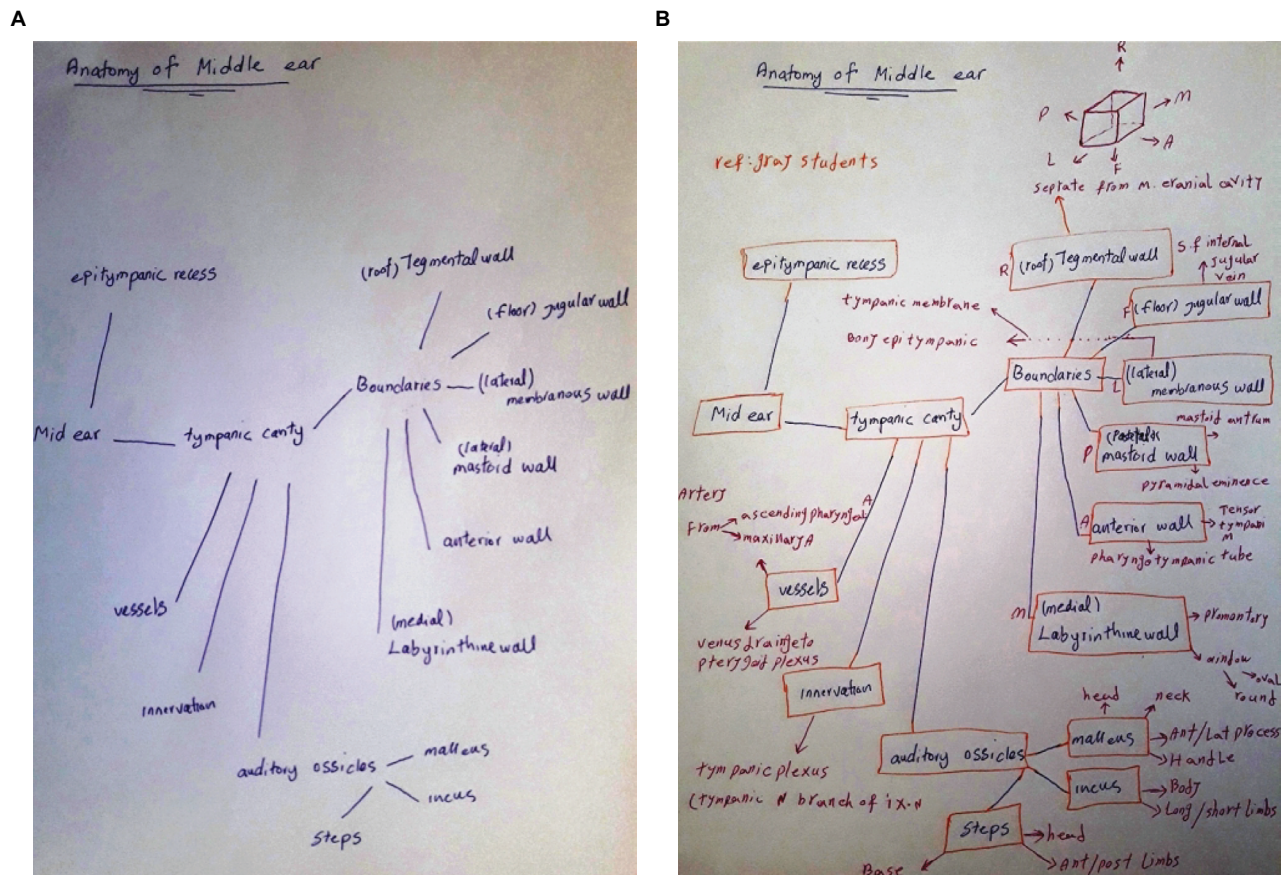


Figure 3 Example of the content and form of the guided notes (middle ear) and student's comments. **Notes:** Instructor-provided notes (A) and comments of students (B). They put the comments on the right side with different colors. They inserted labels such as arrows to represent the directions and contents.

provided notes prior to the class. In Table 5, the questionnaire administered at the end of the course is given. Box 1 shows participants' write-in comments to the survey question regarding how the guided notes may have influenced students' learning. The majority of students (87.09%) responded that the anatomy part of the instructor-provided notes gave more helpful tips than the histology and embryology parts. Also, 87.09% of the students suggested that the anatomy portion of the instructor-provided notes needs to be revised. A total of 80.65% of the students recommended this learning method for physiology and 19.35% for biochemistry courses (Tables 5 and 6).

Discussion

Findings of the present study have indicated that, when students were provided with guided notes, the structure of their notes reflected higher outline, example, verbatim and word than the control groups. Comparing between the two groups, the course final exam performance of the class with a guided note-taking approach was statistically significantly higher than that of the class without a guided note-taking approach.

Questionnaire and interview questions revealed that the instructor-provided notes that integrated basic and clinical information helped students understand the course content (90%), and the majority of students (96%) were in favor of receiving the instructor-provided notes prior to the class. When compared, more females (75%) than males were included in the note-taking process.

In the present study, more females than males were involved in the note-taking process and completed blank spaces with more related terms in the sequence. Previous studies indicated that females record more information in greater detail than males, and the quality of females's notes is a predictor of their performance.^{13,14}

In order to support new types of medical education, the curriculum of Shahroud University of Medical Sciences integrated basic sciences and clinical information. In particular, anatomy is the backbone of the integrated curriculum. But, anatomy education and learning is time consuming for both teachers and students. Furthermore, the field of medical sciences has been expanding over time, and hard work is required for planning, organization and execution of new teaching methods.¹⁵⁻¹⁷

Table 4 Exam scores of students: (G1) 13–16, (G2) 17–20, (G3) 21–24, (G4) 25–28 and (G5) 29–31

Variable	Class	Exam score groups					Chi-squared value	P-value
		G1	G2	G3	G4	G5		
Class	With guided notes	33	34	42	45	33	10.542	0.032
	Without guided notes	55	45	30	36	27		

Table 5 Questionnaire administered to students in order to cover student's satisfaction with the instructor-provided notes

Question	Agree		Disagree	
	n	%	n	%
Benefit to understand course content	179	95.72	8	4.2
Accordance with course exam	160	85.56	27	14.43
Advantage to performance final exam	160	85.56	27	14.43
Note giving prior text reading	165	88.23	21	11.22
Note giving after text reading	80	42.87	107	57.21
Adding contents to note giving for performance final exam	85	45.45	102	54.54
Resolve need for summarizing	170	90.90	17	9.09

Box 1 A sample of participants' write-in comments to the survey question regarding how the guided notes may have influenced their learning

...Providing an outline or guided notes prior to lectures and for later review facilitated my learning...
...Note-reviewing and learning from guided notes encouraged me to be more active and productive...
...Instructors provided notes prior to class helped me to reorganize my note-taking process...
...Guided notes allowed me more focus on relating ideas within the presentation...

Our instructor-provided notes considered several items (space, clear cues) and exposed students to alternative and nonlinear note-taking methods such as the Cornell note-taking system and concept maps to improve student's notes and note-taking skills. We prepared guided notes in a tree map format. Researchers found that notes organized linearly in an outline do not make obvious the relationships among ideas. Studies revealed that students with guided notes wrote significantly more words and key ideas and had more complete notes than students without guided notes.¹⁸ The tree map model provides notes, exposes students to alternative and nonlinear note-taking procedures and guides students how to take notes (selection of method, time of note taking, amount of words, etc) as an integral part of the learning process. Previous studies demonstrated that the students who used instructor-provided notes applied fewer words to cover more main concepts (higher learning level) following the instructional intervention.¹⁹

We designed a normal space in the guided notes. With more space in the instructor-provided notes, students wrote more than just the main idea. With less space available, they did not write on the page. The participants of the study inserted comments on the right side of the paper with different color following guided notes that affected their lecture understanding.

We provided clear cues in notes. With these cues, students recognize critical material and important structural or organizational relationships and connected supporting materials to the appropriate main point by using the abbreviation.²⁰

We provided partial guided notes to students that allowed students to fill in key and supporting information to prioritize lecture information. When students completed partial notes, they performed better in the exam than students with a full set of the instructor's notes. The review of guided notes significantly improves recall of lecture material to earn higher exam scores.^{21,22,27,28}

We provided partial guided notes before class and allowed students to review the material, assisting with their ability to comprehend the material during the lecture to better remember and incorporate the material into long-term storage.²³ Providing partial guided notes decreases the amount of time students have to think about the information being presented or read and improve the overall organization, accuracy and completeness of their notes.^{24,25}

Previous investigations indicated that students who did not receive instructor-provided notes received lower exam scores than students who received the notes before or after lectures.^{8,26} Using guided notes, students can take notes with synthesized information and record key aspects of the lecture

with considerable advantage when using their notes to review for an examination.^{26,27}

Questionnaire data indicated that the majority of students agreed to receive instructor-provided notes to improve lecture understanding. Students reported that provision of notes by the instructors prior to the class helped to reorganize their note-taking process.²⁸

Limitations

The present study encountered some limitations. The first limitation was concerning the research methodology, which was under the control of school environmental factors such as availability of instructional materials and class size which may affect the teaching-learning process. Some participants showed previous experience in school class which in turn could have an impact on the note-taking activity. Also, the note-taking process requires practice, and the content of the lecture may influence the encoding effect. The preparation of guided notes for the first time is time consuming for instructors. Another limitation of the research methodology was that it included non-blind assessment.

Conclusion

Findings of the present study indicated that, when students are provided with guided notes, the note-taking process of students develop with higher outline, example, verbatim and word that improve students' learning and exam performance. Further research to examine the influence of different course contents on the value of instructor-provided notes is recommended.

Disclosure

The author reports no conflicts of interest in this work.

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