Using paper presentation breaks during didactic lectures improves learning of physiology in undergraduate students

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Ghorbani A, Ghazvini K. Using paper presentation breaks during didactic lectures improves learning of physiology in undergraduate students. Adv Physiol Educ 40: 93–97, 2016; doi:10.1152/advan.00137.2015.—Many studies have emphasized the incorporation of active learning into classrooms to reinforce didactic lectures for physiology courses. This work aimed to determine if presenting classic papers during didactic lectures improves the learning of physiology among undergraduate students. Twenty-two students of health information technology were randomly divided into the following two groups: 1) didactic lecture only (control group) and 2) didactic lecture plus paper presentation breaks (DLPP group). In the control group, main topics of gastrointestinal and endocrine physiology were taught using only the didactic lecture technique. In the DLPP group, some topics were presented by the didactic lecture method (similar to the control group) and some topics were taught by the DLPP technique (first, concepts were covered briefly in a didactic format and then reinforced with presentation of a related classic paper). The combination of didactic lecture and paper breaks significantly improved learning so that students in the DLPP group showed higher scores on related topics compared with those in the control group (P < 0.001). Comparison of the scores of topics taught by the didactic lecture and those using both the didactic lecture and paper breaks showed significant improvement only in the DLPP group (P < 0.001). Data obtained from the final exam showed that in the DLPP group, the mean score of the topics taught by the combination of didactic lecture and paper breaks was significantly higher than those taught by only didactic lecture (P < 0.05). In conclusion, the combination of paper presentation breaks and didactic lectures improves the learning of physiology.

didactic lecture; learning; paper; physiology

TRADITIONAL DIDACTIC LECTURE is the technique that is often used to teach impractical lessons at undergraduate medical schools. Several factors, such as the high volume of course material, time pressures, and crowded classrooms, make teachers inclined to use the didactic lecture technique. However, in this technique, students are passive listeners and the teacher may fail to deliver deep learning. In recent years, efforts have been made to improve the quality of teaching by incorporating active learning exercises into traditional lectures (13, 23). Active learning is a student-centered education method that enhances student engagement, motivates students to learn, enhances higher-level thinking skills, and increases classroom satisfaction (1, 19, 21).

Physiology is a difficult course for most medical and paramedical students because a large number of terms and facts have to be memorized. In addition, it needs problem-solving ability and knowledge integration for learning complex concepts. Therefore, teachers often use the didactic lecture technique to present complex concepts and to integrate information from multiple sources. Many studies have emphasized the incorporation of active learning into classrooms to reinforce the didactic lecture technique for physiology courses (6, 17, 23). For example, case-based learning, problem-based learning, cooperative learning, and conceptual change strategies have been suggested as active learning approaches (18, 23).

Health information technology (HIT) is one of the fields where students need to learn medical physiology. However, students of HIT have a strong focus on electronic medical record systems and their importance in patient safety (28). Therefore, they may find it difficult to ascertain the relevance of basic physiological concepts into their professions. Thus, the traditional didactic lecture method may not be sufficient to maintain student motivation and engagement throughout the class period. On the other hand, topics such as research methods and applications of research and clinical data are parts of the curriculum for HIT students, and a combination of research paper presentation breaks and didactic lecture may increase their learning motivation. In addition, original research papers have demonstrated how a basic physiological concept is discovered, and this can help to deepen the learning of physiology. Therefore, the aim of the present study was to determine if presenting classic research papers during didactic lectures improves learning physiology among undergraduate HIT students.

MATERIALS AND METHODS

Participants and course plan. The present study was conducted with 22 undergraduate Bachelor of Science students of HIT enrolled in the physiology course at the Paramedical School of Mashhad University of Medical Sciences (Mashhad, Iran). Before the study began, it was approved by the university’s Human Ethics Committee. The physiology course is a general education course that is required for all first-year students of HIT and is delivered through traditional classroom instruction. This course is divided into 17 sessions (2 h for 1 time/wk) and covers the following general topics: membrane physiology and muscle (2 sessions), the nervous system (3 sessions), gastrointestinal physiology (2 sessions), endocrinology (2 sessions), the kidneys (2 sessions), the heart and circulation (4 sessions), and respiration (2 sessions).

Research design. The study was done in weeks 6–9 of the semester. In session 6, all 22 students (all women) were randomly divided into the following two groups: 1) students who were taught by the didactic lecture technique only (control group) and 2) students who received didactic lectures plus paper presentation breaks (DLPP). In the control

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group, all topics of gastrointestinal and endocrine systems were taught in the form of didactic lecture using PowerPoint presentation. In the DLPP group, some topics were presented entirely by the didactic lecture method (similar to the control group) and some topics were taught by the DLPP technique (first, concepts were covered briefly in a didactic format and then reinforced with the presentation of a related classic paper). In each session, three breaks consisting of 10-min presentations of an original research paper were included (3 breaks took 30 min total). While the DLPP group spent 10 min to teach the METHODS/RESULTS sections of the papers, the control group used this time for additional didactic teaching (e.g., explanations, examples, presenting figures, etc.).

Table 1 shows the topics and lecture techniques used for teaching the physiology of gastrointestinal and endocrine systems. For example, the factors affecting gastric motor activity were described in detail by didactic lectures for control students. In the DLPP group, the same factors were taught briefly by didactic lectures and then the details of the effects of secretin and intestinal osmolality on gastric motor activity were discussed in the paper presentation breaks (using Refs. 6 and 12). For each paper, only the METHODS and RESULTS sections were presented in summary form. Students did not read the papers before the class. Both didactic lecture and DLPP techniques were delivered by the same teacher. The paper presentation break was an interactive discussion with the students that involved examples, questions, and student feedback. Examples of the questions that were discussed about the effect of secretin on gastric motor activity at the beginning of the paper presentation break included the following: Why should gastric emptying be regulated by intestinal factors? Can you suggest a method for determining gastric motor activity? What is the possible mechanism by which secretin induces gastric relaxation?

Assessments. To ensure the homogeneity of the two groups, a pretest was conducted for both groups in session 6 (about gastrointestinal physiology) and session 8 (about endocrine physiology). Pretest questionnaires included multiple-choice questions to test overall knowledge regarding gastrointestinal (6 questions) and endocrine (6 questions) physiology. At the end of session 7 (for gastrointestinal physiology) and session 9 (for endocrine physiology), a posttest consisting of questions about both the topics taught by only the didactic lecture (6 questions) and those taught by the DLPP method (6 questions) was given to assess the learning effectiveness of the two teaching methods. In addition, at the end of the semester (9 wk after session 9), the common final exam was given, and the score was considered for the assessment of 2-mo retention of knowledge. The questions of the pretest, posttest, and final exam were not identical and were not very similar to those asked during the paper presentation breaks. Examples of questions asked on the posttest about topics taught by only didactic lecture (example 1) and those taught by the DLPP method (example 2) are shown below:

Example 1: Which of the following is a product of parietal cells?
A. Intrinsic factor
B. Gastrin
C. Pepsinogen
D. Mucus

Example 2: Which action, for gastric acid suppression, is more effective?
A. Stimulation of the release of gastrin
B. Inhibition of the action of histamine
C. Stimulation of the release of acetylcholine
D. Inhibition of the action of somatostatin

Statistical analysis. The scores obtained for the questions were compared by a paired t-test for the differences between the pre- and posttests. Intergroup comparison was done by an unpaired t-test. Results are presented as means (SD), and P values of <0.05 were considered statistically significant.

RESULTS

All students were women with an age range of 18–22 yr old. There was no significant difference in terms of age between the control and DLPP groups [19.7 (SD 1.2) and 19.6 (SD 1.2),

Table 1. Topics and lecture techniques used for teaching physiology of gastrointestinal and endocrine systems

<table>
<thead>
<tr>
<th>Topics</th>
<th>Lecture technique</th>
<th>Reference(s) of Paper(s) Used</th>
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<tbody>
<tr>
<td>Gastrointestinal physiology</td>
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<tr>
<td>Motor functions of the stomach</td>
<td>Only didactic lecture</td>
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<tr>
<td>Regulation of gastric motor activity</td>
<td>Only didactic lecture</td>
<td></td>
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<tr>
<td>Movements and secretions of bowels</td>
<td>Only didactic lecture</td>
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<tr>
<td>Emptying of the gallbladder</td>
<td>Only didactic lecture</td>
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<tr>
<td>Oxyntic and pyloric glands</td>
<td>Only didactic lecture</td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal physiology</td>
<td></td>
<td></td>
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<tr>
<td>Regulation of gastric acid secretion</td>
<td>Only didactic lecture</td>
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<tr>
<td>Pancreatic digestive enzymes</td>
<td>Only didactic lecture</td>
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<tr>
<td>Composition and functions of bile</td>
<td>Only didactic lecture</td>
<td></td>
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<tr>
<td>Endocrine physiology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metabolic effects of GH</td>
<td>Only didactic lecture</td>
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<tr>
<td>Effects of GH on cartilage and bone</td>
<td>Only didactic lecture</td>
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<tr>
<td>Endocrine physiology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulation of GH secretion</td>
<td>Only didactic lecture</td>
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<tr>
<td>Functions of aldosterone</td>
<td>Only didactic lecture</td>
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<td>Regulation of aldosterone secretion</td>
<td>Only didactic lecture</td>
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<tr>
<td>Metabolic effects of cortisol</td>
<td>Only didactic lecture</td>
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<tr>
<td>Anti-inflammatory effects of cortisol</td>
<td>Only didactic lecture</td>
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<tr>
<td>Endocrine physiology</td>
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<tr>
<td>Regulation of cortisol secretion</td>
<td>Only didactic lecture</td>
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<tr>
<td>Insulin and its metabolic effects</td>
<td>Only didactic lecture</td>
<td></td>
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<tr>
<td>Control of insulin release</td>
<td>Only didactic lecture</td>
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</tbody>
</table>

DLPP, didactic lectures plus paper presentation breaks; GH, growth hormone.
respectively]. All students in the DLPP group completed the pretest, posttest, and final exam. One participant from the control group was excluded from the study because of not having completed the posttest and final exam.

As shown in Table 2, the total scores on the pretest in control and DLPP groups were not significantly different, indicating that students were relatively homogenous regarding their overall knowledge on gastrointestinal and endocrine physiology. In addition, in the pretest, the scores of topics taught by the didactic lecture and those by combined didactic lecture and paper breaks were not significantly different between control and DLPP groups (Fig. 1).

The scores of the posttest and final exam were higher than that of the pretest in both the control ($P < 0.05$) and DLPP groups ($P < 0.01$; Table 2). Although the percent increase in the score of the posttest was greater in the DLPP group (120% vs. 79%), the difference in absolute score [7.0 (SD 1.3) vs. 7.7 (SD 1.0)] did not reach statistical significance. Similarly, data obtained from the final exam showed a higher score for the DLPP group [6.2 (SD 2.1)] than the control group [5.4 (SD 1.3)] in terms of total score related to the gastrointestinal and endocrine topics. However, the difference between the two groups was not statistically significant.

Figure 2 shows that combination of didactic lecture and paper breaks significantly improved learning, in that students in the DLPP group compared with the control group showed a higher score on the paper topics [4.7 (SD 0.6) vs. 3.2 (SD 0.6), $P < 0.001$ vs. the score of DLPP topics in the control group; $P < 0.001$ vs. the score of DL topics in the DLPP group.]

![Fig. 1. Scores on the pretest from students in the didactic lecture (DL) only (control) group and those in the DL plus paper presentation breaks (DLPP) group. The pretest included 12 multiple-choice questions to test overall knowledge regarding gastrointestinal and endocrine physiology. In the control group, after the pretest, all topics were taught in the form of DLs. In the study group, after the pretest, the same topics were taught by DLPP. Data are presented as means (SD) from 10 (control) and 11 (DLPP) samples/group.](advanc.fig1.jpg)

![Fig. 2. Effect of paper presentation breaks during DLs on the learning of physiology as assessed by posttest questions. In the control group, all topics were taught in the form of DLs. In the study group, the same topics were taught by DLPP. Data are presented as means (SD) from 10 (control) and 11 (DLPP) samples/group. $***P < 0.001$ vs. the score of DLPP topics in the control group; $**P < 0.001$ vs. the score of DL topics in the DLPP group.](advanc.fig2.jpg)

![Fig. 3. Effect of paper presentation breaks during DLs on the retention of knowledge as assessed by final exam questions. In the control group, all topics were taught in the form of DLs. In the study group, the same topics were taught by DLPP. Data are presented as means (SD) from 10 (control) and 11 (DLPP) samples/group. $*P < 0.05$ vs. the score of DLPP topics in the control group; $#P < 0.05$ vs. the score of DL topics in the DLPP group.](advanc.fig3.jpg)
The DLPP group (and paper breaks showed a significant improvement only for the DLPP group ($P < 0.001$). Data obtained from the final exam are shown in Fig. 3. In the DLPP group, the mean score of the topics taught by both didactic lecture and paper breaks was significantly higher than those by only didactic lecture [4.1 (SD 1.4) vs. 3.2 (SD 1.4), $P < 0.05$].

DISCUSSION

Traditional didactic lecture in and of itself is a passive technique for education, and, in recent years, efforts have been made to improve its quality by incorporating active learning activities into the technique (13, 23). With this thought in mind, we hypothesized that the presentation of classic research papers during didactic lectures improves learning of physiology. The results obtained showed that, although the total scores of the posttest and final exam were not statistically different between the DLPP and control groups, students in the DLPP group had a higher score for the topics taught by paper presentation compared with those by only didactic lectures. The higher score was observed in both the posttest and final exam, indicating that paper presentation breaks improved both learning and retention of information.

Learning of physiology needs problem-solving ability, the memorization of many facts, and the integration of knowledge to learn complex concepts. Some previous studies have attempted to replace didactic lectures with different methods, including case-based, problem-based, and team-based learning for teaching physiology (16, 6, 10, 22). These methods have their own benefits and disadvantages. It should be taken into consideration that complete replacement of didactic lectures with these active learning methods may be difficult, particularly when the class is crowded and if the education needs the integration of information from multiple sources to describe complex concepts. Instead, the incorporation of some brief active learning activities within didactic lectures can improve learning efficiency (23). Here, we incorporated a number of paper presentation breaks within didactic lectures to create a stimulating learning environment and to improve students' understanding of the content. This technique can be thought of as an evidence-based learning approach, and we demonstrated that it increases student learning. Although we did not quantitatively evaluate satisfaction levels of students, our technique could hold students’ attention during lectures and participants showed high levels of interest throughout the paper presentation breaks.

The use of primary research papers to teach physiology and pharmacology has been previously suggested by some authors (2, 4, 12, 20, 29). For example, a paper by Johnson and Grossman has been used to teach the role of secretin in the regulation of gastric acid secretion (29). Bauer-Dantoin and Hanke (2) recommended a paper by Lawton and Schwartz to teach factors that control the production of the luteinizing hormone. In addition, Hallday et al. (11) evaluated the use of classic papers for teaching basic neurotransmitter pharmacology and reported that it resulted in learning improvements. Since complete replacement of the didactic lecture with paper presentation is not possible, particularly in large class, we designed a combination of didactic lectures and paper breaks. In each break, a summary of the METHODS and RESULTS sections of the paper was presented. Such a use of paper breaks might be a useful technique for improving learning of difficult topics of physiology and other biomedical sciences. This technique needs no laboratory component, can be adapted to any field of medicine, and is relatively easy to run in class sessions.

The present study has a few limitations. One limitation is that each group is limited to only 11 subjects. In our university, only 20–25 students are accepted for HIT science, and all of them are women. This relatively small number of subjects might limit the statistical power of the study, and it is not possible to have a balanced sample including an equivalent number of women and men. The other limitation of our research was that learning was assessed by only multiple-choice questions. In addition, the number of questions in the pretest, posttest, and final exam was relatively small. Due to the time restriction in sessions and limitation of total number of questions in the final exam, we used only 12 questions about the gastrointestinal and endocrine systems in each exam. Further studies using larger numbers of students, more numbers of questions, and different topics of physiology are warranted to improve the limitations of this study.

Taken together, the results of the present study suggest that the combination of didactic lectures and paper presentation breaks improves the learning of physiology and retention of information among undergraduate HIT students.

GRANTS

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DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author(s).

AUTHOR CONTRIBUTIONS

Author contributions: A.G. conception and design of research; A.G. performed experiments; A.G. and K.G. analyzed data; A.G. and K.G. interpreted results of experiments; A.G. prepared figures; A.G. and K.G. drafted manuscript; A.G. and K.G. edited and revised manuscript; A.G. and K.G. approved final version of manuscript.

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