

A guided note taking strategy supports student learning in the large lecture classes

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Abstract. In higher education, lecturing has been found to be the most prevalent teaching format for large classes. Generally, this format tends not to result in effective learning outcomes. Therefore, to support student learning in these large lecture classes, we developed guided notes containing quotations, blank spaces, pictures, and problems. A guided note taking strategy was selected and has been used in our introductory physics course for many years. In this study, we investigated the results of implementing the guided note taking strategy to promote student learning on electrostatics. The samples were three groups of first-year students from two universities: 163 and 224 science students and 147 engineering students. All of the students were enrolled in the introductory physics course in the second semester. To assess the students' understanding, we administered pre- and post-tests to the students by using the electrostatics test. The questions were selected from the conceptual survey of electricity and magnetism (CSEM) and some leading physics textbooks. The results of the students' understanding were analyzed by the average normalized gains ($\langle g \rangle$). The $\langle g \rangle$ value of each group was 0.61, 0.55, and 0.54, respectively. Furthermore, the students' views on learning with the guided note taking strategy were explored by using the five-point rating scale survey. Most students perceived that the strategy helped support their active learning and engagement in the lectures.

1. Introduction

In physics education research (PER), many reports have demonstrated that while students who participate in traditional lectures are able to solve physics problems, they often do not understand the concepts behind these very same problems [1-5]. This provokes physics education researchers to invent novel instructional interventions—especially alternative teaching methods involving active learning; such as Interactive lecture demonstrations (ILDS) [6-7], Peer Instruction (PI) [8], and Interactive Engagement (IE) [9]. These interventions allow teachers to understand and support novice students' perspectives better than the traditional lecture format.

In Thailand, there has been a recent promotion of active learning strategies in classrooms and lecture theatres. Despite this, the number of lecturers who have adopted these ideas remains quite low. Particularly in higher education, teachers still mostly favor delivering lectures on a topic where students were considered to be passive listeners [10]. Even though we are well into the 21st century, lecture notes and worksheets are still widely-used as a teaching tool in lecture classes, mainly due to the constraints of time and budgets. Narjaikeaw *et al* (2009) initially carried out research on lecture classes by studying the effect of guided note taking on students' understanding of electromagnetism.

They found that learning with this strategy helped students achieve a better understanding of electromagnetism than without using the guided notes. This was apparent because the process of guided note taking allowed more interactions between the lecturers and the students during lectures [11].

Almost 10 years on, apart from the Narjaikeaw *et al* (2009)'s study, we have never substantially tracked or reported the effectiveness of the guided note taking strategy that has been used in these lecture classes. Therefore, the aim of this study was to conduct a case study and investigate the effectiveness of the guided note taking strategy used in introductory physics classes while the students were learning electrostatics. The purpose of this study is to investigate the following questions:

- (1) Does the guided note taking strategy help improve students' understanding of electrostatics?
- (2) Do students have good experiences when learning with the guided notes?

2. Research Methodology

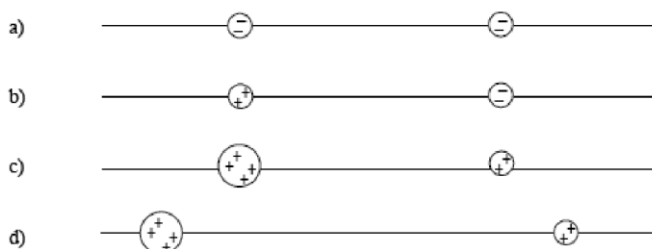
2.1 Participants

The participants were 3 groups of first-year students from two universities. Two groups, 163 and 224 respectively, were science students from a leading university in Bangkok, Thailand and while the third group consisted of 147 engineering students from a university in Northeast Thailand. The background of the students was such that they all had similar prior-knowledge. This was due to the fact that Thai high schools arrange their science-teaching programs under the national science curriculum, developed by the Institute for the Promotion of Teaching Science and Technology (IPST). The introductory physics course of both universities contained electrostatics covering electric force between point charges, electric field due to a point charge, multiple-point charges and continuous charge distributions, as well as electric flux and Gauss's law. It should also be noted that the courses around which the study was developed were the same courses which were used in Narjaikeaw *et al* (2009)'s study.

2.2 Research design

To assist student learning, the guided notes were developed and used in the three classes during the electrostatics lectures. The most important feature of the guided notes was the provision of key information: definitions, concepts, and principles. The guided notes also included pictures or diagrams with blank spaces to improve comprehension, interactive engagement of learning, and retention of the content [11-12]. The notes needed to be well-designed to support lectures. They consisted of a relatively few number of pages (approximately 5 pages each lecture) and were not too detailed so as to avoid detracting from the lectures [11].

Example 1-1: Sketch the electric force vectors on given pairs of charged particles. Signs + and – refer to types of electric charge. Numbers of apparent signs refer to the magnitude of charge.



Notice:

- The magnitude of electric force between a pair of charged particles is directly proportional to.....and inversely proportional to.....
- The directions of electric forces depend on
- The magnitude of electric force on both charged particles is..... according to.....

Figure 1. An example of the guided note used for teaching electric force.

In a practical use of the guided notes, a lecturer would lead students to look at an incomplete idea and challenged them, through interactions, to complete the guided note activity. For example, “the directions of electric forces depend on.....” was one sentence where a blank space was provided in the notes that were distributed to the students. The lecturer may have given a brief talk about the relevant content and then asked the students to write a word or phrase in the blank space. After that, the lecturer would give feedback to the class which allowed the students to check their answer (See an example of the guided note in Figure 1).

The general format of the lectures was as follows: (1) Lecturer introduced and explained a principle, a theory, or a law and then formulated its equation; (2) Lecturer presented qualitative problems; (3) Students solved qualitative problems; (4) Lecture presented calculation problems; (5) Students solved calculation problems; (6) Students were requested to link the knowledge to real-world applications or to other relevant areas of physics content.

2.3 Data collection

To assess whether the guided note taking was effective in aiding student learning, we surveyed students’ cognitive achievement and students’ perceptions by using the electrostatics tests and the survey of student perceptions.

2.3.1. *Surveys of Electrostatics.* The test consisted of 15 questions: half were multiple-choice questions and half were open-ended questions, with 25 marks in total. It took 35 minutes to complete the test. Five questions were on electric force, seven questions on electric field, and three questions on electric flux and gauss's law. The questions were adapted from standard textbooks and standard tests [4, 13-15]. These tests were administered to assess students’ understanding of electrostatics before and after learning.

2.3.2. *Surveys of student perceptions.* The survey of student perceptions on learning with the guided notes had 9 statements designed in line with Narjaikaew *et al.* (2009) [11]. These were: Item 1- Definition, Item 2- Graphic, Item 3- Blank space, Item 4- Number of questions, Item 5- Quality of contents, Item 6- Linking of contents, Item 7- Hierarchy of contents, Item 8- Tracking lectures, and Item 9- Recalling ideas. Each statement had a 5 point rating scale from ‘strongly agree’, ‘agree’, ‘neutral’, ‘disagree’, to ‘strongly disagree’. Examples of the statements are: “The definition/ principle/ law given on the notes supported my learning.” and “The graphics on the notes provided help in learning content.” The survey was distributed to the students after completing the lessons on electrostatics.

3. Results and Discussion

To answer the first research question: *Does the guided note taking strategy help improve students’ understanding of electrostatics?* The results of the electrostatics tests from the three groups of students (worth 25 marks) are shown in Table 1. In the statistics test, the distributions of scores were not Gaussian. Thus, in a comparison of the mean scores, the non-parametric test—Wilcoxon Signed Ranks test would be used. It performed that there was a statically significant difference in the distribution of pre- and post-test scores for each group. In order to get further insight, we considered normalized gains [9] to convey the improvement in the students’ learning. There were average normalized gains of 0.54, 0.55, and 0.54 respectively, which were in the medium-gain regime (See Table 1).

Table 1. Students' mean scores with Wilcoxon Signed Ranks test and the average normalized gain.

Statistics	Group 1 (<i>n</i> = 163)	Group 2 (<i>n</i> = 224)	Group 3 (<i>n</i> = 147)
<i>MPre</i>	5.22	5.07	5.12
<i>SD Pre</i>	3.19	3.35	3.19
<i>M Post</i>	17.07	15.95	15.79
<i>SD Post</i>	4.43	4.48	4.04
<i>z</i>	-11.04	-12.95	-10.45
<i>p</i>	< 0.01	< 0.01	< 0.01
< <i>g</i> >	0.61	0.55	0.54

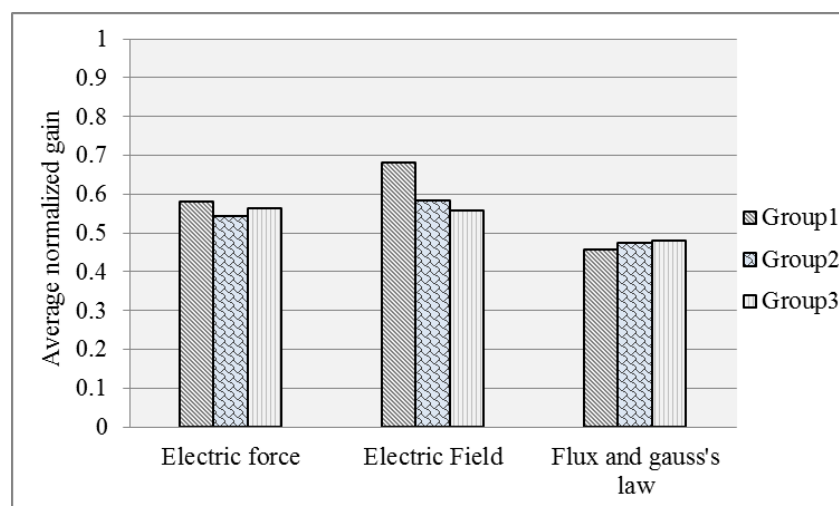


Figure 2. The average normalized gains of each topic among the three groups.

To look deeper into student learning outcomes, figure 2 shows the average normalized gains of the three sub-topics of the three groups. All bar graphs within each sub-topic were consistent with the average normalized gains of greater than 0.4, which fell in the medium regime [9]. However, the topics of electric force and electric field, whose gains were 0.5- 0.6, were better than flux and Gauss's law.

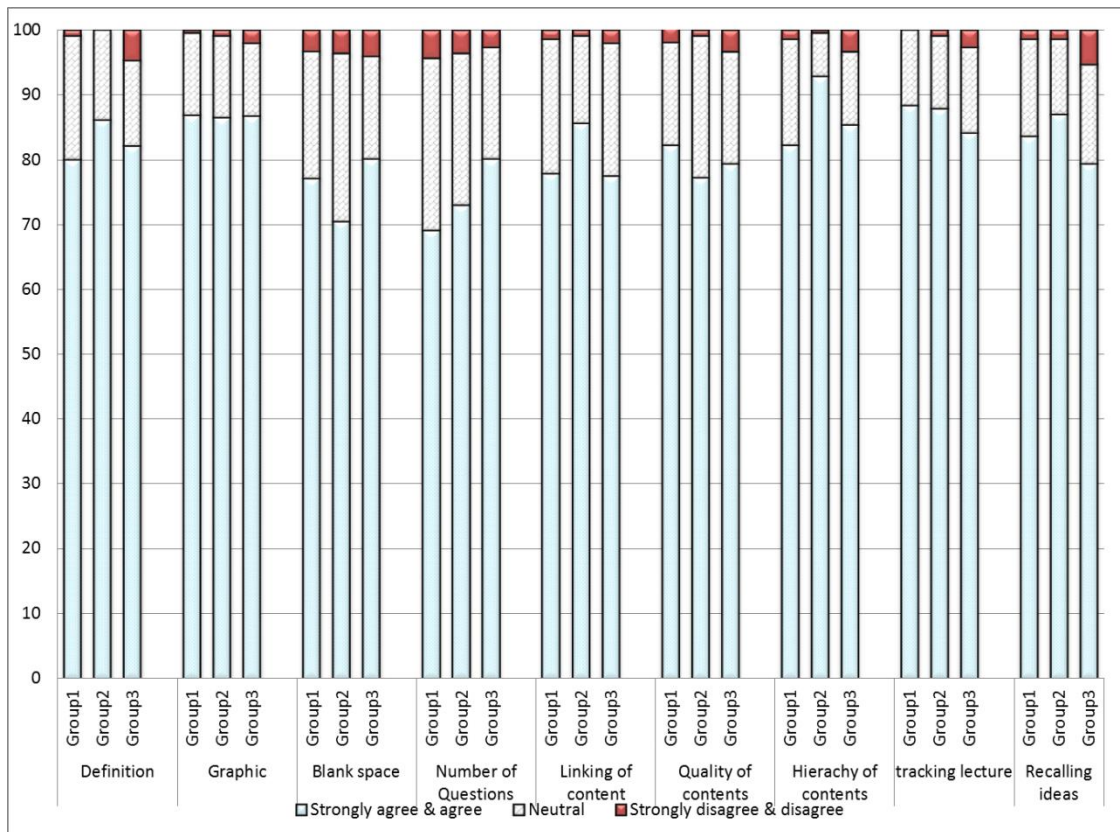


Figure 3. The students' perceptions on learning with the guided notes among the three groups.

To answer the second research question: *Do students have good experiences when learning with the guided notes?* The results from the surveys found that the students had positive perceptions of learning with the guided notes in all groups. Approximately 70% of students were in agreement with the statements. Some were neutral and less than 5% had a negative experience with the guided notes. Over 80% of the students agreed with the items about graphics, hierarchy of content, tracking lectures, and recalling ideas as they perceived that the guided notes aided them in understanding the lectures enabled them to actively participate in the lectures, and helped them recall the main ideas that had been taught (See Figure 3).

4. Conclusions and implication

The set goal of this study was to investigate whether implementing the guided note taking strategy could support student learning in large classes of the introductory physics course, particularly as the chosen course for this study had been used in the study by Narjaikeaw *et al* (2009) [11] approximately 10 years earlier.. Throughout the study of the three groups, the guided note taking strategy was shown to improve the students' understanding of electrostatics, with the average normalized gains of classes falling in the medium regime. In addition, a majority of the students provided positive agreements when responding to the surveys of their perceptions after learning with the guided notes.

As we found that the guided note strategy yielded positive results in both cognitive and affective facets, this could be a useful instructional approach for lecturers who are facing problems in managing large lecture classes and, in particular, for those who wish to engage their classes with an active learning strategy.

5. Acknowledgements

We would like to thank Thailand Center of Excellence in Physics for funding this research project. Additionally, we would also like to extend our sincere thanks to Narumon Emarat and Kwan Arayathanitkul for their advice and very kind support.

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