International Society of the Learning Sciences

The Way to Better Learning Online: Using Online Discussions in College Classes During COVID-19

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Abstract: In recent years, a large body of evidence demonstrates that active learning through engaging college students in a discussion leads to increased learning outcomes. However, more empirical studies are needed to understand its effectiveness in online classes. In Experiment 1, students majoring in veterinary medicine were randomly assigned to three conditions: Lecture and Review, Lecture and Discussion, and Self-study and Discussion. Post-test results showed that the two discussion groups achieved significantly higher scores than the review group. Moreover, among the two discussion groups, the self-study group performed better than the lecture group. To reconsider the reliability and generalizability of our study we conducted Experiment 2 in which, we compared the performance of the two discussion conditions again for students majoring in social science. Our findings indicate that not only online discussions but active learning activities such as self-studying before the discussion is also crucial for students' learning.

Introduction

COVID-19 caused substantial confusion around the world, and education was no exception. As a result, educational institutions and schools in many countries have opted for online education (Rose, 2020; Kogan et al., 2020; Daniel, 2020). While the concept of online learning differs within researchers, it exists in various formats, such as, e-learning, web-based learning, cyber learning, distance learning, or mobile learning (Jacobson, 2004; Khan, 2005). Nevertheless, most online education consists of pre-recorded one-way style lectures shared by the instructors.

Growing bodies of studies show that the benefits of active learning move beyond those of one-way traditional lectures (Yannier et al., 2021). In particular, interacting with peers through discussions facilitates students' learning. According to the ICAP theory of cognitive engagement, collaborative dialogue through discussions often promotes greater learning than studying alone (Chi, 2009, 2021). However, although there is ample evidence that discussion facilitates students' learning, giving a lecture is a commonly used instructional method throughout the undergraduate curriculum (Lim et al., 2018; Stains et al., 2018). It is also difficult to find research comparing activities that come before and after the discussion, and even, the effect of active online learning activities has not been examined enough.

The present study compared the learning effects of reviewing study materials with those of discussions. We also compared two different pre-discussion activities, watching a lecture and self-studying. Additionally, through two experiments from two different majors, we can also pave the way for instructors who practice online discussions to promote better active learning online during and after COVID-19.

Literature Review

Pedagogical framework

Passive learning often refers to a teacher-centered instructional method. An example of passive learning is where students listen and watch teachers' didactic lectures. Chi (2009) posits that when students watch a lecture without any manipulation of the learning material, this is regarded passive (learning). Traditional lectures are lectures that are not effective in encouraging learners' discussions and acquiring deeper comprehension (Bligh, 1998). Therefore, it is possible that teachers wrongly believe that their lectures can draw students' attention, promote their motivation, and increase learning outcomes.

Although there is ample research on the limitation of passive learning, most classes are still composed of didactic lecturing (Stains et al., 2018). Wieman and Perkins (2005) emphasize that lectures deliver too much information and knowledge to students, while they do not understand much of it. In particular, STEM subjects still seem to be predominated by lectures (Stains et al., 2018). Stains and colleagues analyzed observation data

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from about 2,000 classes taught by more than 500 STEM faculty members. Their findings indicate that lecturing (i.e., teacher-centered learning) is pervasive in STEM courses. Likewise, Freeman et al. (2014) conducted a meta-analysis comparing students' academic performances in traditional lecture-centered classes to those who took active learning classes in the field of STEM. The results showed that active classes bring about higher scores and lower drop and failure rates compared to traditional lectures.

In accordance with previous studies indicating the limitations of lectures and passive learning, various alternative instructional methods have been explored (Mayer & Alexander, 2017; Chi & Wyle, 2014). Among the various definitions of active learning, Chi and Wyle (2014) classified active learning using Interactive-Constructive-Active-Passive (ICAP) modes. The ICAP framework is based on students' behaviors of engagement. Not surprisingly, the order of the modes (I > C > A > P) matches the order of students' learning outcomes. In detail, the *P mode* includes learning that happens when students sit in traditional lectures. The *A mode* involve activities in which students physically manipulate learning materials such as highlighting. The *C mode* refers to situations where students add new information to the given learning materials on their own, such as drawing a concept-map, or asking a question. Lastly, the *I mode* occurs when two or more students in *C mode* collaborate with each other. A representative example would be discussions that occur among students in class.

Schwartz and Bransford (1998) focused on preliminary activities that comes before lectures. Schwartz and Bransford showed that the learning effect of lectures differs depending on what learning activities were conducted in advance. They experimented three groups to prove their point. Group 1 simply summarized the learning materials and then listened to the lectures; group 2 analyzed the learning materials twice; finally, group 3 analyzed the learning materials and listened to the lectures. As a result, there were no significant differences in the recognition test, but group 3 had the highest score on the transfer test. Thus, even if instructors give a lecture, the learning effect varies depending on what and how students do before and after learning.

Therefore, we adopted the framework of Schwartz and Bransford (1999) and Chi and Wyle (2014). We conducted an experiment to compare the learning outcomes between a group that simply reviews the material after a lecture, a group that discusses the material with each other after the lecture, and a group that discusses after self-studying.

Peer discussions in classes

As an alternative to traditional lectures, researchers have claimed discussion as a promising instructional method (Almasi & Garas-York, 2014). Although students learn better or best when they are active, and engaged (Yannier et al., 2021), discussions are still rarely used in most classes (Walsh & Sattes, 2015). Specifically, even though students who participated in the discussion recognize that it helps themlearn and understand, discussions are rarely used in educational settings (Alvermann et al., 1996; Almasi et al., 2001). What is worse, discussion occurs as merely a post-reading event in which the teacher assists and intervenes students' interactions. This type of discussion is referred to as a teacher-led discussion or structured discussion. In a teacher-led discussion, teachers play a central role by starting the discussion, by asking a question and putting their opinions forward. In other words, the Initiate-Response-Evaluate (IRE) structure of discourse is dominantly used by the teacher in a teacher-led classroom (Cazden, 1986; Mehan 1979). Many teachers in teacher-led discussions wait less for students to respond and provide feedback authoritatively. Thus, students in teacher-led discussions often choose to remain passive (Good et al., 1987).

However, not all teacher-led discussions have only negative effects. Wolf et al. (2005) investigated the relationship between the quality of talk and reading comprehension. Twenty-one reading comprehension lessons in ten schools were examined. Results showed that student talk was predictors of knowledge sharing during the lessons. Also, the type of teacher's question was important for students' learning, where open-ended questions and follow-up probes were most effective.

McIntyre et al. (2006) also investigated the effect of teacher's scaffolding during students' discussions. They analyzed data from classroom observations, videos, and interviews. Their results indicated that teacher discourse can lead to students' engagement in interaction, facilitate students' participation and help bring them into the discussions.

Even still many researchers posit that student-centered discussion (i.e., peer discussion or unstructured discussion) are more effective than teacher-led discussion (Almasi, 1995; Hogan et al. 1999; Many & Wisman, 1992). Wilson et al. (1984) contended that discussions occur when a student deliberately initiate a talk with peers with a definite topic or goal in mind. For example, Almasi (1995) compared the effects of teacher-led discussions and those of student-led discussions. As a result, students in peer discussion were able to internalize their ability to recognize and resolve conflicts better than students in teacher-led discussions. Students in students-led discussion were also able to learn to think critically and retrieve argument-relevant information as they learn the principles of argumentative reasoning during peer discussions.

However, related research above has mainly focused on young children's literacy skills generalized in expository text. In the present study, we expanded on previous works and observed various aspects of unstructured discussions in college students. In particular, we investigated college students' academic achievements when they learned the contents of the textbook through discussions in actual classroom settings.

We conducted our research in online classes. With the demands of the times due to COVID-19 and the advent of online learning methodologies and technologies, educational stakeholders are actively utilizing effective e-learning methods. In this study, we investigated whether online discussion has a greater learning effect than other traditional instructions, and what pre-discussion activities maximize the effect of peer discussions. All in all, we compared the learning effects of three learning (experimental) conditions: Lecture Review (LR); Lecture Discussion (LD); and Self-study Discussion (SD), representing the combination of learning activities conducted by students, respectively. Based on the ICAP framework, we predicted that students in the two discussion groups would show greater learning achievement than those in the review group (LD, and SD > LR). In addition, compared to those who listened to a lecture, which is a relatively passive learning activity, we expected that the students who self-studied prior to the discussion would also show higher learning gains (SD > LD).

Experiment 1

Experiment 1 investigated the learning effect of the peer discussion activity itself, and the effect of different prior learning activities before the discussion. In this experiment, veterinary medical students were randomly assigned to three groups: LR, LD, and SD conditions.

Participants

All experiments were reviewed and approved by the university Institutional Review Board. Eighty-five undergraduate students majoring in veterinary medicine participated in this experiment (N = 85, female = 39). Students were randomly assigned to three groups: LR (n = 7), LD (n = 20), and SD (n = 18) conditions. There were no significant differences in age and gender between groups.

Materials

A monologue-style video clip was used as the lecture video in this experiment. The lecture video was from an actual lecture clip uploaded on the Internet for open use. The learning topic covered in this experiment was chemistry, specifically sections concerning covalent bonds. The topic was basic knowledge for veterinary medical students. We tried to secure the ecological validity of the learning material and made sure all veterinary students learned chemistry in their undergraduate curricula. A six-page lecture note was written based on the video clip which was used for self-study during the experiment.

The final test was comprised of transfer type items. Transfer type items were designed to test participants' improvement in transfer of learning which refers to applying learned knowledge from the materials (i.e., lectures and textbooks) to new situations. A total of 12 transfer type items worth 33 points were used.

Procedure

Students filled out a consent form and were given an explanation regarding the procedures. The LR group watched the lecture video for 20 minutes and then studied the six-paged text for 15 minutes. The text was not provided when watching the lecture. The LD group watched the lecture for 20 minutes, and then discussed about what they learned in groups of three for 15 minutes. The SD group studied the text by themselves for 20 minutes, and then had a group discussion of three for 15 minutes. All three groups had the same total amount of learning time. After completing the entire learning process, a 20-minute test was taken.

Results and discussions

The mean values and standard deviations of test scores for transfer type items (i.e., total score) are presented in **Table 1**. We conducted an analysis of covariates (ANCOVA) to examine the difference among the three groups. Age and gender were controlled as covariates. Significant differences were found between the three groups, $F(2, 40) = 7.72$, $P = .001$, partial eta-squared = .279. There were no significant effects of gender and age.

In detail, the LR group (M = 13.86, SD = 4.22) had the lowest score, Ps <.05, but the LD group (M = 18.90, SD = 4.33) and the SD group (M = 20.83, SD = 3.85) showed no significant difference, P = .317.

Table 1

Descriptive statistics of Experiment 1

	LR group (n = 7)	LD group (n = 20)	SD group (n = 18)
Transfer type items	13.86 (4.22)	18.90 (4.33)	20.83 (3.85)

Note. Data are shown as values of mean (standard deviation). LR refers to lecture and review; LD refers to lecture and discussion; and SD refers to self-study and discussion.

In line with our prediction that discussions would enhance students' learning, the results showed the LD group scored significantly higher than the LR group. Therefore, our findings supported the findings from the ICAP framework by Chi and Wylie (2014).

However, although there was a trend between the scores, there was no significant difference between the two discussion groups as expected. The result may be due to a small number of participants. Moreover, the results may be due to the topic of learning which was too familiar to veterinary medical students. Therefore, in Experiment 2, participants were recruited from the college of social sciences who were not familiar to, and had no prior knowledge on the learning contents. We conducted Experiment 2 with only the LD group and the SD group, which did not show a significant difference in Experiment 1.

Experiment 2

Experiment 2 examined the learning effects of having a discussion after different prior learning activities. In this experiment, students from the college of social sciences were recruited and randomly assigned to different two discussion groups (i.e., LD and SD groups).

Participants, learning materials, and procedure

Undergraduate students from the college of social sciences participated in this experiment for course credits. A total of sixty-two students were randomly assigned to two different groups: LD (n = 30) and SD (n = 32) conditions (N = 62, female = 32). There were no significant differences in age and gender between the groups.

Learning materials and experimental procedures were identical to Experiment 1.

Results and discussions

The mean values and standard deviations of final test scores for transfer type items are presented in **Table 2**. We conducted orthogonal planned comparison to examine the difference between the two discussion groups. The results showed that the SD group (M = 17.03, SD = 3.09) scored significantly higher than the LD group (M = 10.67, SD = 3.40), $t(60) = 7.731$, $P < .001$.

Table 2

Descriptive statistics of Experiment 2

	LD group (n = 30)	SD group (n = 32)
Transfer type items	10.67 (3.40)	17.03 (3.09)
Comparison	*t*	*P*
	7.731	< .001

Note. Data are shown as values of mean (standard deviation). LD refers to lecture and discussion; and SD refers to self-study and discussion.

In line with our prediction, the results showed that the SD group outperformed the LD group. Therefore, students' learning achievements varied depending on the type of learning activities before the discussion. The more active the learning activities before the discussion, the greater the outcome students gain through the discussion.

Comparison of Experiment 1 and Experiment 2

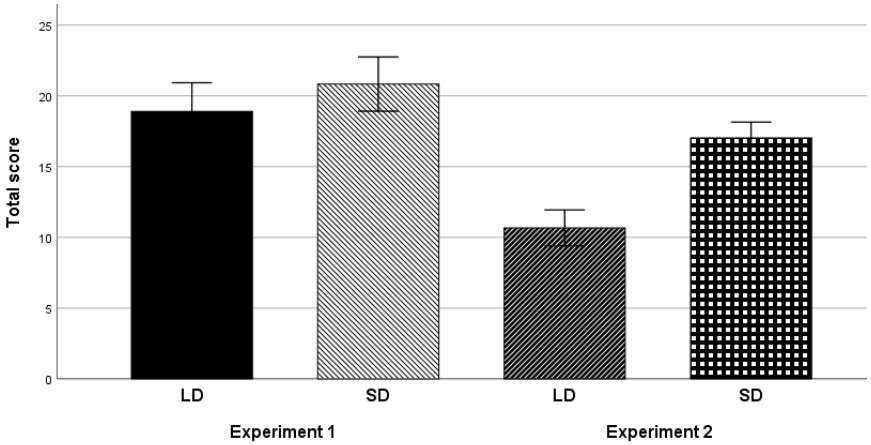
A summary of the results of both experiments is presented in **Figure 1**. In Experiment 1, there was no significant difference between the LD group and the SD group. On the other hand, in Experiment 2, the two discussion groups showed a significant difference.

Specifically, scores of the LD group of Experiment 1 had no significant difference with those of the SD group of Experiment 2, $P = .426$, while the scores were higher than those of the LD group of Experiment 2, $P < .001$. The SD group of Experiment 1 scored significantly higher than the SD group of Experiment 2, $P = .003$. Finally, the LD group of Experiment 2 scored significantly lower than the other three groups, Ps $< .001$.

Therefore, considering that there was no significant difference between the two SD groups across the two experiments, while no significant difference was also observed between the two discussion groups (i.e. LD and SD groups) in Experiment 1, the results may have been affected by the topic of the learning material. Participants in Experiment 1 already had basic understanding in chemistry, a fundamental subject needed to learn veterinary medicine, resulting in no significant difference between the two discussion conditions. However, with participants in Experiment 2 all majoring in social science with no background knowledge on the given topic, experimental results better revealed the effects of different prior activities each conducted by the two discussion groups.

Figure 1

Summary of Experiment 1 and Experiment 2



Note. Data are shown as values of mean (standard deviation). LD refers to lecture and discussion; and SD refers to self-study and discussion. The total score corresponds to scores for transfer type items. Error bars show +/- 2 standard error.

General discussion

The present study investigated whether discussions could be used as an effective instructional method in online learning. Our predictionswere that discussions would promote students' learning than reviewing, which is a more familiar and traditional learning method. Based on Chi and Wyle (2014)'s ICAP framework that showed active learning activities enhanced students' learning outcomes over passive learning, we predicted that self-studying before the discussion would be more effective than listening to a lecture. In other words, we expected that self-study, a relatively more active activity, would increase students' engagement in discussion and its learning effects.

In Experiment 1, we compared students' learning gains between the three learning conditions: Lecture Review (LR), Lecture Discussion (LD), and Self-study Discussion (SD). In line with our prediction based on the proposal by Chi and Wylie and other theoretical frameworks on active learning, discussions increased students' learning gains. The LD group had significantly higher scores than the LR group. However, unlike our initial prediction, there was no significant difference between the two discussion groups, the LD group and the SD group. This result was probably because veterinary medical students had prior knowledge of the contents related to the learning materials. Therefore, in order to increase the reliability and validity of the experiment, we conducted Experiment 2 with students majoring in social science.

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In Experiment 2, the LD group and the SD group were compared with other participants majoring in social science. The learning materials and experimental procedures were the same as Experiment 1. The results showed that the scores of the SD group were significantly higher than those of the LD group. Thus, students' learning gains varied depending on the type of learning activities before the discussion. The SD group who self-studied the material before the discussion were involved in a more active learning activity than listening to a lecture as the LD group did, leading to greater achievements.

Our findings denote that discussions indeed enhance students' learning. In addition, its effect on learning varies depending on the type of activities before the discussion. Therefore, educational stakeholders, including teachers, should actively use discussion as a learning tool and provide opportunities and time for students to fully explore the learning materials before the discussion.

Finally, the result of this study suggests that effective online discussions are also possible. As Daniel (2020) suggested, we need to prepare for the upcoming disaster by applying the existing instrumental method to various types of classes (e.g., from offline discussion to online discussion). Now as we reconsider the effectiveness of online education due to COVID-19, our results show the potential and applicability of online discussions in student learning.

Limitations and suggestions

This study is early research for verifying the effect of online discussions, and more research is required in the future. First, the discussions in this study are unstructured, whereas our experiment can be repeated for structured discussions that involve teachers' interventions or for other semi-structured discussions. For example, Lim et al. (2019) used students' questions and summary notes of learning materials during the discussion that(and) added more structure. Therefore, future research should validate the effect of various forms of discussions used for learning.

Second, it is necessary to analyze the contents of the discussion. Future studies need to check how students changed their discussion patterns and contents according to their pre-discussion learning activities. Through more sophisticated dialogue analysis and topic modeling, researchers should be able to find additional evidence on the effectiveness of discussions that differs by what learning activity comes in advance.

Lastly, the long-term effects of discussions must be investigated. This study was conducted as a one-time study, and ended in an hour, but future studies may consider changes and trajectories of learning during discussions through a longer study up to one week or one semester.

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Acknowledgments

This work was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF-2021R1A6A3A13039453).