

Online collaborative note-taking and discussion forums in flipped learning environments

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As the number of students learning in online and flipped contexts grows, an important question arises: to what extent is it necessary to have places or activities where students interact regarding course content? The present paper looked at three flipped learning environments: one with no online collaboration, one featuring an online discussion forum and one involving online collaborative note-taking. The subjects ($N = 178$) were all graduate students taking a flipped version of an English scientific writing class at a university in South Korea. The results show that students in the experimental conditions with online collaboration (collaborative note-taking and discussion forums) outperformed peers in the control condition (no online collaboration) on individual writing assignments. Furthermore, there was a benefit in the experimental condition with discussion forums regarding students' group writing scores compared to the control group. These results show the value of implementing online student-to-student collaboration in flipped learning contexts and that both modes of collaboration tested herein add value to students' learning.

Implications for practice or policy:

- Incorporating online collaborative learning activities improves performance in flipped courses.
- Using collaborative forums and collaborative note-taking provide similar benefits, and their implementation will improve the online portion of a flipped class.
- Flipped classes generally include an online lecture component but should also feature online collaboration as well.

Keywords: flipped instruction, online discussion forums, collaborative note-taking, collaborative writing, online learning

Introduction

Flipped classrooms typically consist of two components: an online component in which students engage in learning activities that they can complete on their own, such as reading course textbooks and watching online lecture videos, taking quizzes, and completing homework assignments (Bishop & Verleger, 2013), and an offline (face-to-face) component in which students engage in active learning activities with one another in order to practise and reflect on the knowledge they have gained from the online portions of the course (Prince, 2004).

Flipped learning has become increasingly popular and important because it can combine the benefits of online and offline modalities (J. Y. Kim, 2017). Namely, individual instruction proceeds conveniently via materials that can be accessed by each student at their convenience, and the offline meeting provides students with an opportunity to engage in collaborative learning activities. In this context, it is worthwhile to explore how online and offline learning modalities in flipped learning affect each other and how learning can be best utilised to benefit students. More specifically, there is a gap in the research on the interaction between online and offline aspects of flipped learning concerning online collaboration (as opposed to offline collaboration during the face-to-face class meeting). As collaboration is well prescribed in online and offline contexts in higher education, research is needed to understand how collaboration can be applied in flipped learning contexts (Herrmann, 2013). It is reasonable to expect that collaborative work that takes place in an online flipped context would provide similar benefits to those found in fully online contexts (W. Hung, 2013). However, research has not sufficiently addressed whether students' collaboration online in flipped contexts is useful or what type of online collaboration would yield the most significant benefits to students.

It is possible that some of the problems associated with online learning, such as low motivation and challenging content, may be mitigated by online collaboration and effective teamwork (DeChurch & Mesmer-Magnus, 2010). Allowing learners to interact online may reduce some of the negative impacts of strictly online learning in addition to bridging the gap between the offline and online phases of a flipped class (Butson & Thomson, 2014). Implementing online collaboration in flipped learning contexts may increase learning as it may serve to supplement collaboration students are already engaging in offline (Butson & Thomson, 2014). Understanding how students' different ways of working together would impact their individual and group writing quality will help fill a gap in the research regarding the impact of students' collaboration on their performance in a flipped learning context.

According to the literature, two common types of online interactive writing students engage in are posting in an online discussion forum and collaborative note-taking. Online discussion forums have been widely used in various education settings to enable student-to-student collaboration (Bergmann & Sams, 2012) due to their value in generating discussion and interaction among learners (Dubosson & Emad, 2015). These forums have been shown to build trust and a sense of learning community among people who are engaged in them (Ouyang & Scharber, 2017). Moreover, collaborative note-taking may be an effective avenue to promote student collaboration and learning (Bikowski & Vithanage, 2016). In collaborative note-taking, students work together to complete a single text that can induce the sharing of expertise and negotiation (Fung, 2010). These two online modalities have similarities and differences, and understanding their influence on student learning in the flipped learning context is understudied (Fisher et al., 2021).

Literature review

Theoretical framework

New types of technology have been progressively adding to the ability of higher education institutions to generate social interactions among their students with the goal of improving performance (Yadav et al., 2017). The current study is grounded in social constructivist theory, strongly influenced by Vygotsky's (1978) work. Social constructivists stress that learning is an active social process where knowledge is constructed when individuals are engaged in social activities. Social constructivists suggest that collaborative elaboration (Van Meter & Stevens, 2000) will lead to meaningful learning where learners construct understanding together. They assume that this construction of knowledge does not occur in isolation but requires collaboration. Ashcraft et al. (2008) stated that, according to social constructivism, knowledge is assumed to develop through a cognitive activity that takes place when discussing experiences with other individuals or in groups.

Accordingly, Shunk (2000) indicated that social constructivist teaching methods and materials stress reciprocal teaching, peer collaboration, problem-based instruction, web quests and other approaches that involve learning with peers. Within social constructivist theory, instructors are viewed more as facilitators and less as teachers (Fleener et al., 2004; Lambert, 2002), as they are responsible for helping learners to actively create meaning and understand the content rather than to passively receive information. According to Ndon (2011, p. 253), “a teacher as a facilitator, should provide rich environments, experiences, and activities for learning by incorporating opportunities for collaborative work, problem-solving, authentic tasks”.

Social constructivist views on the roles of the instructor and learner, as well as the style of instruction, are compatible with those commonly used during the face-to-face class meetings of flipped courses, where students tend to engage in collaborative learning activities with their peers. However, there has been a lack of research regarding the extent to which such social constructivist teaching approaches should be implemented during the online portions of the course, which tend to be more reliant on individual learning activities, such as viewing course lecture videos or reading course textbooks. Therefore, the present study investigated the effects of participation in collaborative learning activities on learning performance within three flipped learning environments: one that contained no online collaboration, one that included an online discussion forum and one that contained collaborative note-taking.

Flipped learning

Flipped courses are becoming increasingly prevalent, particularly in higher learning institutions, because they provide several advantages over their traditional counterparts, including increased course availability and scheduling flexibility for students (Tang et al., 2020). Many studies discuss the benefits of flipped learning (Davies et al., 2013; Fulton, 2012; J. Y. Kim, 2017) but generally do not define the extent of student-to-student collaboration within the flipped learning environments. Flipped learning is generally associated with an environment where students learn autonomously before class time at their own pace and where learners attend a scheduled class meeting in which they receive the guidance and assistance of an instructor (J. Y. Kim, 2017; Lavelle et al., 2013). This indicates that flipped instruction may present a portion of the instructional content asynchronously online in the form of online lecture videos that learners can utilise at their own pace and often with personalised assessments that match their academic levels and individual needs (Fanguy & Costley, 2021; D. Kim, 2016; Wanner & Palmer, 2015). Sociocultural theory supports such a student-centred, self-paced approach to enable opportunities for all learners to reach their maximum potential. In flipped classrooms, learning depends not just on the learners’ abilities and individual efforts but also on the type of collaboration and support they receive from their peers and instructors (Hwang & Chen, 2019). During in-class learning, instructors should provide learners with opportunities to collaborate, guide learners’ interaction, motivate them to reflect on their unique knowledge and encourage them to inspire other learners in their environment.

Flipped learning environments have been shown to provide a variety of benefits to different types of learners. For example, in their study, Zainuddin and Attaran (2016) reported that flipped classrooms positively impact introverts and quiet students. According to Challob’s (2021) study, flipped English writing classes create a user-friendly collaborative learning environment that enhanced learners’ English writing performance, autonomy and motivation. However, even though many studies have confirmed that learners have a positive attitude towards flipped learning (Doman & Webb, 2017; Lee & Wallace, 2018; McLean & Attardi, 2023), few researchers have investigated which type of out-of-class online activities are most effective for students’ learning. Fisher et al. (2021, p. 3) stated that “there is limited understanding of which type of learning activity benefits students or why they benefit from flipped learning”.

Moreover, despite such benefits, there are also challenges (e.g., quality and quantity of learning materials) to flipped learning approaches. Students reported that, when taking a flipped course, they felt that time constraints limited their ability to spontaneously and informally interact with one another and to become acquainted with the content before attending the class (Lo & Hew, 2017; Zainuddin & Attaran, 2016). Furthermore, the online component of flipped courses can be isolating for students as they experience

substantial portions of the course alone (Bergmann & Sams, 2012), depriving them of the benefits of collaboration in these parts of the class. Challenges exist in the flipped instruction model concerning student collaboration, instruction and general course operations (Lo & Hew, 2017). Therefore, instructors are challenged to find practical collaborative opportunities for students during the online components of flipped courses, and there is some debate regarding which methods of online collaboration would be most effective, if any are effective at all.

Collaboration and writing online

Research has shown that students' learning outcomes and their satisfaction with e-learning can be increased through computer-supported collaborative learning tools, for example, discussion boards (Fung, 2010), digital note-taking (Orndorff, 2015) and wiki writing (M. Li & Zhu, 2017). It is important to note that technology can be used to promote learners' collaboration, but cannot enforce collaboration nor guarantee enhanced learning outcomes (Marra et al., 2016). This highlights the importance of a skillful combination of technological tools, pedagogical techniques and instructor content knowledge for effective employment of technology in collaborative learning (Koehler et al., 2013).

The social constructivists' view is that collaborative learning occurs when learners interact in pairs or groups to discuss and solve a learning problem to accomplish a learning task (Laal & Ghodsi, 2012). Storch (2018) defined collaborative writing as "the coauthoring of a single text by two or more writers, where the coauthors are involved in all stages of the composing process and have a shared ownership of the text produced" (p. 1). Vygotsky (1978) suggested that all cognitive development occurs when novices and experts interact. Experts are the more knowledgeable members (e.g., parents, teachers, more able peers) who assist and scaffold the novices. According to Storch, "this assistance is internalized by the novice and eventually enables the novice to perform a task independently" (p. 2).

Collaborative writing provides several learning benefits, such as increased understanding of course content (Fung, 2010), exposure to various perspectives and the development of shared knowledge (Yilmaz, 2017). Collaborative writers may gain other cognitive and social benefits as well (Niu et al., 2018), as the processes necessary in collaboration with others can help to develop critical thinking skills, deep reflection on the topics of learning and the open exchange of ideas while mitigating some of the isolating feelings students may experience when learning online (Smith, 2020).

Since most collaborative writing occurs asynchronously (Fung, 2010), learners are allowed to reflect before providing their own revisions and/or comments to other members' writing (Bikowski & Vithanage, 2016). This reflection opportunity may increase learners' awareness of the numerous complex viewpoints and interpretations that may be held on a given issue or academic topic (Zainuddin & Attaran, 2016). Moreover, the interactive nature of the collaborative writing activity allows learners to provide scaffolding for and benefit to one another (Challob, 2021). According to J. Li and Mak (2022), students preferred online collaborative learning activities using a digital note-taking app over the traditional face-to-face setting because of the enjoyable social interaction and the instant feedback from the instructor and peers. In courses with an online component, collaboration among students through writing posts on discussion boards or in live chat rooms concerning the contents of lecture videos has been shown to increase their attention spans (e.g., N. Li et al., 2014; Wise & Cui, 2018), eventually improving their learning outcomes and skills (e.g., Costley et al., 2022; I. C. Hung et al., 2018; Kurucay & Inan, 2017; J. Li & Mak, 2022; N. Li et al., 2014).

Online discussion and student learning

When students face confusion in a course, they may request support and timely feedback. However, the isolating nature of online instruction may impede their ability to do so (e.g., Bergmann & Sams, 2012; Smith, 2020). Therefore, in such learning environments, students can engage in online discussion forums to create and reply to topic posts to mitigate or resolve their confusion (Zainuddin & Attaran, 2016). For instance, research has shown that learners who post new topics are more likely to be more engaged in course concepts than those who reply to existing posts (Southam et al., 2022). However, research on this

issue has produced mixed results as Fanguy and Costley (2021) found that students who most often contribute new topic posts on discussion boards tend to achieve better learning outcomes than those who post replies to existing topics. Such findings may suggest that posting new topics on a discussion board represents an active attempt by the learner to alleviate confusion by interacting with classmates and the instructor. The instructor can serve as a moderator on online discussion forums, assisting the students in constructing knowledge (Hew, 2015).

Furthermore, well-subscribed discussion boards provide valuable support for active learning through scaffolding techniques (Hsieh, 2017), which are a standard feature of the face-to-face component of flipped classrooms. Participants in online discussions are exposed to various perspectives and opinions and, therefore, tend to think critically about their own points of view, which may cause them to change their minds (Niu et al., 2018). As a result, discussion forums can serve as an essential avenue for learning interaction in a course.

Such awareness of others' varying viewpoints, fostered by active online discussion boards, can increase students' awareness of broader audiences who may read their writing, and this awareness may cause students to work harder to improve their writing (Luo et al., 2020). Written collaboration among students on discussion boards can help improve students' writing in many ways, including selecting a writing topic, using varying modalities and significantly revising their drafts. This notion was corroborated in research by Cheng et al. (2011), who found that a single post on an online discussion forum was associated with higher writing scores, although the cause for this correlation is unclear, as it is possible that students with better writing skills were more likely to post comments online. Zheng and Warschauer (2015) found that participating in online discussion boards also improved English language learners' writing ability, as the most frequent posters on discussion forums enjoyed the most considerable improvements in their writing post-test scores compared to their pretest scores.

Collaborative note-taking and student learning

Although most students take notes to alleviate the need to remember everything that was said (Jensen et al., 2018), note-taking is cognitively demanding (Niu et al., 2018), as learners must simultaneously understand what is being said and write it down. Attempting to do so can overwhelm the working memories of learners (Jansen et al., 2017). The emergence of shared online word processors, such as Google Docs, has now made it possible for students to take notes online in groups. Studies have suggested that, when students collaborate, they may be able to share the cognitive burden of note-taking (Kiewra, 1989). Although research on online collaborative note-taking is relatively sparse, initial studies examining its effects on learning outcomes are promising. The reduction in cognitive burden seems to translate to improved academic success, as research has shown that students who take notes collaboratively online received higher grades than students who took notes individually (Courtney et al., 2022; Fanguy et al., 2021; Orndorff, 2015).

Within this research, it is critical to compare the distinctions between discussion boards and online collaborative note-taking. Student participation in online discussion forums and the creation of group notes represent two different methods of applying a group's knowledge and talents towards a learning situation to benefit the constituent members. However, the research on these topics tends to describe these collaborative methods' aims and benefits differently. Research on discussion board participation generally describes the practice as beneficial to students in terms of the opportunity to share ideas, gain exposure to varying viewpoints, build teams and communities and share support and feedback (e.g., Hew, 2015; Hsieh, 2017). On the other hand, the goals of note-taking are often described in cognitive terms, namely storing necessary information from a lecture so that it can be called up at a later time (such as while studying for an exam) and encoding information, which refers to relating information to one's own knowledge structure (Di Vesta & Gray, 1972). Although there is a limited discussion of interaction among participants and varying points of view, most of the literature suggests that collaborative note-taking reduces the mental strain of taking notes while listening via the division of labour (e.g., Courtney et al., 2022; Fanguy et al., 2021; Kiewra, 1989; Orndorff, 2015).

Although online collaborative note-taking is a relatively recent phenomenon, with online word processing emerging in 2009, online discussion forums have been used for decades. Studies have consistently shown numerous learning benefits associated with posting on forums, particularly concerning improving writing ability (e.g., Cheng et al., 2011; Luo et al., 2020; Zheng & Warschauer, 2015). Both discussion forums and collaborative note-taking can help expose students to various perspectives on course content issues and make students more aware of their audience due to having their writing read by others. However, lecture notes tend to be written in a sparse, abbreviated style, as opposed to discussion board posts, which tend to be written in paragraph form. This difference may represent an advantage to an online discussion board posting compared to online collaborative note-taking with regard to improving writing ability as more proficient writers can serve as writing models for less proficient writers.

The present study

Although flipped courses tend to be highly collaborative in their face-to-face (offline) component, the online component can be rather isolating for students due to limited interaction among them (Bergmann & Sams, 2012). There are some suggestions that online learning can reduce the amount that students can connect with each other (Hehir et al., 2021). However, Fanguy and Costley (2021) posited that increasing collaboration online could reduce feelings of isolation while helping students make deeper connections between the online and offline content of flipped courses. Students who actively take online collaborative notes in small groups (Fanguy et al., 2021) and students who actively post new topics on discussion boards (Fanguy & Costley, 2021) showed improved learning performances compared to those who did not engage in these respective collaborative practices online. While these two online collaboration methods provide students with ways of making higher-level connections with the course material through collaborating with one another, there are essential differences between them. Since it is unknown whether one of these methods is more effective than the other, if effective at all, we conducted an experimental study to compare each student's performance on writing assignments in a flipped English scientific writing course. An internal review board approved the study's ethics at the institution where it was conducted.

Research questions

The present study was guided by the following research questions:

- (1) Does online collaboration enhance students' learning performance in a flipped course?
- (2) If so, which has a greater impact on students' learning performance: online collaborative note-taking or participation in online discussion forums?

Hypotheses

- (1) Hypothesis 1: Collaboration enhances students' learning performance in flipped courses.
 - H1a: Students in the conditions that involve collaboration will have higher individual writing scores than those in the control.
 - H1b: Students in the conditions that involve collaboration will have higher group writing scores than those in the control.
- (2) Hypothesis 2: Participation in online discussion forums will lead to a greater improvement in learning compared to online collaborative note-taking.
 - H2a: Students engaging in online forums will receive higher scores on individual writing assignments than those in control.
 - H2b: Students engaging in online forums will receive higher scores on group writing assignments than those of students in engaging in note-taking.

Methodology

Context

This experimental study investigated the relationship between participation in online collaborative writing activities related to course content within three flipped learning environments: one with no online interaction, one that features an online discussion forum and one involving online collaborative note-taking. The present study examined the experiences of 201 students enrolled in 10 sections of an English scientific writing class at a large university in South Korea. Among these 201 students, 23 failed to completely fill out a survey that was included in this research or chose not to participate in the study and were therefore case-wise deleted. Of the final sample of 178 students, 34 (19%) were females and 144 (81%) males, and the average age was 27 years (22–45). As the English scientific writing class examined in the study was a graduate-level course, all participants were PhD or master's students. Participants majored in a variety of science, technology, engineering and mathematics fields.

The purpose of the English scientific writing course was to teach graduate students how to communicate their research results in the form of a journal manuscript. The course was offered in a flipped format to reduce the number of required face-to-face meetings for graduate students, who typically spend substantial amounts of time in their research laboratories. The online component of the flipped format required students to watch four to nine online lecture videos each week via the course learning management system. After watching the videos, students would attend a weekly 90-minute face-to-face class meeting with the instructor. In these offline class meetings, students participated in either one of two collaborative activities, both of which required face-to-face collaboration among students and were usually completed during the 90-minute class meeting. In cases where these collaborative activities were not completed during the allotted class time, students could finish them through further online collaboration outside of class. The first type of collaborative activity involved writing an example of a specific section of a research manuscript based on a scenario provided by the instructor. The second involved pairs of students providing feedback and editing for each other's research writing related to a specific section of the manuscript. Every 2 weeks during the 14-week semester, students had to submit an individual writing assignment on one of five sections of a journal manuscript they were working on during the semester: Introduction, Methodology, Results, Discussion & Conclusion, and Abstract. More details about the course examined in the present study can be found in Fanguy et al. (2016).

Participants

Participants in the study were divided into the following groups based on which semester they took the class: in the control group, students were not required to engage in online collaboration with one another; in Treatment 1, students were asked to actively participate in online discussion forums relating to the contents of the online video lectures in the course; and in Treatment 2, students were encouraged to take online collaborative notes on the video lecture contents of the course in small groups of three to five students. The demographic information for the participants in each experimental group is shown in Table 1.

Table 1
Demographic breakdown by each experimental condition

Experimental group	N	Min. age	Max. age	Mean age	Female	Male
Control	60	23	44	27.5	10	50
Forums	58	22	37	26.97	12	46
Note-taking	60	22	45	27.18	12	48

Control group: No online collaboration

In the control group, the flipped English scientific writing course examined in this study was run as described in the Context and Participants subsections, with no additional online collaborative activities required by the course instructor. However, students still had the option of posting messages to one another and the course instructor on a discussion forum on the learning management system. As posting on the board was possible though not explicitly encouraged by the course instructor, the discussion board was poorly subscribed, with a total of only 17 messages posted during the semester.

Treatment 1: Online discussion forums

The Treatment 1 courses contained an online discussion forum, and participants in this condition were required to post at least three messages each week. Figure 1 shows a discussion thread from the Treatment 1 condition. Students could be credited for posting a message in two ways: by posting a new topic on the discussion board or by creating reply posts to existing topics posted by other class members. To incentivise active participation on the discussion board, a maximum of 20% of the total course grade could be earned by posting at least three messages each week. Students were not provided with any specific instructions or requirements regarding the topic or length of posts; however, the instructor encouraged thoughtful posts on concepts covered in the online videos and/or academic writing in general. Both the instructor and the teaching assistant read each message posted on the board and replied in cases where doing so was deemed necessary or helpful. However, such student-instructor interactions via the discussion forum were relatively minimal and mostly restricted to cases when guidance was needed regarding a question about a topic or a misunderstanding of a course concept. There were 1904 posts made over the course of the experiment.

Writer : ██████████ Wrote on : Wednesday, 14 November 2018, 1:42 AM View : 32

When I do the peer editing with someone who did a similar field with me, I know where to focus — on the methodology or analysis. However, the things aren't as simple for other fields. Where do you focus when you do the peer editing for the paper related to 1) your field and 2) not your field?

Prev : w13? No videos??!?

Next : W13. Discussion for your data

List New post Reply Modify Delete

██████████ Wednesday, 14 November 2018, 11:09 AM
As time is limited, we should first focus on the overall structure and grammar points. If time is left and you are familiar with the research or it is related to your research, also look at the content. In my opinion, there is not enough time to intensively peer edit the content.

██████████ Wednesday, 14 November 2018, 11:11 AM
I think that you should look at the following:
1) Good grammar and spelling. Journals often don't peer review for bad writing and if a paper has that, I probably won't finish, or cite it.
2) Flow of argument and display of data. This course has given us a lot of information on how an argument should be structured. You can go through and see did the paper accomplish those things
3) Are you convinced that this study was worthwhile? If not, probably tell the person to add data or re-write what they have.

██████████ Wednesday, 14 November 2018, 12:07 PM
I agree with you on #1. I always skip a paper that is poorly written.

██████████ Thursday, 15 November 2018, 10:53 PM
For papers that are related to my field, I read the paper with a critical or even cynical view, to find any flaws or imperfections in their statements. On the other hand, for papers that are not part of my field, I try to see if the paper flows logically and is easy to understand.

Figure 1. Discussion thread on the online forum used in the Treatment 1 condition

Treatment 2: Online collaborative note-taking

Participants in the Treatment 2 condition were asked to take collaborative notes on online course videos' contents by using Google Documents in small groups of three, four or five students. These Google Documents were created and monitored by the course instructor. One document was created for each of 10 instructional weeks so that a total of 10 documents were shared with the student groups. To distinguish each group member's written contributions to a document, students were asked to select a unique font colour and write only with that colour throughout the document.

Students were also encouraged to utilise the comment embedding feature within the Google Docs platform to comment on or discuss interesting or confusing points within the collaborative notes. At the end of each instructional week, these online collaborative notes were checked by the instructor to make sure that each member had made at least a minimal contribution, and this included adding even one line of notes or embedding a single comment within the notes to ask a question or add a reflection on the content. Members were given 1 point for participating in composing each set of notes for 10 points out of the 100-point course total. Students who did not contribute writing to the collaborative notes received a score of 0 and were encouraged by the course instructor or teaching assistant to add their own written notes or to contribute embedded comments adding their reflections or questions.

Measures

In-class group writing assignments. During the face-to-face component of the course, students worked in groups of three, four or five students to complete a collaborative writing assignment that would require them to apply concepts they had learned from the lecture videos they had watched in the online component of the course. For the collaborative note-taking treatment condition, the same groups were maintained for note-taking and for group writing assignments. These group writing assignments were written collaboratively so that only one assignment was turned in per group during a given face-to-face class meeting. Each group assignment was scored by the course instructor on a scale of 0–9 using a rubric that the instructor had created. A single score was given to each group per assignment so that every member received the same score. As there were four group assignments during the semester, each with a maximum score of 9 points, students could receive a total of 36 possible points on group work. However, the instructor's scores and comments on these group writing assignments were intended only to inform students of their strengths and weaknesses in research writing, so these group writing scores did not count towards the course total. As the contents of the video lectures covered issues of content, organisation, style and grammar in manuscript writing for academic journals, students were required to apply this knowledge and incorporate it into their own group writing assignments, which therefore served as a proxy for group learning in this study.

Individual writing assignments. The primary form of assessment in the course was the five individual writing assignments each student turned in during the semester. Each of these assignments corresponded to a significant section of a journal manuscript, that is, Introduction, Methodology, Results, Discussion & Conclusion, and Abstract. Individual writing assignments were scored on a scale of 0 to 10 by using rubrics adapted from Clabough and Clabough (2016). The scores on these five individual writing assignments were then totalled to create an individual writing score, with a maximum score of 50, accounting for half of the total possible grade points in the semester. The other half of the course grade consisted of 10 points for students to correctly create and format the reference list for their scientific manuscript, 30 points for 10 weekly online quizzes that covered topics from the course video lectures and 10 points for attendance and participation. For the same reasons mentioned in the prior subsection, the total individual writing score served as a proxy for individual learning in the study.

Results

Although it does not meet all the criteria for a randomised controlled trial, the design of the study used the principles of assignment to treatment and control groups in order to gain an understanding of how the different learning environments impact individual and group writing. The first step in the analysis was looking at the descriptive statistics of the primary dependent variables used in this study. As shown in Table 2, the mean score for individual writing was 39.5 out of a possible maximum score of 50. Group writing had a mean score of 28.1 out of a possible maximum score of 36. As standard ANOVA makes assumptions about the sample's distribution and skewness, in cases like these where skewness is high (Table 2), non-parametric tests such as the Kruskal-Wallis analysis of variance are more appropriate (Tabachnick et al., 2013).

Table 2

Overview of the dependent variables used in the present study

	N	Min.	Max.	Mean	SD	Skewness
Group total	178	8	36	28.06	5.26	-1.31
Individual total	178	16	50	39.51	5.061	-0.37

Secondly, we looked at the mean values for individual writing and group writing and compared them with the experimental group (Table 3). As can be seen for individual writing, using online forums had the highest mean (40.7), followed closely by online note-taking (40.3), with the no online learner-to-learner interaction (control) condition having the lowest mean score (37.6). Group writing followed the same pattern, with the online forums having the highest score (28.4), note-taking having the second-highest mean score (28), and the control group having the lowest mean score (27.7).

Table 3

Mean for individual writing and group writing based on the experimental condition

	Experimental group	Mean	N	SD
Individual writing	Control	37.62	60	4.91
	Forums	40.71	56	4.63
	Note-taking	40.28	60	5.12
Group writing	Control	27.72	60	4.00
	Forums	28.45	56	6.45
	Note-taking	28.02	60	5.14

Following an overview of the mean, the Kruskal-Wallis test results showed that the differences between the three groups were significant in terms of individual writing (p value = 0.00213). To look more deeply at the statistical difference among experimental and control groups in terms of individual writing, the Dunn test with Holm-Bonferroni method for adjusting p values was used. As shown in Table 4, both the forum and note-taking experimental conditions had significantly higher achievement than the control condition. The forums' mean was 3.10 average points higher, which accounts for 0.61 of standard deviation. The note-taking mean was 2.70 higher than in the control condition, which equals to 0.53 of standard deviation. When comparing the forums and note-taking experimental conditions, the forums group scored slightly higher (0.40), though this difference was not statistically significant.

Table 4

Dunn test for comparing individual writing by experimental grouping

Comparison	Mean difference in raw scores	Mean difference in standardised scores	Z	P.unadj	P.adj
Control group – Forums group	-3.10	-0.61	-3.25	0.001	0.001
Control group – Note-taking group	-2.70	-0.53	-2.74	0.011	0.014
Forums group – Note-taking group	0.40	0.09	0.56	0.582	0.583

Following the same approach, the Kruskal-Wallis test was assessed for students' group writing scores, that indicated some significant differences between the experimental conditions (p value = 0.03716). As shown in Table 5, the reason for this difference is mainly due to the difference in mean group writing between the control and forums, as forums have a significantly higher mean score than that of the control. This difference accounted for 0.70 raw score, which equals to 0.14 of standard deviation.

Table 5
Dunn test for comparing group writing by experimental grouping

Comparison	Difference in raw scores	Difference in standardised scores	Z	P.unadj	P.adj
Control group – Forums group	-0.70	-0.14	-2.53	0.015	0.032
Control group – Note-taking group	-0.30	-0.06	-0.86	0.392	0.395
Forums group – Note-taking group	0.40	0.08	1.67	0.091	0.194

Discussion

This section will discuss the results of the study by first focusing on the effects of the collaboration conditions on students' individual writing performance (Hypotheses 1a and 2a) and will then focus on the effects of students' group writing performance (Hypotheses 1b and 2b).

The present results show that students in the forums group and the collaborative note-taking group, which both involved learner-to-learner collaboration online, achieved higher scores on individual writing assignments than their peers in the control group, which did not include online collaboration. These findings support Hypothesis 1a and corroborate the results of several studies showing that individual writing scores improved through participation in online discussion forums (e.g., Cheng et al., 2011; Luo et al., 2020; Zheng & Warschauer, 2015). The findings are also consistent with those of studies showing that contributors to online collaborative notes received higher individual writing scores (Baldwin et al., 2019) and better grades overall (Orndorff, 2015). However, there was no statistically significant difference between the individual writing scores of both the forums group and the collaborative note-taking group, so that Hypothesis 2a was not supported. In other words, both online collaborative methods examined in the present study were helpful to students' individual writing ability, and neither provided a clear advantage over the other.

The improvements in individual writing quality found with both the forums group and the collaborative note-taking group support the idea that learning is an active social process where knowledge is constructed when individuals are involved in collaborative activities. This result is also consistent with Van Meter and Stevens (2000), who found that collaborative elaboration would lead to meaningful learning where learners construct understanding together. In flipped courses, improvement may occur because opportunities to collaborate can help create stronger and clearer connections between the course's online and offline components (Fanguy & Costley, 2021). When students are allowed to write collaboratively regarding the contents of lecture videos, their learning outcomes are improved (e.g., I. C. Hung et al., 2018; D. Kim, 2016; Kurucay & Inan, 2017; N. Li et al., 2014). Accordingly, the present result indicates that both online collaboration forms positively affect students' individual writing ability in flipped courses. Although there are essential differences between these two modes of collaboration, there are similarities such as improved understanding of course content (Bergmann & Sams, 2012; Fung, 2010; J. Y. Kim, 2017), exposure to the knowledge and viewpoints of group members (Yilmaz, 2017) and increased audience awareness due to students having their writing read by others (Luo et al., 2020).

The results further demonstrate no statistical differences among the three treatment conditions' group writing scores, so Hypothesis 1b was not supported. This result is unexpected because the results of this study have already shown a benefit to collaboration on the writing ability of individual students, and group writing performance depends on the writing proficiency of constituent group members as well as their ability to effectively and efficiently work together in composing their ideas. Since participants in collaborative treatment conditions exhibited better writing performance and had more opportunities to write collaboratively in small groups through their contributions to forum posts or collaborative notes, we expected that their group writing scores would be higher than those of the control condition. The fact

that this did not occur indicates that the collaborative skills and processes that students refined while engaging in online forum posting or online collaborative note-taking did not transfer well to the group writing assignments that students composed during face-to-face class meetings. This may have occurred because the approaches to and skills required by collaborative writing in the offline component of a flipped course differ in important ways from those used in the online collaboration that took place in the collaborative treatment conditions. Specifically, face-to-face collaborative writing (group writing assignments) requires more intensive effort to work together due to the time constraints of the 90-minute class meeting, while the online collaborative writing (forums or collaborative note-taking) requires a more sustained and patient approach, checking in on the forum or online note-taking document regularly to read and respond to contributions by group mates during each instructional week.

Although participants in the forum group received higher group writing scores than those of the collaborative note-taking group, the differences were not statistically significant, so the results of this study did not support Hypothesis 2b. Interestingly, the group writing scores of the forum group were significantly higher than those of the control, although the same did not hold true when comparing the group writing scores of the collaborative note-taking group to those of the control. Perhaps this difference was caused by the nature of these two forms of written collaboration: online discussion forums may enable students to exchange ideas more deeply than is possible in online collaborative note-taking, as note-taking tends to focus on shorthand recording of information and does not always contain deep reflection. The exchange of ideas in online forums could lead to a deeper understanding of course content (Smith, 2020), enabling students to communicate more effectively and better coordinate the composition of group assignments. Although Hypothesis 2b is not supported, research suggests that lower-level writers may benefit from the writing being modeled by more proficient writers on the online discussion forum, while the same might not occur in the collaborative note-taking condition (Niu et al., 2018). Although the present study weakly suggests that online forum discussion may benefit learners' collaborative writing, it is unclear why this form of written collaboration did not show greater benefit than note-taking, as it did when compared to the control condition.

The findings from this study raise two implications for educators and practitioners: one regarding individual writing proficiency and another regarding group writing proficiency. When improving individual writing proficiency is the goal, writing instructors should include learning activities in their courses that require students to collaborate through writing, as the present study found that doing is beneficial to individual writing performance. When improving group writing is the goal, instructors administering collaborative writing activities may want to encourage students to reflect on their learning and to share deeper insights about the course materials with one another rather than merely attempting to record information, as may occur with note-taking. An example of a way to encourage such sharing of deeper insights would be for the instructor to add embedded comments to students' collaborative notes asking questions for note-takers to reflect on and discuss.

Conclusion

The present study examined the effects of two different forms of online written collaboration on students' writing skills enrolled in a flipped course. The results indicate that posting in online discussion forums and taking lecture notes collaboratively online benefit students' individual writing abilities compared to the control condition, which contained no online collaboration. Considering these findings, practitioners teaching flipped courses should seek to provide students with opportunities to interact through writing on concepts they are learning in the course. Concerning group writing ability, although no difference was shown between participating in online discussion forums and taking notes collaboratively, only online discussion forum participation provided benefit compared to the control. This finding suggests that online discussion forums may be a better choice for practitioners when improving students' group writing ability is a goal. We propose that participation in online discussion forums may have induced a more in-depth exchange of ideas regarding course content, rather than merely recording ideas, as is commonly done in note-taking. For instructors who wish to make effective use of the advantages of collaborative note-taking (e.g., Bikowski & Vithanage, 2016; Jensen et al., 2018), it may be beneficial to guide students to utilise

social features within shared online documents, including embedding comments within the text, responding to the comments of others within a comment thread and chatting in real-time with one another.

There are several limitations in the present study that must be discussed. The first is that the study distinguished treatment conditions only by the type of writing collaboration that was included (or not) in the course but did not examine how much collaboration occurred in these treatment groups. Although this gives insight into more effective pedagogical practice, it does open the question of the mechanisms that drive the gains made by students in the forum and note-taking conditions. Another limitation is that this study did not examine the quality of the contributions being made by the individual members in the collaborative treatment groups. A third limitation of the study is that it fails to account for the possibility of social equity obstacles that could have prevented certain individuals from taking part. The study concentrates mainly on the environment individuals are in and how the utilisation of online collaborative tools impacts subsequent performance, but it remains unclear how social inequality may impede their capacity to engage in collaborative activities. Exploring this area in future research could lead to a more comprehensive understanding of the barriers and facilitators of online collaboration participation. Furthermore, more in-depth statistical multilevel analysis of how different groups within each condition performed could help make connections between the variables used in this study. Qualitative research designs might be most suitable to address the limitations mentioned herein, as semi-structured interviews or open-ended survey items might reveal deeper insights about students' backgrounds and motivations with respect to online collaboration. The current study has a fourth limitation in that it did not account for the underlying processes and back-channel communications that might have taken place and could have been significant to the learning experience of the students in the class. We could not investigate such interactions since they are inherently confidential.

Despite these limitations, this study provides valuable direction for practitioners that inclusion of students' opportunities to collaborate online through writing would benefit their learning. The limitations mentioned previously also provide the direction for future research. Note-taking and discussion boards should be further investigated in the light of note-taking and discussion board effectiveness as an online teaching model. Future research should also examine both the frequency and types of interactions students engage in during collaborative note-taking and posting on online forums and their effects on students' learning outcomes. This will allow the field of collaborative learning research to develop an understanding of the mechanisms that drive the benefits found in the present study. Such research may yield insights into combining the best features of online discussion forums with those of collaborative note-taking to provide the most significant benefit to students' learning.

Author contributions

Mik Fanguy: Conceptualisation, Investigation, Data curation, Writing – original draft, Writing – review and editing; **Jamie Costley:** Investigation, Formal analysis, Writing – review and editing; **Norah Almusharraf:** Writing – review and editing; **Asma Almusharraf:** Writing – review and editing.

References

- Ashcraft, D., Treadwell, T., & Kumar, V. K. (2008). Collaborative online learning: A constructivist example. *Journal of Online Learning and Teaching*, 4(1), 109–117.
<https://jolt.merlot.org/vol4no1/treadwell0308.pdf>
- Baldwin, M. P., Fanguy, M., & Costley, J. H. (2019). The effects of collaborative note-taking in flipped learning contexts. *Journal of Language and Education*, 5(4), 25–35.
<https://doi.org/10.17323/jle.2019.9726>
- Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day* (1st ed.). International Society for Technology in Education.

- Bikowski, D., & Vithanage, R. (2016). Effects of web-based collaborative writing on individual L2 writing development. *Language Learning & Technology*, 20(1), 79–99. <https://core.ac.uk/download/pdf/84321441.pdf>
- Bishop, J. L., & Verleger, M. A. (2013, July 23-26). *The flipped classroom: A survey of the research*. [Paper presentation]. *ASEE National Conference, Atlanta, United States of America*.
- Butson, R., & Thomson, C. (2014). Challenges of effective collaboration in a virtual learning environment among undergraduate students. *Creative Education*, 5(16), 1449–1459. <https://doi.org/10.4236/ce.2014.516162>
- Challob, A. I. (2021). The effect of flipped learning on EFL students' writing performance, autonomy, and motivation. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-021-10434-1>
- Cheng, C. K., Paré, D. E., Collimore, L. M., & Joordens, S. (2011). Assessing the effectiveness of a voluntary online discussion forum on improving students' course performance. *Computers & Education*, 56(1), 253–261. <https://doi.org/10.1016/j.compedu.2010.07.024>
- Clabough, E. B., & Clabough, S. W. (2016). Using rubrics as a scientific writing instructional method in early stage undergraduate neuroscience study. *Journal of Undergraduate Neuroscience Education*, 15(1), A85–A93. <https://www.funjournal.org/wp-content/uploads/2016/10/june-15-85.pdf?x36670>
- Costley, J., Courtney, M., & Fanguy, M. (2022). The interaction of collaboration, note-taking completeness, and performance over 10 weeks of an online course. *The Internet and Higher Education*, 52, Article 100831. <https://doi.org/10.1016/j.iheduc.2021.100831>
- Courtney, M., Costley, J., Baldwin, M., Lee, K., & Fanguy, M. (2022). Individual versus collaborative note-taking: Results of a quasi-experimental study on student note completeness, test performance, and academic writing. *The Internet and Higher Education*, 55, Article 100873. <https://doi.org/10.1016/j.iheduc.2022.100873>
- Davies, R. S., Dean, D. L., & Ball, N. (2013). Flipping the classroom and instructional technology integration in a college level information systems spreadsheet course. *Educational Technology Research and Development*, 61(4), 563–580. <https://doi.org/10.1007/s11423-013-9305-6>
- DeChurch, L.A. & Mesmer-Magnus, J.R. (2010). The cognitive underpinnings of effective teamwork: A meta-analysis. *Journal of Applied Psychology*, 95(1), 32–53. <https://doi.org/10.1037/a0017328>
- Di Vesta, F. J., & Gray, G. S. (1972). Listening and note taking. *Journal of Educational Psychology*, 63(1), 8–14. <https://doi.org/10.1037/h0032243>
- Doman, E., & Webb, M. (2017). The flipped experience for Chinese university students studying English as a foreign language. *TESOL Journal*, 8(1), 102–141. <https://doi.org/10.1002/tesj.264>
- Dubosson, M., & Emad, S. (2015). The forum community, the connectivist element of an xMOOC. *Universal Journal of Educational Research*, 3(10), 680–690. <https://doi.org/10.13189/ujer.2015.031004>
- Fanguy, M., Baldwin, M., Shmeleva, E., Lee, K., & Costley, J. (2021). How collaboration influences the effect of note-taking on writing performance and recall of contents. *Interactive Learning Environments*, 1–15. <https://doi.org/10.1080/10494820.2021.1950772>
- Fanguy, M., & Costley, J. (2021). Creating a framework for understanding and defining flipped learning. *Journal of Educators Online*, 18(1). https://www.thejeo.com/archive/archive/2021_181/fanguy_costley.pdf~1
- Fanguy, M., Wang, H., & Baldwin, M. (2016). Flipping the classroom in the context of blended learning initiatives. In M. Pinto & D. Shaffer (Eds.), *Proceedings of the 23rd Annual KOTESOL International Conference* (pp.79–88). Korea TESOL. https://mail.koreatesol.org/sites/default/files/pdf_publications/KOTESOL.Proceedings.2015.web_.pdf#page=86
- Fisher, R., Perényi, A., & Birdthistle, N. (2021). The positive relationship between flipped and blended learning and student engagement, performance and satisfaction. *Active Learning in Higher Education*, 22(2), 97–113. <https://doi.org/10.1177/1469787418801702>
- Fleener, M. J., Carter, A., & Reeder, S. (2004). Language games in the mathematics classroom: Teaching a way of life. *Journal of Curriculum Studies*, 36(4), 445–468. <https://doi.org/10.1080/0022027032000150411>
- Fulton, K. (2012). Upside down and inside out: Flip your classroom to improve student learning. *Learning & Leading with Technology*, 39(8), 12–17. <https://www.iste.org/node/6678>

- Fung, Y. M. (2010). Collaborative writing features. *RELC Journal*, 41(1), 18–30. <https://doi.org/10.1177/0033688210362610>
- Hehir, E., Zeller, M., Luckhurst, J., & Chandler, T. (2021). Developing student connectedness under remote learning using digital resources: A systematic review. *Education and Information Technologies*, 26(5), 6531–6548. <https://doi.org/10.1007/s10639-021-10577-1>
- Herrmann, K. J. (2013). The impact of cooperative learning on student engagement: Results from an intervention. *Active Learning in Higher Education*, 14(3), 175–187. <https://doi.org/10.1177/1469787413498035>
- Hew, K. F. (2015). Student perceptions of peer versus instructor facilitation of asynchronous online discussions: further findings from three cases. *Instructional Science*, 43(1), 19–38. <https://doi.org/10.1007/s11251-014-9329-2>
- Hsieh, Y. C. (2017). A case study of the dynamics of scaffolding among ESL learners and online resources in collaborative learning. *Computer Assisted Language Learning*, 30(1-2), 115–132. <https://doi.org/10.1080/09588221.2016.1273245>
- Hung, I. C., Kinshuk, & Chen, N. S. (2018). Embodied interactive video lectures for improving learning comprehension and retention. *Computers and Education*, 117, 116–131. <https://doi.org/10.1016/j.compedu.2017.10.005>
- Hung, W. (2013). Team-based complex problem solving: a collective cognition perspective. *Educational Technology Research and Development*, 61(3), 365–384. <https://doi.org/10.1007/s11423-013-9296-3>
- Hwang, G. J., & Chen, P. Y. (2019). Effects of a collective problem-solving promotion-based flipped classroom on students' learning performances and interactive patterns. *Interactive Learning Environments*, 31(5), 2513–2528. <https://doi.org/10.1080/10494820.2019.1568263>
- Jansen, R. S., Lakens, D., & IJsselstein, W. A. (2017). An integrative review of the cognitive costs and benefits of note-taking. *Educational Research Review*, 22, 223–233. <https://doi.org/10.1016/j.edurev.2017.10.001>
- Jensen, M. M., Thiel, S.-K., Hoggan, E., & Bødker, S. (2018). Physical versus digital sticky notes in collaborative ideation. *Computer Supported Cooperative Work (CSCW)*, 27(3–6), 609–645. <https://doi.org/10.1007/s10606-018-9325-1>
- Kiewra, K. A. (1989). A review of note-taking: The encoding-storage paradigm and beyond. *Educational Psychology Review*, 1(2), 147–172. <https://doi.org/10.1007/BF01326640>
- Kim, D. (2016). Flipped interpreting classroom: flipping approaches, student perceptions and design considerations. *The Interpreter and Translator Trainer*, 11(1), 38–55. <https://doi.org/10.1080/1750399X.2016.1198180>
- Kim, J. Y. (2017). A study of students' perspectives on a flipped learning model and associations among personality, learning styles and satisfaction. *Innovations in Education and Teaching International*, 55(3), 314–324. <https://doi.org/10.1080/14703297.2017.1286998>
- Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *Journal of Education*, 193(3), 13–19. <https://doi.org/10.1177/002205741319300303>
- Kurucay, M., & Inan, F. A. (2017). Examining the effects of learner-learner interactions on satisfaction and learning in an online undergraduate course. *Computers & Education*, 115, 20–37. <https://doi.org/10.1016/j.compedu.2017.06.010>
- Laal, M., & Ghodsi, S.M. (2012). Benefits of collaborative learning. *Journal of Procedia-Social and Behavioral Sciences*, 31, 486–490. <https://doi.org/10.1016/j.sbspro.2011.12.091>
- Lambert, L. (2002). *The constructivist leader*. Teachers College Press.
- Lavelle, J. P., Stimpson, M. T., & Brill, E. D. (2013). Flipped out engineering economy: Converting a traditional class to an inverted model. In A. Krishnamurthy & W. K. V. Chan (Eds.), *Proceedings of the 2013 IIE Annual Conference* (pp. 397–406). Institute of Industrial and Systems Engineers.
- Lee, G., Wallace, A. (2018). Flipped learning in the English as a foreign language classroom: Outcomes and perceptions. *TESOL Quarterly*, 52(1), 62–84. <https://doi.org/10.1002/tesq.372>
- Li, J., & Mak, L. (2022). The effects of using an online collaboration tool on college students' learning of academic writing skills. *System*, 105, Article 102712. <https://doi.org/10.1016/j.system.2021.102712>

- Li, M., & Zhu, W. (2017). Good or bad collaborative wiki writing: Exploring links between group interactions and writing products. *Journal of Second Language Writing*, 35, 38–53. <https://doi.org/10.1016/j.jslw.2017.01.003>
- Li, N., Verma, H., Skevi, A., Zufferey, G., Blom, J., & Dillenbourg, P. (2014). Watching MOOCs together: Investigating co-located MOOC study groups. *Distance Education*, 35(2), 217–233. <https://doi.org/10.1080/01587919.2014.917708>
- Lo, C. K., & Hew, K. F. (2017). A critical review of flipped classroom challenges in K-12 education: Possible solutions and recommendations for future research. *Research and Practice in Technology Enhanced Learning*, 12(4), 1–22. <https://doi.org/10.1186/s41039-016-0044-2>
- Luo, Z., O’Steen, B., & Brown, C. (2020). Flipped learning wheel (FLW): A framework and process design for flipped L2 writing classes. *Smart Learning Environments*, 7(10), 1–21. <https://doi.org/10.1186/s40561-020-00121-y>
- Marra, R. M., Steege, L., Tsai, C. L., & Tang, N. E. (2016). Beyond “group work”: An integrated approach to support collaboration in engineering education. *International Journal of STEM Education*, 3(17), 1–15. <https://doi.org/10.1186/s40594-016-0050-3>
- McLean, S., & Attardi, S. M. (2023). Sage or guide? Student perceptions of the role of the instructor in a flipped classroom. *Active Learning in Higher Education*, 24(1), 49–61. <https://doi.org/10.1177/1469787418793725>
- Ndon, U. (2011). *Hybrid-context instructional model: The Internet and the classrooms: The way teachers experience it*. Information Age Publishing.
- Niu, R., Jiang, L., & Deng, Y. (2018). Effect of proficiency pairing on L2 learners’ language learning and scaffolding in collaborative writing. *The Asia-Pacific Education Researcher*, 27(3), 187–195. <https://doi.org/10.1007/s40299-018-0377-2>
- Orndorff, H. N., III. (2015). Collaborative note-taking: The impact of cloud computing on classroom performance. *International Journal of Teaching and Learning in Higher Education*, 27(3), 340–351. <https://www.isetl.org/jtlhe/pdf/IJTLHE2035.pdf>
- Ouyang, F., & Scharber, C. (2017). The influences of an experienced instructor’s discussion design and facilitation on an online learning community development: A social network analysis study. *The Internet and Higher Education*, 35, 34–47. <https://doi.org/10.1016/j.iheduc.2017.07.002>
- Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, 93(3), 223–231. <https://doi.org/10.1002/j.2168-9830.2004.tb00809.x>
- Shunk, D. H. (2000). *Learning theories: An educational perspective* (3rd ed). Prentice-Hall.
- Smith, K. D. (2020). Is it face time or structure and accountability that matter? Moving from a flipped to a flipped/hybrid classroom. *Journal of Applied Research in Higher Education*, 13(2), 609–621. <https://doi.org/10.1108/jarhe-08-2019-0229>
- Southam, A., Zhang, H., Cao, R., Fanguy, M., & Costley, J. (2022). How the COI framework explains the online discussion patterns in a flipped course. *Innovations in Education and Teaching International*, 1–13. <https://doi.org/10.1080/14703297.2022.2130392>
- Storch, N. (2018). Collaborative writing. *The TESOL Encyclopedia of English Language Teaching*, 1–6. <https://doi.org/10.1002/9781118784235.eelt0395>
- Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2013). *Using multivariate statistics*. Pearson.
- Tang, T., Abuhmaid, A. M., Olaimat, M., Oudat, D. M., Aldhaeabi, M., & Bamanger, E. (2020). Efficiency of flipped classroom with online-based teaching under COVID-19. *Interactive Learning Environments*, 31(2), 1077–1088. <https://doi.org/10.1080/10494820.2020.1817761>
- Van Meter, P., & Stevens, R. J. (2000). The role of theory in the study of peer collaboration. *The Journal of Experimental Education*, 69(1), 113–127. <https://doi.org/10.1080/00220970009600652>
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Wanner, T., & Palmer, E. (2015). Personalising learning: Exploring student and teacher perceptions about flexible learning and assessment in a flipped university course. *Computers & Education*, 88, 354–369. <https://doi.org/10.1016/j.compedu.2015.07.008>
- Wise, A. F., & Cui, Y. (2018). Learning communities in the crowd: Characteristics of content related interactions and social relationships in MOOC discussion forums. *Computers & Education*, 122, 221–242. <https://doi.org/10.1016/j.compedu.2018.03.021>

- Yadav, R., Tiruwa, A., & Suri, P. K. (2017). Internet based learning (IBL) in higher education: A literature review. *Journal of International Education in Business*, 10(2), 102–129. <https://doi.org/10.1108/JIEB-10-2016-0035>
- Yilmaz, R. (2017). Exploring the role of e-learning readiness on student satisfaction and motivation in flipped classroom. *Computers in Human Behavior*, 70, 251–260. <https://doi.org/10.1016/j.chb.2016.12.085>
- Zainuddin, Z., & Attaran, M. (2016). Malaysian students' perceptions of flipped classroom: A case study. *Innovations in Education and Teaching International*, 53(6), 660–670. <https://doi.org/10.1080/14703297.2015.1102079>
- Zheng, B., & Warschauer, M. (2015). Participation, interaction, and academic achievement in an online discussion environment. *Computers & Education*, 84, 78–89. <https://doi.org/10.1016/j.compedu.2015.01.008>
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