

RESEARCH

Free and Open Access

Zoom in the face-to-face classroom and its effects on the class performance of college students

Michael Jijin Zhang

*Correspondence:
zhangm@sacredheart.edu
Department of Management,
Sacred Heart University,
5151 Park Avenue, Fairfield,
Connecticut 06825,
United States.
Full list of author information is
available at the end of the article

Abstract

This study explored how Zoom, a popular videoconferencing and online collaboration tool, may influence college students' class participation and learning in the traditional (face-to-face) classroom. Specifically, the study examined and tested the effects of using two main functions of Zoom, chat and quizzes, for in-person class participation on the overall class performance of students. The data from 240 undergraduate students participating in a face-to-face course of international business during the past three years provided evidence showing that the use of Zoom chat and quizzes was positively related to the students' overall class performance. The pedagogical and research implications from this research are discussed.

Keywords: Zoom, Classroom participation, Student involvement, Face-to-face learning

Introduction

Participation in classroom activities has long been viewed as a key part of students' involvement or engagement that determines their learning, performance, and satisfaction in higher education (Bond et al., 2020a; Frisby, 2015; Mundelsee & Jurkowski, 2021). Yet, how to increase college students' participation in classroom discussions and other activities remains a challenge for educators, as active classroom participation is still lacking among many college students for various personal, behavioral, and cultural reasons (Axelson & Flick, 2010; Ko, 2011; Medaille & Usinger, 2019; Mullaney, 2023; Reda, 2009; Wilt & Revelle, 2009). Before the Covid-19 pandemic, the advancements in digital technology had provided college teachers with many tools, most of which are online, for facilitating and



© The Author(s). 2025 **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.

assessing student participation in the classroom (Bond & Bedenlier, 2019; Bond et al., 2020a; Haleem et al., 2022). For example, discussion forums in Blackboard were found effective in increasing student participation in class activities in online as well as face-to-face environments (Haleem et al., 2022; Szabo & Schwartz, 2011). During the height of the pandemic, a new set of videoconferencing and online collaboration tools such as Zoom, Webex and Microsoft Teams emerged and became ubiquitous as many colleges and universities around the world turned to online instruction to keep most of their classes going. These new tools offer some functions such as online text-based chat and quizzing that are more in real time and flexible than similar applications based on traditional platforms such as Blackboard and Canvas and thus have the potential to further enhance student participation in both virtual and in-person classrooms. While these new tools have been found instrumental in facilitating online class activities and student learning (Gantner & Kimbrel, 2022; Goodman & Moore, 2023; Sørnum et al., 2021), whether and how they may augment student participation in the traditional (face-to-face) classroom have received scant attention in the extant literature. As many colleges and universities have returned to the face-to-face instruction mode, a better understanding of the contributions of the new online tools to student experience in and learning from the traditional classroom may help college teachers appreciate and harness the new technology to achieve their teaching goals. The purpose of the present study is, therefore, to explore the potential impact of using one popular online tool (Zoom) and its two main functions, chat and quizzing, in the face-to-face classroom on college students' learning and performance.

The rest of the paper is structured as follows. It begins with a review of the existing literature on 1) the pedagogical value of classroom participation in student involvement and learning in higher education, 2) some limitations in the traditional view of classroom participation, and 3) technological enhancements of student participation in both online and face-to-face classrooms. The potential contributions of Zoom and two of its main functions, chat and quizzing, to student participation in the face-to-face classroom as well as their effects on student learning and class performance are then examined to develop the research hypotheses for empirical testing. The method and results sections describe the sample, data collection, measures of the key variables and statistical analyses of the study as well as presenting the results from the empirical testing. The research and pedagogical implications of the study along with its limitations are then discussed and followed by the conclusions.

Literature review and research hypotheses

Pedagogical value of classroom participation

Educational scholars have long recognized the crucial role of student involvement or engagement in the learning process (Astin, 1999; Cuseo, 2012; Kuh, 2009). A very popular

theoretical paradigm on what determine college students' learning, development and academic success on campus is the theory of active involvement pioneered by Astin (1993, 1999), which holds that the amount of *time, effort and energy* students put into activities inside and outside the classroom increase their learning and development from their college experience. The *time* consists of how often a student participates in an activity, and the *effort* and *energy* are dependent on how fully or thoroughly the student delves into the activity. A large body of research based on this theoretical framework has empirically linked student involvement to a plethora of desirable outcomes for students and universities alike. Astin's (1993) early research revealed that the time a college student spent on studying was positively related to certain (cognitive and affective) skills developments, student retention, graduating with honors and enrolling in graduate schools. Kuh (2009) found that college students who were involved in productive learning activities - writing, analyzing and problem-solving - became adept at dealing with complexity and ambiguity and working with people from different backgrounds and perspectives. Shulman (2002) also noted that engagement in learning helped college students cultivate habits of the mind and heart that could increase their capacity for continuous learning and personal development. More recent engagement research in the U.S. and other countries has further identified many other critical skills (e.g., critical thinking and collaboration), academic performance (e.g., GPA and GRE scores) and even student satisfaction/enjoyment derived from active involvement (Akpur, 2021; Bolliger & Halupa, 2018; Choi & Rhee, 2014; Denovan et al., 2020; Guo et al., 2022; Kahu, 2013; Ko et al., 2016; Kuh & O'Donnell, 2013; Leach, 2016; Maxwell-Stuart & Huisman, 2018; Webber et al., 2013). In view of the vast empirical support for the involvement theory, active involvement in terms of time, effort and energy invested is viewed as one of the seven 'timeless and universal principles of student success in college' (Cuseo, 2012) and even referred to as the 'grand meta-principle' of student learning (Cross, 1999).

In the student engagement literature, three facets of student involvement in the learning process have been identified: behavioral, cognitive and affective (Ben-Eliyahu et al., 2018; Fredricks et al., 2016), and the behavioral aspect of involvement in turn reflects two main experiences: class participation and campus engagement (Gunuc & Kuzu, 2015). Student participation in various class-related activities is deemed as a key (behavioral) dimension of student involvement (Bond et al., 2020a) and encompasses time and effort a student puts into a range of activities inside and outside the classroom, such as preparation for a class, participation in class discussions, and interaction with the instructor and other students after class (Christenson et al., 2012). Participation inside the classroom, including voicing questions, answers and comments and involving in other in-class activities, has long been viewed as an integral part of class participation (Frisby, 2015; Mundelsee & Jurkowski, 2021) due to the educational value of dialog and interaction in the classroom. Freire (2000)

viewed dialog between teachers and students in the classroom as critical in enabling students to critically evaluate long-held assumptions and challenge authority in social and economic situations as well as identifying possibilities and helping each other out. In a similar vein, Frisby (2015) noted that students participating in discussions and other classroom activities can practice “verbalizing, synthesizing, analyzing, clarifying and evaluating information that leads to learning” (2). Classroom participation also allows students to develop and refine oral communication skills (Frisby, 2015) and enables teachers to interact with their students in ways, such as providing feedback on student accomplishments and errors, which facilitate higher order learning (Chi, 2009). Another pedagogical benefit of in-class participation is that it is easily observable, hence allowing teachers to gain valuable insights into students’ progress and understanding (Fassinger, 1995). Indeed, prior empirical research has generally confirmed the educational value of classroom participation by linking it to different learning outcomes and academic achievements of college students. For example, several large-scale studies conducted in the U.S. and other countries found that active participation in classroom activities had significant impact on the developments of certain critical skills and competencies in critical thinking (Ko et al., 2016), comprehensive thinking (Yu et al., 2011), problem solving (Choi & Rhee, 2014), communication (Choi & Rhee, 2014; Guo et al., 2022; Yu et al., 2011), and collaborative working (Choi & Rhee, 2014). Classroom participation has also been found positively related to college students’ academic performance such as grades in a class, GRE test scores and overall GPA (Akpur, 2021; Bolliger & Halupa, 2018). While most of the existing evidence upheld the pedagogical value of classroom participation, some studies revealed certain situations where active classroom involvement or efforts to increase classroom involvement might not generate the desirable learning results or even hindered learning and class performance (D’Errico et al., 2016; Hein, 2012; Rau et al., 2017). In their study of the efficacy of certain classroom engagement practices, Rau et al. (2017) found that the use of flipped classroom and teachers’ support for group discussions and problem solving had not led to more learning from the group sessions than traditional lectures, as perceived by the students. The collaboration support also did not improve the students’ exam scores and course grades when compared with traditional instruction. D’Errico et al. (2016) reported that the students’ chat discussions with the teachers in an online class had resulted in more negative student emotions, such as anxiety and sadness, than other engagement methods, such as web forum. The negative emotions in turn impaired the students’ perceptions of skill development and performance in tests.

Assessment of classroom participation

While the critical role of classroom participation in student engagement in higher education is well established in the literature, what constitute the desirable behaviors a student should

demonstrate in a classroom meeting is somewhat controversial among educators. The popular approach to inducing and ensuring active classroom participation is to encourage or even require students to speak out their thoughts, such as answers, questions, or comments. In explaining why many teachers highly value vocal participation, Macfarlane (2014) pointed out that: “Like all forms of performativity, applicable to academics and students alike, only things that are observable count. Only what is visible is audited” (44). In addition to its visibility, speaking out in a dialog is considered central to the interactive and problem-posing approach to education advocated by Freire (2000) and adopted by many other educators. Collins (1996) further noted that it is through talk students “develop their perceptions of themselves and their worlds” (2). On the other hand, critics of equating active classroom participation with speaking out argue that, although vocal participation in in-class discussions is desirable, such a behavior is often hard to attain in practice due to a variety of barriers. Researchers on why many college students remain quiet in classroom discussions have uncovered some personal, behavioral, cultural, and situational reasons for silence in the classroom (Axelson & Flick, 2010; Ko, 2011; Medaille & Usinger, 2019; Mullaney, 2023; Reda, 2009; Wilt & Revelle, 2009). Some students may experience anxiety, control loss or social judgement when forced to speak out, while some have a hard time learning the academic norms of communication or figuring out what a teacher expects to hear (Reda, 2009). Introvert students tend to be shier or more reserved in the classroom (Wilt & Revelle, 2009). Minority students influenced by family or group cultures that value reserved behaviors are more hesitant to talk (Medaille & Usinger, 2019). For example, Ko (2011) observed that students from Korean families tend to be passive in classroom activities and interaction with faculty. In addition, students with mental disabilities such as anxiety and depression are likely to disassociate and talk less (Mullaney, 2023). In short, these impediments to active classroom participation in the traditional view suggest that a quiet student can be very engaged in classroom activities in manners not manifested in speaking loud (Medaille, 2018). To allow quiet or shy students to express themselves in ways they are more comfortable with, several educators have recently called for recognizing a student’s written responses as valuable contribution to discussions in the classroom (Medaille & Usinger, 2019; Mullaney, 2023). Mullaney (2023) also argued that voicing thoughts anonymously to other students allows a student to feel less the subject of unwanted attention. Employing polls and quizzes to solicit students’ opinions without revealing their identities to the others can also help teachers better assess quiet students’ understanding of the discussed topics (Friedner et al., 2020; Medaille & Usinger, 2019).

Technology-assisted classroom participation

The rapid developments of digital technologies, especially online and web-based tools, and their applications in higher education during the past two decades have made them an

indispensable part of student learning and experience in college (Bond & Bedenlier, 2019; Bond et al., 2020a; Gunuc & Kuzu, 2015; Henderson et al., 2015). Run on electronic devices such as laptops, smartphones and tablets which have become ubiquitous nowadays, these technologies have been widely employed by universities and teachers to increase student engagement in in-class and out-of-class activities on campus (Bond & Bedenlier, 2019; Haleem et al., 2022). The technology-enhanced learning environment in turn can result in both short-term and long-term learning outcomes, such as knowledge and skill development, interest and motivation, social belonging and relationship, satisfaction and retention, lifelong learning, personal growth, and campus involvement (Bond & Bedenlier, 2019; Gunuc & Kuzu, 2015). Inside the classroom, online tools such as discussion forums, text-based chats, quizzes and polls can enhance student engagement in class discussions and activities by increasing teacher-student communication and interaction as well as student collaboration (Gunuc & Kuzu, 2014; Haleem et al., 2022). Growing up with more digital technologies than ever, college students of the 21st century are accustomed to and interested in the use of various technologies in the classroom (Gunuc et al., 2013; Haleem et al., 2022). A survey of over 1600 of undergraduate students studying in different fields such as medicine, engineering, business, sciences, and humanities at two Australian universities found that the students had perceived the use of digital technologies helpful and/or useful (Henderson et al., 2015). Another survey further revealed that educational applications of digital technologies had been most applied to student participation, involvement, or interaction in the classroom (Bond et al., 2020a). Researchers on the classroom impact of online educational tools have identified several ways they can enhance student engagement in in-class activities. Class discussions supported by these tools can be more open, frequent, and equal (Sharma & Tietjen, 2016), overcoming class time and size limits (Szabo & Schwartz, 2011) and helping less confident students express their opinions (Arnold & Paulus, 2010). Moreover, writing out one's thoughts concisely is conducive to thorough recapitulation of the course content (Deng & Tavares, 2013). A study of a plethora of over 50 educational technologies showed that online text-based tools were most effective at promoting student engagement in the classroom among the different technologies (Bond et al., 2020b).

While mainly applied to learning and teaching in the remote or virtual environment, especially during the Covid-19 pandemic, online educational tools have been deployed to support class instruction in the traditional (face-to-face) setting with some positive learning outcomes. In an experiment comparing two modes of teaching an in-person educational psychology course, one supported by online discussions through Blackboard and the other one without such support, Szabo and Schwartz (2011) found that the students participating in the two sections that had used online discussions increased their critical thinking skills more than their counterparts in two other sections without the use of the online tool. In a

more recent study of the efficacy of blending online tools into traditional class instruction, Nayar and Koul (2020) used one management course, *Negotiation Skills*, at an Indian university to compare the levels of student engagement and learning in an in-person roleplay simulation coupled with two other different teaching tools: a traditional lecture vs. the use of a massive open online course (MOOC) and flipped classroom. Surveys of the students after the roleplay simulations revealed that those who had used the MOOC and flipped classroom perceived higher levels of classroom participation, enjoyable experience, and improved comprehension of the course material than their counterparts taught with the lecture only. Other studies on the efficacy of blended learning or courses have also confirmed the value of integrating online tools into face-to-face classroom (Hilliard, 2015). One study showed that blended learning promoted more student engagement as well as increasing student retention and classroom capacity and decreasing costs (Center for Digital Education, 2012). In a large-scale of survey of over 600 students in two higher education institutions, 76% of the respondents viewed blended learning more effective than traditional classroom and 73% felt learning from a blended course offered higher learner value or impact than a non-blended one (Boyle et al., 2003). Overall, prior research suggests that integrating online tools into traditional instruction may enhance student involvement in classroom activities, improve the learning environment, and increase learning.

Zoom and classroom participation

As colleges and universities around the world turned to virtual instruction during the peak of the pandemic, a few online videoconferencing and collaboration software such as Zoom, Webex and Microsoft Teams gained popularity in higher education. These new digital tools typically support synchronous audio-video communication and offer a suite of interactive features such as text-based chat, polling, quizzing, emoji response, and breakout room. In addition to supporting online lectures, such functionalities enable teachers to provide more immediate learning, quicker assessments, and more student participation than the traditional classroom instruction lacks (Haleem et al., 2022). Unlike a traditional online learning system like Blackboard, Zoom and its similar apps closely replicate the in-person classroom experience by allowing a student to communicate and interact with the teacher and other students in real time (Mullaney, 2023). In keeping with Bond et al. (2020a, 2020b) who found that digital technologies were most applied to classroom instruction and that online text-based tools were most effective at promoting student engagement in the classroom, the present study explored the potential learning and performance impact of using a key function of Zoom, chat, in the face-to-face classroom. Research on the use of Zoom chat in classroom instruction suggests that this online tool can provide more opportunities for college students to be more involved in class discussions. Mullaney (2023)

argued that by using Zoom chat a teacher can avoid relying on spoken communication to assess a student's classroom participation. Allowing written contributions thus engages students in class discussions and enables them to linger on thoughts that may be bypassed by spoken conversations during an in-person meeting where teachers often feel pressured to rush through the content. Miller (2020) observed some additional benefits from using Zoom chat in a traditional classroom. First, multiple students can speak at the same time without drawing the teacher's attention to any one of them, thus turning the traditional classroom into a space of collective learning. Second, students have better opportunities to provide affirmations of and compliments to each other's contributions in online chat than in person, hence promoting responses that build on one another. Third, a private chat can allow a student to explain a personal reason of being less engaged without sharing it with everyone else in the classroom.

Empirical evidence on the efficacy of Zoom chat in the face-to-face classroom is lacking in the extant literature. There were several studies on Zoom chat use in the virtual classroom, which produced mixed results about the influence of this tool on student participation and learning in the online environment. Goodman and Moore (2023) used the Zoom chat record of 89 students participating in an online lecture of an introductory psychology course at a small liberal arts college in the U.S. to explore the potential impact of the Zoom chat frequency on student learning during the lecture. The learning outcomes were both measured by a comprehension test and student perceptions of learning from the lecture. The study results showed that higher chat frequency increased perceived student learning from the lecture and that a moderate level of chat activities was associated with higher comprehension of the lecture content than no chat or heavy chat activities. It appears from these findings that there might be a limit on the learning benefits derived from frequent Zoom chat usage. In another study, Sørnum et al. (2021) surveyed 200 Norwegian undergraduate students of information technology who had attended online lectures in Zoom. The survey revealed that more students had asked and answered questions in Zoom chat during lectures than through microphone or sound. On the other hand, nearly half of the respondents did not use Zoom chat to ask and answer questions. Serhan (2020) also used student survey data from 31 undergraduate students in a major university in the U.S. to assess students' perceptions of using Zoom and its learning impact in an online class. The results showed that the students had recognized some engagement enhancements from Zoom chat, such as the abilities to ask questions in real time and communicate questions without voicing them publicly or even showing one's face. Despite these advantages, over 60% of the students surveyed did not find the use of Zoom helping them participate in the class or improve their learning. In their study of Zoom use in a class taken by both in-person and online graduate students of teacher education, Wang et al. (2018) asked the online students to reflect on their experience of using Zoom in class activities in two short

papers. The student reflections showed low class participation through Zoom and another challenge - time delays in checking and responding to others' chats among the students and teachers. Overall, the existing empirical research on students' Zoom experience in the online environment provided some evidence for Zoom chat's potential to enhance student classroom participation and learning, while revealing some negative student views of the tool. In view of the observations by Miller (2020) and Mullaney (2023) as well as the evidence from Goodman and Moore's (2023) research based on both perceived and actual learning data, it is possible that more students would embrace this online tool and enjoy higher levels of actual learning and performance from Zoom-enhanced participation in a different (face-to-face) environment. Hence, it is argued in this study that students' use of Zoom chat in in-class discussions and other activities may increase their learning and class performance in a face-to-face class.

In addition to chat, this study investigated another function of Zoom, quizzing, and its impact on student class participation and learning in the face-to-face classroom. Zoom quizzing differs from that in the traditional learning management platforms by allowing a teacher to compose a quiz before, during and even after a class activity such as a lecture, a discussion, or an exercise. Besides enhancing information retention, providing feedback to track and reflect on learning progress and increasing self-regulation in study (Paul, 2015; Pennebaker et al., 2013), quizzing has been shown to motivate students to attend and participate in class activities. As Connor-Greene (2000) noted, students who are quizzed in a course tend to feel more prepared for class meetings and consequently be more inclined to participate in class discussions. In a study of the use of pop quizzes as extra credit in an English for Tourism Studies course, Ennis (2018) found that the quizzes had improved the students' regular attendance, active class participation and overall class performance. Quizzing students during a class session can also ensure they participate in a class activity, especially in the online setting (Darby & Lang, 2019; Gantner & Kimbrel, 2022). In their investigation of the quizzing effect on the video-watching behavior of the graduate students in three post-master courses, Gantner and Kimbrel (2022) found that the students required to take a short and graded quiz at the end of watching a video made by the teacher had viewed more videos and performed better in the quizzes than those who had not had to take a quiz. Even if students in a face-to-face course are allowed to take online quizzes outside a class meeting, they tend to be more engaged in class activities. In a study of the influence of online out-of-class quizzing on student in-class engagement in an undergraduate anatomy class of 24 students, Urtel et al. (2006) observed that the quizzes had increased the total number of questions, especially those reflecting solid understanding and application of the course material, asked by the students during class. The students also answered more questions from the teacher when they were required to take the online quizzes. Two surveys of the students in the study showed that a majority (83%) of the class

felt they had learned the course material better. Applying online quizzes in Blackboard to the face-to-face teaching of an undergraduate auditing class, Mo (2011) found that forty-four students taking twelve out-of-class and in-class quizzes voluntarily in one semester had viewed more course content and interacted more with the teacher in Blackboard than thirty-one students who had not taken those quizzes in another semester. The increased engagement in the course activities had also resulted in higher course grades. In view of the above-mentioned evidence of positive influence of online quizzes on student engagement in class activities, it is reasonable to expect the use of Zoom quizzes in face-to-face instruction to improve student learning and class performance.

Research hypotheses

Based on the above literature review, two hypotheses regarding the Zoom's impact on the overall class performance of students were developed for testing in this study.

Hypothesis 1: Students' use of Zoom chat at a face-to-face class is positively related to their overall class performance.

Hypothesis 2: Students' performance in Zoom quizzes at a face-to-face class is positively related to their overall class performance.

Method

Sample and use of Zoom

The participants in this study were 240 undergraduate business students who took a course of Principles of International Business in person at a northeastern university in the United States between Fall 2021 and Spring 2023. The class size averaged about 30 students. The majority of the students were either seniors (52.9%) or juniors (42.5%) at the typical age ranges (21-22) of traditional full-time undergraduate students in the U.S. The gender split was close to even (49.6% males and 50.4% females). At the beginning of the course, the students were informed of the use of Zoom for class discussions, quizzes and other activities in each class meeting. The students were encouraged to participate in or contribute to in-class discussions and exercises by speaking out and/or texting in Zoom chat their questions, answers, comments, or suggestions. The teacher also made it clear that both forms of communication would count equally towards a student's class participation grade. A mandatory quiz covering the topic(s) discussed in a class meeting was typically administered at the end of the meeting.

Measures of main and control variables

The use of Zoom chat was measured by the frequency at which a student used the function in a class meeting. At the end of each meeting, the teacher reviewed the chat record of the

meeting and awarded a student one point for each relevant text message the student had sent. To be considered as relevant, a text message must be related to something discussed in a meeting, such as a discussion question, an idea learned from a video, or a question about a topic. The total points earned by the students from using Zoom chat for the entire semester ranged from 1 to 56, and the average earned points for the whole sample were 30. A student's oral participation in a class meeting was evaluated based on the teacher's recollection and notes for the meeting. A student earned a point from speaking out a relevant thought. The total points earned by the students from the oral participation during the entire semester ranged from 0 to 26, and the average earned points for the whole sample were about 4. A student's performance in the Zoom quizzes was measured as the total score (in percentage) the student earned in the whole semester.

Overall class performance was measured by the overall grade a student earned for the course, which was based on individual and team assignments (52.5%), exams (25%), quizzes (10%), and class participation (12.5%). The overall course grade thus reflected the student's comprehension of the course material as well as its application in the assignments. To facilitate the statistical analyses, the reported course grades in letters, such as A, A-, B+ or B, were converted into numeric points: A = 4.0, A- = 3.67, B+ = 3.33, B = 3.0. Since the class participation (including the use of Zoom chat and oral participation) and the Zoom quizzes were part of the original course grade, the numeric course grades were further adjusted by subtracting the class participation and quiz grades. In view of some prior research that showed gender differences in academic performance (Haemmerlie & Montgomery, 2012; Tsaoasis & Alghamdi, 2022), gender was used as a co-variate to control its potential effect on the course grade in the statistical analyses. Female was coded as 0 and male as 1. The oral participation score was also included as a control variable due to its influence on student learning (Freire, 2000; Macfarlane, 2014). The means and standard deviations of the main and control variables are presented in Table 1.

Statistical analyses

A correlation analysis was first conducted to test the hypotheses, followed by a hierarchical regression analysis. In the regression models, Zoom chat frequency and quiz score were

Table 1 Means, standard deviations and correlation coefficients^a

Variables	Means	s. d.	1	2	3	4
1. Course grade	3.49	.62				
2. Zoom chat frequency	30.11	9.79	.63			
3. Zoom quiz score	.81	.18	.71	.75		
4. Oral participation	3.86	4.01	.25	.23	.30	
5. Gender	0.50	0.50	-.34	-.28	-.26	-.04

^a N = 240. Correlations greater than or equal to .12 are significant at the .10 level; $r \geq .15$ are significant at the .05 level; $r \geq .21$ are significant at the .01 level; all two-tail tests.

the independent variables and course grade served as the dependent variable. In the first step (Model 1) of the regression analysis, gender and oral participation were entered in the model to separate out their effects on the dependent variable. In the second step (Model 2), the two independent variables (Zoom chat frequency and quiz score) were both added to the model simultaneously.

Results

The bivariate correlations from Table 1 showed that Zoom chat frequency and quiz score were both strongly correlated with course grade ($r = .63$) and ($r = .71$) respectively in the expected directions, providing initial support for both hypotheses. It is worth noting that gender was negatively correlated with Zoom chat frequency ($r = -.28$), Zoom quiz score ($r = -.26$) and course grade ($r = -.34$). It appears that female students tended to fare better than their male counterparts in those three areas. Oral participation was also moderately correlated with Zoom chat frequency ($r = .23$) and course grade ($r = .25$), confirming the need to control the former's effect in the sample.

As depicted in Table 2, the hierarchical regression analysis indicates that adding both independent variables to the regression model increased the explained variance ($\Delta R^2 = .38$). Moreover, Zoom chat frequency was positively related to course grade ($b = .19$) at the .01 significance level. Zoom quiz score was also significantly related to course grade ($b = .52$, $p < .01$) in the expected direction. Hence, the regression results provided further support for both hypotheses. The gender difference in the course grades ($b = -.15$, $p < .01$) was also confirmed in the regression analysis.

Discussion

The current study investigated the use of two Zoom functions, chat and quizzing, in the face-to-face classroom and tested the impact of such use on the overall class performance of college students. The empirical results showed that the students' frequencies in using

Table 2 Hierarchical regression results^a

Variables	Course Grade	
	Model 1	Model 2
Gender	-.33**	-.15**
Oral participation	.24**	.04
Zoom chat frequency		.19**
Zoom quiz score		.52**
R ²	.17	.55
ΔR^2		.38
F	24.76**	72.37**
ΔF		99.42**

^a N = 240. Standardized regression coefficients are shown.

* $p < .10$, ** $p < .05$, *** $p < .01$

Zoom chat and their scores in Zoom quizzes were positively related to their overall class performance. By demonstrating that Zoom-enhanced classroom participation could help students learn more in face-to-face class activities, these findings shed some light on the potential contributions of Zoom to student learning and success in the face-to-face environment. While researchers have previously found some negative effects of Zoom on class participation in the online setting (Serhan, 2020; Sørnum et al., 2021; Wang et al., 2018), the current investigation shows some positive influence of Zoom used in the face-to-face classroom on student learning and class performance. It then appears that Zoom can be an effective tool in augmenting and complementing face-to-face learning. Additional research on Zoom's enhancement of in-person participation of students in the classroom can further increase our confidence of this educational value of Zoom. Since gender was correlated with Zoom chat use and quiz scores as well as overall class performance in this study, future research can also explore the gender differences in Zoom's impact on classroom participation, learning and class performance, hence helping us understand the conditions under which Zoom is effective. In addition, this study assessed the impact of Zoom in terms of actual learning and performance of students rather than their perceptions used in previous studies (Serhan, 2020; Sørnum et al., 2021; Wang et al., 2018). To the extent that perceived learning may differ from actual learning (Anderson & Lawton, 2009), it is advisable for future studies to gather and use more data on actual learning and performance of students to assess the efficacy of Zoom in the face-to-face or online environment.

By showing that text-based participation in in-person class discussions, facilitated by online technology like Zoom, can provide students with more opportunities to engage and learn in the classroom, this study suggests that technology can enable teachers to redefine, facilitate and assess student involvement in the traditional classroom in nonverbal forms, as suggested by Medaille and Usinger (2019) and Mullaney (2023). To further increase student participation in face-to-face class discussions, online quizzes from Zoom and similar platforms can be employed to induce students to better prepare for and participate in a class meeting. Since this technology-assisted engagement strategy requires having two modes of dialogue (in-person and online) and its assessment, teachers may face greater demands in designing and applying such an approach to class instruction. For example, classroom management needs to accommodate written contributions of students while maintaining their interest in speaking up. Another instructional challenge is to track, evaluate and utilize a potentially much larger volume of student inputs to a discussion question, especially with a large class size. Future research on how to best coordinate or combine oral and written communications in face-to-face class meetings would help us better understand how to make the most of Zoom-assisted class discussions.

The present investigation also helps advance the discourse on how to deploy digital technology in higher education. While finding educational technology most frequently used to the enhancement of student engagement in the classroom (Bond et al., 2020b), previous research has focused on the use and impact of traditional online tools such as discussion forums and quizzes in Blackboard (Haleem et al., 2022; Henrie et al., 2015; Mo, 2011; Szabo & Schwartz, 2011). This study empirically demonstrated that further technology enhancement of student classroom participation may come from videoconferencing and collaboration platforms like Zoom and its key functions, chat and quizzing, which can be run more spontaneously and flexibly than the traditional online tools. Other functions in Zoom and similar platforms, such as online polling and breakout room, may offer additional opportunities for increasing student participation in the traditional classroom and thus warrant attention in future research. From the course design perspective, this investigation echoes studies that called for a blended approach to designing and running face-to-face courses through integration of online tools into in-person class interaction to enhance student experience and learning in the face-to-face environment (Hilliard, 2015; Mo, 2011; Nayar & Koul, 2020).

The findings from this study need to be interpreted within its limitations. First, conclusions about the causal relationships between use of Zoom and student class performance could not be drawn due to the cross-sectional nature of the data used in the study. Secondly, the homogeneity of the study sample, highly concentrated in one ethnic group, from a single university may make the study's findings less generalizable to other colleges or universities with more diverse undergraduate student bodies. Additional studies involving students from different ethnic or cultural backgrounds or controlling the influence of personality (e.g., introverts vs. extroverts) are needed to further ascertain the impact of Zoom. Thirdly, since the study was based on the experience of the students in classes of small to medium sizes (around 30 per section), the learning and performance impact of Zoom may be different for large classes (over 100). Thus, future research needs to incorporate or control the potential class size effect. Despite these limitations, this study suggests Zoom's chat and quizzing functions may be of interest to those who teach face-to-face classes and desire to increase student participation in in-class activities.

Conclusions

It appears from the present study that using Zoom chat and quizzes to enhance student classroom participation may increase learning and class performance in the face-to-face environment. These findings contribute to our thinking about how to expand student involvement in the physical classroom beyond verbal contribution and participation. Students' written comments, answers and questions in class discussions should be recognized and facilitated with an online text-based tool such as Zoom chat, especially in

the text-intensive fields of study. Besides assessing and tracking student learning in an in-person meeting, Zoom quizzes can be employed to increase student participation in the classroom. From a broader perspective, this investigation supports calls for more application of online teaching tools to the face-to-face learning environment in higher education.

Abbreviation

MOOC: Massive open online course.

Author's contributions

The author is responsible for the whole manuscript. The author read and approved the final manuscript.

Author's information

Michael Jijin Zhang is a professor of Department of Management, Sacred Heart University, United States.

Funding

Not applicable.

Availability of data and materials

Not applicable.

Declarations

Competing interests

The author declares that he has no competing interests.

Received: 1 March 2024 Accepted: 1 November 2024

Published online: 1 January 2026 (Online First: 3 March 2025)

References

- Akpur, U. (2021). Does class participation predict academic achievement? A mixed-method study. *English Language Teaching Education Journal*, 4(2), 148–160. <https://journal2.uad.ac.id/index.php/eltei/article/view/3551>
- Anderson, P. H., & Lawton, L. (2009). Business simulations and cognitive learning: Developments, desires, and future directions. *Simulation & Gaming*, 40(2), 193–216. <https://doi.org/10.1177/1046878108321624>
- Arnold, N., & Paulus, T. (2010). Using a social networking site for experiential learning: Appropriating, lurking, modeling and community building. *The Internet and Higher Education*, 13(4), 188–196. <https://www.sciencedirect.com/science/article/abs/pii/S1096751610000333>
- Astin, A. W. (1993). *What matters most in college: Four critical years revisited*. Jossey-Bass, San Francisco, CA.
- Astin, A. W. (1999). Student involvement: A development theory for higher education. *Journal of College Student Development*, 40(5), 518–529.
- Axelson, R., & Flick, A. (2010). Defining student engagement. *Change*, 43(1), 38–43. <https://doi.org/10.1080/00091383.2011.533096>
- Ben-Eliyahu, A., Moore, D., Dorph, R., & Schunn, C. D. (2018). Investigating the multidimensionality of engagement: Affective, behavioral and cognitive engagement across science activities and contexts. *Contemporary Educational Psychology*, 53, 87–105. <https://doi.org/10.1016/j.cedpsych.2018.01.002>
- Bolliger, D. U., & Halupa, C. (2018). Online student perceptions of engagement, transactional distance, and outcomes. *Distance Education*, 39(3), 299–316. <https://doi.org/10.1080/01587919.2018.1476845>
- Bond, M., & Bedenlier, S. (2019). Facilitating student engagement through educational technology: Towards a conceptual framework. *Journal of Interactive Media in Education*, 2019(1), 1–14. <https://doi.org/10.5334/jime.528>
- Bond, M., Bedenlier, S., Buntins, K., Kerres, M., & Zawacki-Richter, O. (2020a). Facilitating student engagement in higher education through educational technology: A narrative systematic review in the field of education. *Contemporary Issues in Technology and Teacher Education*, 20(2), 315–368. <https://www.learntechlib.org/primary/p/208718/>
- Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter, O., & Kerres, M. (2020b). Mapping research in student engagement and educational technology in higher education: A systematic evidence map. *International Journal of Educational Technology in Higher Education*, 17(2), 1–30. <https://doi.org/10.1186/s41239-019-0176-8>

- Boyle, T., Bradley, C., Chalk, P., Jones, R., & Pickard, R. (2003). Using blended learning to improve student success rates in learning to program. *Journal of Education Media*, 28(2/3), 165–178. <https://www.tandfonline.com/doi/abs/10.1080/1358165032000153160>
- Center for Digital Education. (2012). *Realizing the full potential of blended learning*. eRepublic. <https://fliphtml5.com/nums/wdli/basic>
- Chi, M. T. (2009). Active-constructive-interactive: A conceptual framework for differentiating learning activities. *Topics in Cognitive Science*, 1, 73–105. <https://doi.org/10.1111/j.1756-8765.2008.01005.x>
- Choi, B., & Rhee, B. (2014). The influences of student engagement, institutional mission, and cooperative learning climate on the generic competency development of Korean undergraduate students. *Higher Education*, 67, 1–18. <https://link.springer.com/article/10.1007/s10734-013-9637-5>
- Christenson, S. L., Reschly, A. L., & Wylie, C. (Eds.). (2012). *Handbook of research on student engagement*. Springer US, Boston, MA.
- Collins, J. (1996). *The quiet child*. Cassell, London, England.
- Connor-Greene, P. A. (2000). Assessing and promoting student learning: Blurring the line between teaching and testing. *Teaching of Psychology*, 27(2), 84–88. https://doi.org/10.1207/S15328023TOP2702_01
- Cross, K. (1999). What do we know about students' learning, and how do we know it? *Innovative Higher Education*, 23, 255–270. <https://doi.org/10.1023/A:1022930922969>
- Cuseo, J. (2012). *Seven universal principles of student success*. <https://www.ucarecdn.com/11da8223-aaaa-49bb-962e-00b39d86da96/>
- Darby, F., & Lang J. M. (2019). *Small teaching online: Applying learning science in online classes*. Josey-Bass.
- Deng, L., & Tavares, N. J. (2013). From Moodle to Facebook: Exploring students' motivation and experiences in online communities. *Computers & Education*, 68, 167–176. <https://doi.org/10.1016/j.compedu.2013.04.028>
- Denovan, A., Dagnall, N., Macaskill, A., & Papageorgiou, K. (2020). Future time perspective, positive emotions and student engagement: A longitudinal study. *Studies in Higher Education*, 45(7), 1533–1546. <https://doi.org/10.1080/03075079.2019.1616168>
- D'Errico, F., Paciello, M., & Cerniglia, L. (2016). When emotions enhance students' engagement in e-learning processes. *Journal of e-Learning and Knowledge Society*, 12(4), 9–23. https://www.je-lks.org/ojs/index.php/Je-LKS_EN/article/view/1144
- Ennis, M. J. (2018). The potential of 'extra credit pop quizzes' in university English language instruction in Italy. *The Electronic Journal for English as a Second Language*, 22(3), 1–21. <https://api.semanticscholar.org/CorpusID:158340749>
- Fassinger, P. A. (1995). Understanding classroom interaction: Students' and professors' contributions to students' silence. *The Journal of Higher Education*, 66(1), 82–96. <https://doi.org/10.2307/2943952>
- Fredricks, J. A., Filsecker, M., & Lawson, M. A. (2016). Student engagement, context and adjustment: Addressing definitional, measurement, and methodological issues. *Learning and Instruction*, 43, 1–4. <https://doi.org/10.1016/j.learninstruc.2016.02.002>
- Freire, P. (2000). *Pedagogy of the oppressed*. Translated by Myra Bergman Ramos. Bloomsbury Academic, New York, NY.
- Friedner, M., Mills, M., & Sanchez, R. (2020). How to teach with text: Platforming down as disability pedagogy. *Avidly, Los Angeles Review of Books*, 2 August. <https://avidly.lareviewofbooks.org/2020/08/02/how-to-teach-with-text-platforming-down-as-disability-pedagogy/>
- Frisby, B. N. (2015). *Effective instructional practice: Facilitating student participation*. https://www.natcom.org/sites/default/files/pages/EIP_Facilitating_Student_Participation.pdf
- Gantner, M. W., & Kimbrel, L. A. (2022). Shaping the engagement of online learners through instructor-made videos with quizzes. *Journal of Educators Online*, 19(1), 3. <https://doi.org/10.9743/JEO.2022.19.1.4>
- Goodman, S., & Moore, E. (2023). To chat or not to chat: Text-based interruptions from peers improve learning confidence in an online lecture environment. *Journal of the Scholarship of Teaching and Learning*, 23(2), 29–56. <https://doi.org/10.14434/josotl.v23i2.33413>
- Gunuc, S., & Kuzu, A. (2014). Factors influencing student engagement and the role of technology in student engagement in higher education: Campus-class- technology theory. *The Turkish Online Journal of Qualitative Inquiry (TOJQI)*, 5(4), 86–113. <https://dergipark.org.tr/en/pub/toiqi/issue/21405/229418>
- Gunuc, S., & Kuzu, A. (2015). Confirmation of campus-class-technology model in student engagement: A path analysis. *Computers in Human Behavior*, 48, 114–125. <http://dx.doi.org/10.1016/j.chb.2015.01.041>
- Gunuc, S., Misirli, O., & Odabasi, F. (2013). Primary school children's communication experiences with twitter: A case study from turkey. *Cyberpsychology, Behavior, and Social Networking*, 16(6), 448–453. <https://doi.org/10.1089/cyber.2012.0343>
- Guo, J., Yang, L., Zhang, J., & Gan, Y. (2022). Academic self-concept, perceptions of the learning environment, engagement, and learning outcomes of university students: relationships and causal ordering. *Higher Education*, 83, 809–828. <https://doi.org/10.1007/s10734-021-00705-8>
- Haemmerlie, F. M., & Montgomery, R. L. (2012). Gender differences in the academic performance and retention of undergraduate engineering majors. *College Student Journal*, 46(1), 40–45. <https://psycnet.apa.org/record/2012-18560-005>

- Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, 3, 275–285. <https://doi.org/10.1016/j.susoc.2022.05.004>
- Hein, S. M. (2012). Positive impacts using POGIL in organic chemistry. *Journal of Chemical Education*, 89(7), 860–864. <https://pubs.acs.org/doi/10.1021/ed100217v>
- Henderson, M., Selwyn, N., & Aston, R. (2015). What works and why? Student perceptions of ‘useful’ digital technology in university teaching and learning. *Studies in Higher Education*, 42(8), 1567–1579. <https://doi.org/10.1080/03075079.2015.1007946>
- Henrie, C. R., Halverson, L. R., & Graham, C. R. (2015). Measuring student engagement in technology-mediated learning: A review. *Computers & Education*, 90, 36–53. <https://doi.org/10.1016/j.compedu.2015.09.005>
- Hilliard, A. T. (2015). Global blended learning practices for teaching and learning leadership and professional development. *Journal of International Education Research*, 11(3), 179–188. <https://doi.org/10.19030/jier.v11i3.9369>
- Kahu, E. R. (2013). Framing student engagement in higher education. *Studies in Higher Education*, 38(5), 758–773. <https://doi.org/10.1080/03075079.2011.598505>
- Ko, J. (2011). College student engagement in Korea. In *Strengthening of excellence in higher education* (pp. 33–50). Korean Council for University Education, Seoul, Korea.
- Ko, J., Park, S., Yu, H., Kim, S., & Kim, D. (2016). The structural relationship between student engagement and learning outcomes in Korea. *Asia-Pacific Educational Researcher*, 25(1), 147–157. <https://doi.org/10.1007/s40299-015-0245-2>
- Kuh, G. D. (2009). What student affairs professionals need to know about student engagement. *Journal of College Student Development*, 50(6), 683–706. <https://doi.org/10.1353/csd.0.0099>
- Kuh, G. D., & O’Donnell, K. (2013). *Ensuring quality and taking high-impact practices to scale*. American Association of Colleges and Universities, Washington, D.C.
- Leach, L. (2016). Enhancing student engagement in one institution. *Journal of Further and Higher Education*, 40(1), 23–47. <https://doi.org/10.1080/0309877X.2013.869565>
- Macfarlane, B. (2014). Speaking up for the introverts. *Times Higher Education*, 25 September, 43–45. https://brucemacfarlane.weebly.com/uploads/8/5/4/1/85415070/introverts_2014.pdf
- Maxwell-Stuart, R., & Huisman, J. (2018). An exploratory study of student engagement at transnational education initiatives: Proactive or apathetic? *International Journal of Educational Management*, 32(2), 298–309. <https://doi.org/10.1108/IJEM-03-2017-0059>
- Medaille, A. (2018). *Quiet students’ experiences with collaborative learning at the postsecondary level*. PhD Dissertation. University of Nevada, Reno, NV.
- Medaille, A., & Usinger, J. (2019). Engaging quiet students in the college classroom. *College Teaching*, 67(2), 130–137. <https://doi.org/10.1080/87567555.2019.1579701>
- Miller, R. (2020). Long live the zoom class chat. *Slate*, 8 October. <https://slate.com/technology/2020/10/long-live-zoom-class-chat-remote-learning.html>
- Mullaney, C. (2023). Reimagining classroom participation in the era of disability justice and Covid-19. *Pedagogy*, 23(1), 51–68. <https://doi.org/10.1215/15314200-10081993>
- Mundelsee, L., & Jurkowski, S. (2021). Think and pair before share: Effects of collaboration on students’ in-class participation. *Learning and Individual Differences*, 88, 1–11. <https://doi.org/10.1016/j.lindif.2021.102015>
- Mo, S. (2011). Evidence on instructional technology and student engagement in an auditing course. *Academy of Educational Leadership Journal*, 15(4), 149–158. <https://api.semanticscholar.org/CorpusID:142812873>
- Nayar, B., & Koul, S. (2020). Blended learning in higher education: A transition to experiential classrooms. *International Journal of Educational Management*, 34(9), 1357–1374. <https://doi.org/10.1108/IJEM-08-2019-0295>
- Paul, A. M. (2015). Researchers find that frequent tests can boost learning. *Scientific American*, 313(2), 54–61. <https://www.scientificamerican.com/article/researchers-find-that-frequent-tests-can-boost-learning/>
- Pennebaker, J. W., Gosling S. D., & Ferrrell J. D. (2013). Daily online testing in large classes: Boosting college performance while reducing achievement gaps. *PLoS ONE*, 8(11), 1–7. <https://doi.org/10.1371/journal.pone.0079774>
- Rau, M. A., Kennedy, K., Oxtoby, L., Bollom, M., & Moore, J. W. (2017). Unpacking ‘active learning’: a combination of flipped classroom and collaboration support is more effective, but collaboration support alone is not. *Journal of Chemical Education*, 94, 1406–1414. <https://doi.org/10.1021/acs.jchemed.7b00240>
- Reda, M. M. (2009). *Between speaking and silence: A study of quiet students*. State University of New York Press, Albany, NY.
- Serhan, D. (2020). Transitioning from face-to-face to remote learning: Students’ attitudes and perceptions of using Zoom during COVID-19 pandemic. *International Journal of Technology in Education and Science*, 4(4), 335–342. <https://doi.org/10.46328/ijtes.v4i4.148>
- Sharma, P., & Tietjen, P. (2016). Examining patterns of participation and meaning making in student blogs: A case study in higher education. *American Journal of Distance Education*, 30 (1), 2–12. <https://doi.org/10.1080/08923647.2016.1119605>
- Shulman, L. S. (2002). Making differences: A table of learning. *Change*, 34(6), 36–45. <https://doi.org/10.1080/00091380209605567>

- Sørnum, H., Raaen, K., & Gonzalez, R. (2021). Can Zoom replace the classroom? Perceptions on digital learning in higher education within IT. In C. Busch, R. Frieß, M. Steinicke & T. Wendler (Eds.), *Proceedings of the 20th European Conference on e-Learning* (pp. 427–434). Academic Conferences International Limited.
<https://doi.org/10.34190/EEL.21.024>
- Szabo, Z., & Schwartz, J. (2011). Learning methods for teacher education: The use of online discussions to improve critical thinking. *Technology, Pedagogy and Education*, 20(1), 79–94.
<https://doi.org/10.1080/1475939X.2010.534866>
- Tsaousis, I., & Alghamdi, M. H. (2022). Examining academic performance across gender differently: Measurement invariance and latent mean differences using bias-corrected bootstrap confidence intervals. *Frontiers in Psychology*, 13, 1–12. <https://doi.org/10.3389/fpsyg.2022.896638>
- Urtel, M. G., Bahamonde, R. E., Mikesky, A. E., Udry, E. M., & Vessely, J. S. (2006). On-line quizzing and its effect on student engagement and academic performance. *Journal of Scholarship of Teaching and Learning*, 6(2), 84–92.
<https://api.semanticscholar.org/CorpusID:145213126>
- Wang, Q., Huang, C., & Quek, C. L. (2018). Students' perspectives on the design and implementation of a blended synchronous learning environment. *Australasian Journal of Educational Technology*, 34(1), 1–13.
<https://doi.org/10.14742/ajet.3404>
- Webber, K. L., Krylow, R. B., & Zhang, Q. (2013). Does involvement really matter? Indicators of college student success and satisfaction. *Journal of College Student Development*, 54(6), 591–611. <https://doi.org/10.1353/csd.2013.0090>
- Wilt, J., & Revelle, W. (2009). Extraversion. In M. R. Leary & R. H. Hoyle (Eds.), *Handbook of individual differences in social behavior* (pp. 27–45). The Guilford Press, New York, NY.
- Yu, H., Ko, J., & Lim, H. (2011). Examining learning experiences influencing on the communication skills and high-order thinking skills. *The Journal of Educational Administration*, 29(4), 319–337.

Publisher's Note

The Asia-Pacific Society for Computers in Education (APSCE) remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Research and Practice in Technology Enhanced Learning (RPTeL)
is an open-access journal and free of publication fee.