

Supporting Learning Online Through Interaction, Collaboration and Engagement

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Abstract: The article discusses three concepts supporting online learning: interaction, collaboration, and engagement. It aims to inform about the similarities and differences of these concepts through definition, description, and discussion of their characteristics in selected instructional activities. Further, the authors identify and discuss how these ideas intersect to provide a meaningful online learning experience. Also, the authors share sample activities demonstrating each concept in action. Finally, the article proposes to address the challenges and issues of using, embedding, or integrating these concepts in the online activities' design, development, and delivery.

Keywords: Collaboration, Engagement, Interaction, Online Learning, Teaching

Introduction

Teaching and learning online have become significant educational experiences in the last decade (Kim & Bonk, 2006; Montelongo, 2019) and during the pandemic (Coman et al., 2020; Lei & So, 2021). The experience of learning online is familiar to those involved in teaching or attending schools in secondary and higher education contexts. Still, it gained attention among younger learners worldwide during the pandemic since face-to-face attendance has been limited or prevented by lockdown decisions due to health and safety reasons (Adedoyin & Soykan, 2020; Hasan & Khan, 2020).

Several issues forced K-12 learners to attend school online, including inadequate teacher preparation (Franks, 2021; VanLone, Panse-Barone, & Long, 2022), restricted skills training, lack of student readiness, limited technology access, and increasing mental health concerns (Freisthler et al., 2021; Garcia & Weiss, 2020). For higher education institutions, the focus and shift to online education stem from the need to increase enrollment and generate other revenue sources (Allen & Seaman, 2008; Schiffman, 2007).

Teaching online means changes in expectations on how the student population engages with educators, peers, content-based resources, and instructional tools (Quezada, Talbot & Quezada-Parker, 2020). Reports state that many online educational experiences ended negatively as one-way delivery, zoom meeting fatigue, boredom and isolation, and feelings of loss and inadequacy (El Mansour & Mupinga, 2007; Jalongo, 2021). Due to the sudden changes caused by the global pandemic, students and teachers found themselves insufficiently prepared for online instruction (Salas-Pilco et al., 2022). Teachers face significant challenges in engaging students in active learning in online environments (Chiu, 2021). Moreover, with the return to a semblance of pre-pandemic teaching practices, more studies point to the criticality of engagement in online learning experiences (Dumford & Miller, 2018; Moore, Trust, Lockee, Bond, & Hodges, 2021). Several existing studies have addressed these issues focusing on active learning strategies, practices, and models that promote student engagement in online learning (e.g., Baepler et al., 2014; Espasa et al., 2022; Koohang et al., 2016). However, the strategies/practices/models alone cannot guarantee effective online instruction. Teachers must understand "why" and "how" the strategies/practices/models are relevant and essential to the corresponding teaching contexts. Therefore, research is needed to contextualize these strategies, practices, and models and outline the critical dimensions to consider that could inform the design and development of practical approaches to online

teaching. The study examined three courses to explore the key dimensions of successful online learning and the characteristics in related instructional activities.

Defining the Concepts

The article defines and discusses three interrelated concepts of interaction (Kuo et al., 2014; Muirhead, 2004), collaboration (Stephens & Roberts, 2017; Tseng et al., 2009), and engagement (Abla & Fraument, 2019) as facilitators of successful teaching and learning activities in online environments. The authors argue that interaction and collaboration as observable behaviors contribute to engaged teaching and learning between and among stakeholders.

Interaction

There are multiple definitions or interpretations of interaction as a concept. The authors operationally define interaction as an action occurring when two or more objects (or individuals) affect one another. The authors see that it is essential to have a two-way effect in interaction as opposed to a one-way or causal effect. In teaching and learning contexts, one can observe the interaction between an individual and an object or between individuals.

Moore (1989) describes three types of interaction observed in an online environment: learner-content, learner-instructor, and learner-learner. First, Moore argued that without learner-content interaction, there is no education "since it is the process of intellectually interacting with content that results in changes in the learner's understanding, perspective, or the cognitive structures of the learner's mind" (p.2). Also, he discussed that interactions with print media as a source of content have recently moved to electronic or technology-based forms.

Moore also identified learner-instructor interaction involving the learner and the individual delivering the content material to develop knowledge and skills. He stated, "the frequency and intensity of the teacher's influence on learners when there is learner-teacher interaction is much greater than when there is only learner-content interaction" (p.3). Finally, Moore described the interaction "between one learner and other learners, alone or in group settings, with or without the real-time presence of an instructor" (p.4). He stated that this type of interaction could be valuable for facilitating learning within a group of individuals.

Collaboration

CORE Education (2022) identifies the concept of collaboration as "working with specific intent, an agreement to a common purpose or goal, and to a common way of achieving" (para 2). Collaborating means working with another person to create a product or produce an output. Activities involving brainstorming, group discussions, consensus building, and problem-solving demonstrate collaboration. Common collaboration skills include efficient communication, purpose-driven, data management, openness, problem management, technology literacy, and humility (Anjos, n.d.; Koh & Lim, 2012; Maushak & Ou, 2007).

Engagement

Abla and Fraument (2019) stated that teachers are demanding and intentional in their expectations of their students and act as providers of nurturing learning environments. Support meant that teachers engage students through interactive activities, exciting content, encouraging feedback, and safe space. The research literature provides multiple definitions of student engagement. A common explanation is the "recognition that school is not merely a place where knowledge is transferred from one generation to the next but is also a place for emotional connections, which can be either negative or positive" (p.1). Further, the types of engagement identified include behavioral, emotional, and cognitive. Abla and Fraument define student engagement as "a condition of emotional, social, and intellectual readiness to learn characterized by curiosity, participation, and the drive to learn more" (p. 2).

Intersection

How are the three concepts related to teaching and learning activities in online environments? After review and deliberations, the authors agreed that a potential relationship exists between interaction, collaboration, and engagement (see Figure 1). The authors argue that exchanges (as interactions) happen while working together based on the definitions and descriptions from the literature. Since interaction involves two or more individuals in a teaching or learning context, then a similar scenario occurs during collaboration. However, those engaged in the exchange may

not have a specific intent or agreement toward an outcome. The interaction could result from an unplanned or casual encounter leading to more talks or discussions.

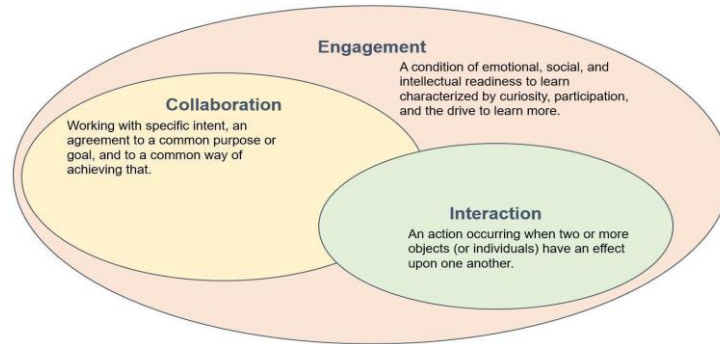


Figure 1. The figure demonstrates the intersection between interaction, collaboration, and engagement concepts.

Strategies for Engagement

The researchers employed three strategies for engagement in the following cases. Case A uses the Delphi Method to assist online graduate students in coming to a consensus on the three most important topics they wish to explore and discuss. Case B employs social annotations to encourage interaction among online graduate students with the text, each other, and their instructor. Case C explores how small group work combined with a hands-on project and an external client can increase engagement in an online course.

Delphi Method

The first strategy highlighted, the Delphi Method, was initially intended to be used outside the classroom. It has increased in popularity since the 1950s as a forecasting tool and by the military. Now, various fields use it, including educational research. Traditionally in the Delphi Method, a researcher uses interactive rounds of questionnaire responses from anonymous experts to develop forecasts or improve understanding of issues (Linstone & Turoff, 1975). Use in a classroom remains a novel approach, with few studies reporting the use of this method in the classroom (e.g., Brummer, 1985; Vieira et al., 2022).

Social Annotations

The second strategy employs social annotations to increase student engagement. Social annotation platforms are educational tools that allow students to annotate and highlight texts or images in a reading on a shared platform (Novak, Razzouk, & Johnson, 2012). Other students can read their fellow students' annotations and reply to or upvote (the equivalent of a social media "like") annotations. When examined in the context of Moore's interaction theory, social annotations can meet three types of interaction. The students interact with the content and by interacting with each other. Depending on the assignment setup, students interact with the instructors by responding to their questions and annotations.

Social annotations demonstrated reading comprehension improvement (Archibald, 2010; Johnson, Archibald, & Tenenbaum, 2010; Kawasaki, Sasaki, Yamaguchi, & Yamaguich, 2008) and time spent on information search (Kawase, Herder, & Nejd, 2009). In addition, reports informed that higher education students demonstrated favorable attitudes toward social annotation tools and activities (Kawase et al., 2009; Mendenhall & Johnson, 2010; Samuel, Kim, & Johnson, 2011). Finally, studies found that the implementation of social annotations activities motivated students (Nokelainen et al., 2005; Samuel, Kim, & Johnson, 2011).

Collaborative learning through small group work

The third strategy employs collaborative learning through group work. Collaborative learning while working in groups in online courses has been shown to increase participation (Kim, 2013), higher levels of knowledge construction (Schellens, Van Keer, & Valcke, 2005), and promote learner engagement and motivation (Bryant & Bates, 2015; Du

et al., 2019). A meta-analysis of the literature found that collaborative learning positively affects knowledge gain and skill acquisition in computer-based learning settings (Chen et al., 2018).

The Current Study

The literature identified numerous studies focused on promoting student interaction, collaboration, and engagement to develop effective online instruction (e.g., Bao, 2020; Mahmood, 2020; Peimani & Kamalipour, 2021). Among the three dimensions, most of the existing studies on online instruction have focused on the dimensions of interaction and collaboration (Vuopala et al., 2016). Nevertheless, the research found that in online environments, student interaction and collaboration often stay at a relatively surface level (Cole et al., 2021; Hou & Wu, 2011; Vuopala et al., 2016). Surface-level interacting cannot guarantee the occurrence of active learning. The level of student engagement with the learning materials is of greater importance to the quality of online learning (Garrison & Anderson, 2003). More research attention, therefore, should be allotted to the connection between interaction/collaboration and the development of student understanding (Vuopala et al., 2016).

Additionally, although previous research has suggested several strategies and models for effective online learning, teachers still need help implementing online instruction (Peimani & Kamalipour, 2021). One of the limitations of these studies is that they need to fully contextualize the teaching and learning experience (McLoughlin & Olive, 2000). Implementing an engaging and meaningful online course is a complex process. Therefore, to help teachers better understand, from a holistic perspective, why and how these strategies could be utilized meaningfully, it is crucial to situate the strategies and models within specific course scenarios.

To address the above gaps, in this article, the authors embedded interaction and collaboration in the dimension of engagement and studied the intersection of the three elements by examining three cases of online courses. All three authors had considerable online teaching experience, varying from thirteen to twenty years. The article's findings were based upon the author's first-hand observation and reflection in the three courses they taught. The insider perspectives could help develop a good case study since the authors have developed a good understanding of the course culture being studied and have established a researcher-participants rapport that promotes "both the telling and the judging of truth" (Bonner & Tolhurst, 2002, p.9). In addition, as insider instructors, the authors had convenient access to class documents and records such as syllabi, assignment instructions, student discussion postings, student artifacts, and student grades (Unluer, 2012). Such resources could serve as a rich database to facilitate the authors' accurate descriptions of the cases. The authors wrote case reports for each course that summarized teaching focus, target learners & contexts, activities & processes, and challenges & lessons. The authors reviewed all the case reports to produce a more accurate description and met to reach a consensus.

Demonstration in Practice

In discussing the concept of interaction, collaboration, and engagement as critical elements in teaching and learning in online environments, the authors reviewed courses they taught, specifically online activities. They identified and described instructional activities that demonstrated at least one of the concepts of international collaboration or engagement. The authors presented and discussed the selected instructional activities as cases.

Case A: Integrating the Delphi Method in Writing a Paper

Focus. Case A focuses on students learning about the issues in the field of instructional technology. The assignment allows the students to explore and acquire knowledge about the area focusing on the problems. In the end, the students write an issue paper.

Context. The instructional activity came from a graduate-level course in an educational specialist program in instructional technology. Students enroll in this course at the beginning of their degree program --- the first semester in the sequence of four classes as part of the core. They are primarily K-12 teachers working full-time and attending a regional comprehensive public university in the Southeastern United States.

Process. For this course, the writing assignment of an issue paper starts with a discussion on what is available and accessible resources contain literature on issues in instructional technology. After reviewing these resources, students identified and posted on five issues as a component of the online discussion activity.

After the discussion, all the issues identified and posted were collated into a list. The instructor asked the students to rank the top twenty issues. Based on the literature reviewed, the students rated the identified instructional technology problems using their perceptions and experiences. The instructor subjected the students' output to a process called the Delphi method--- ranking items as a process towards consensus building (Keeney, Hasson, & McKenna, 2001; Okoli & Pawlowski, 2004). Collating the top twenty issues provided by the students, the instructor initiated a second Delphi survey to identify the top ten. A third and final Delphi survey identified the top-ranked base resulting from the consensus-building exercise. Once the list generates the highly-ranked issues, students choose the top three as the topic of interest. Based on the student's preferences, each one gets assigned a problem to write about.

A draft paper was submitted and assigned for peer review. Each student reviews three draft papers using an instructor-made checklist. Also, they provided qualitative feedback. Students used the feedback to revise their papers for submission.

Case B: Co-Creating New Knowledge through Social Annotations

Focus. Case B is an instructional activity focusing on getting graduate students to read and review digital content and work with peers to co-create new knowledge. The instructor based the activity's design on adult learning principles where students bring their current knowledge and experience in developing new content (Brown & Croft, 2020). The instructor set up the class as a community of inquiry.

Context. The course enrolls graduate students from an instructional technology program and is part of a sequence of courses toward completing an online teaching endorsement. The course is delivered online from a comprehensive regional university in the southeastern United States. Students are primarily in-service teachers from K-12 settings and are employed full-time.

Process. For this activity, students received prompts from the instructor to think about and answer while reading an assigned digital content -- mainly book chapters. In preparing the students for the activity, the instructor includes a low-stakes icebreaker assignment during the first week of the term. Students create an account and practice using *Perusall*, an online social reading platform. The platform also allows the class to purchase textbooks and use them throughout the semester.

The instructor used two approaches to engaging the students. Sometimes, the instructor highlights specific sentences or paragraphs and posts questions. Other times, the instructor presents broad questions for students to select strategies in response and discuss how they would employ them in their online teaching practices. The student's responses to the instructor's questions became annotations to the assigned readings (Kalir, 2020). Once students post their responses to *Perusall*, they must respond to at least two of their classmates' annotations using the reply feature.

Case 3: Designing and Developing Multimedia Solutions

Focus. As an instructional activity, Case C focuses on a small group of graduate students (2-4) working together to complete a multimedia project. Students use various communication tools and team up in small groups, such as emails, phone calls, and video conferencing (e.g., Collaborate Ultra). Specifically, the associated activities include hands-on tasks and a client project.

Context. The activity is part of a graduate-level online course teaching instructional multimedia design and development. In this course, students explore the topics of 3D modeling and printing (Elrod, 2016; Novak & Wisdom, 2018), makerspace (Hanover, 2021), graphics, and digital storytelling (Smeda, Dakich, & Sharda, 2014). The students are primarily in-service K-12 teachers, administrators, or school librarians who bring different expertise, experiences, and backgrounds. To encourage students to learn with peers, they work on projects in small-group and as a whole class.

Process. Given a media topic, students complete a hands-on project. For example, they created a 3D model to use as a learning tool in their classrooms. They also design learning activities to integrate the 3D model or similar 3D modeling processes. After completing the hands-on project, students identify a client with multimedia design and development needs. The clients could be K-12 teachers, school administrators, or school librarians. Students must identify a performance problem in the client's workplace and propose and develop a multimedia solution to address it.

Students use the discussion board to express and share their ideas and thoughts in an asynchronous online format. In discussion activities, the instructor provides guiding questions for students to discuss their experience using multimedia solutions in teaching K-12 subjects as a large group. Individual students review a group submission and provide critical and constructive feedback. Also, they collectively reflect on the class experience.

Framing the Practice

The authors discussed the course activities shared and reflected on how they used the concepts of interaction, collaboration, and engagement. Using Table 1, the authors mapped out how interactive and collaborative actions contributed to student engagement.

Table 1

Observed behaviors during online activities based on definitions and descriptions of the concepts: Interaction, collaboration, and engagement

Concept	Case A	Case B	Case C
Interaction	<p>Student-content interaction happened during the completion of the Delphi survey.</p> <p>Student-student interaction occurs when receiving feedback to draft submission of the paper.</p>	<p>Student-content interaction occurs through the reading of the assigned material.</p> <p>Student-student interaction occurred through annotations of the reading and replies to others' annotations.</p>	<p>Student-content interaction occurred when students worked on the projects (e.g., creating a 3D model, reading course materials, and discussing readings).</p> <p>Student-student interactions occurred in online discussions and peer critique activities.</p>
Collaboration	<p>No collaboration occurred between students.</p>	<p>Collaboration occurred as students made meaning of the text together through annotations and discussion via replies.</p>	<p>Collaboration happened when students worked together as a group to design and develop a multimedia product (e.g., mini projects, client projects)</p>
Engagement	<p>Student engagement with the course content and process resulted from interactions at multiple levels: Delphi survey completion and peer review of draft submissions. The activities allowed students to revise and finalize their issue papers.</p>	<p>Students self-report higher engagement and interaction when using social annotations over traditional discussion boards.</p>	<p>Based upon the ideas generated from interacting with course materials and classmates, students, working with peers, engaged in collectively designing and making multimedia products.</p>

Reflective Practice

The authors shared the challenges and lessons from implementing the selected course activities concerning interaction, collaboration, and engagement.

Challenges

The author of Case A discussed the challenge of time. The Delphi method required multiple survey completion to narrow the list of instructional technology issues for students to choose from. The students needed the luxury of four weeks to do three or four rounds of surveys to whittle down the list to ten.

The implementation of the peer review activity also became a time-related issue (Hsu & Sandford, 2007). Each submitted draft received feedback from other students. A student reviewed at least two, if not three. The author provided a checklist based on the assignment to facilitate a speedy peer review process. The peer reviewer marked

each checklist item if the submission met the expectation of the instruction or not. The peer review process asked the students to provide comments given their marks.

Case B author notes that using a social annotation platform like Perusall or Hypothesis shares the same challenges as traditional learning activities. One must carefully select the readings and develop prompts or questions for the students to respond to.

Additionally, implementing social annotations in a course will require using a different platform than the LMS, which presents challenges. Students will have to learn a new medium, and the instructor will have to spend a little time orienting students to the social annotation platform. The instructor must create a new Perusall class each semester and copy the readings over, and remember to update the due dates in this.

The Case C author noticed that a common challenge students faced in makerspace projects was collaborating and communicating effectively and efficiently in an online environment. Miscommunication happened as students were brought in from different personal backgrounds and disciplines. When the team members were full-time teachers, coordinating schedules became challenging due to teachers' workload, and teachers from other schools may have different school schedules. Furthermore, the author found monitoring, facilitating, and evaluating student involvement in the collaborative design/making processes in an online environment challenging.

Lessons

For Case A, the author learned that the number of students makes the difference in using the Delphi method. In the first semester that the author used the Delphi method, more than twenty students were involved. If each student provides five issues, then the list of topics is substantive. However, the following term enrolled at least ten students. The numbers generated challenges in creating a list of issues and later assigning students as peer reviewers.

Case B author learned that her students strongly preferred social annotation activities to discussion boards, leading the instructor to replace more discussion boards with social annotation activities. Students reported higher engagement, more interaction with the readings, and greater understanding through social annotation. The quality of annotations and responses was also much higher than on traditional discussion boards and more pleasant to grade.

Case C author learned that to trigger effective collaboration and interaction, the self-introduction discussion in the first week is essential. Through this activity, students could get familiar with each other or revisit the discussion postings later in the course to find a potential teammate. Some guiding questions could help students structure their self-introduction. By doing so, students will cover the information that could help connect them to potential teammates.

In addition, the Case C author found that interaction (e.g., online discussion, peer critique) and collaboration (e.g., group projects) activities involved rich opportunities to engage students in reflection and learning. Reviewing students' final examination of the course experience, the author noticed that students appreciated that sharing project ideas and interacting with classmates encouraged them to learn reflectively. After learning about others' projects, students were more likely to revisit and think about improving their work. Moreover, peer support from group projects, peer critique, or online discussion could be an effective strategy to help students navigate new technologies in the making and design processes. Students usually need help exploring a technology tool alone in an online learning environment. Working in a group allowed them to understand the course materials better. Some students who took the course with their colleagues considered the group projects an excellent opportunity to learn from others or about colleagues outside their workplace.

Conclusion

The article considered the three concepts of interaction, collaboration, and engagement essential in online teaching and learning. The authors identified and reviewed online activities for characteristics aligning with the concepts' definitions and descriptions. The initial review provided information on how the students demonstrated interactive and collaborative behaviors in completing the online activities. The authors argue that online behaviors identified as interactions or collaborations promote engagement.

Further, the authors discussed the challenges observed as students interact or collaborate in completing the online activities and shared potential reasons. For example, adult students who usually work full-time face many challenges collaborating in an online learning environment. Given this scenario, the authors suggest that more facilitation is needed to guide and support students' interaction and collaboration so they can actively work with each other and

engage in meaningful collaborative learning. In this process, peer learning opportunities (e.g., peer critique, discussion, and sharing of project ideas) could promote reflective making and design processes.

The authors also shared lessons learned from the review. They thought that providing students access to various collaboration tools and applications (e.g., web conferencing, GoogleDocs, project management program) is essential to support communication and teamwork skills in online environments. While at the same time, the authors thought it would be beneficial to provide clear instructions on the collaboration and interaction aspects of the typical designing and making processes (e.g., identifying problems, designing and making, interpreting and communicating, collecting feedback, testing, revising).

The findings of this article may help facilitate the decision-making in designing and implementing online instruction, especially in the teacher education setting. Diverse literature on online teaching and learning supported the key concepts the authors examined in the case study. They could be used as a generic framework to guide the design, implementation, and assessment of online learning. In addition, since the case study was based on the author's first-hand observation, experience, and reflection in three different online courses in teacher education programs, the case study's findings could apply to the online learning of K-12 teachers in similar contexts.

The return to the pre-pandemic instructional scenario seems unrealistic, or one may have to wait a long time. The authors recommend finding new ways that allow for engaged learning. Based on the information gained from this exploration, they believe in continuing to study how the three concepts relate to each other as the design and development of learning experiences remain toward online delivery.

References

- Abla, C., & Fraument, B. R. (2019). *Student engagement: Evidence-based strategies to boost academic and social-emotional results*. McREL International.
- Adedoyin, O. B., & Soykan, E. (2020). Covid-19 pandemic and online learning: The challenges and opportunities. *Interactive Learning Environments*. DOI: 10.1080/10494820.2020.1813180
- Allen, I. E., & Seaman, J. (2008). *Staying the course: Online education in the United States, 2008*. Sloan Consortium.
- Anjos, A. (n.d.). *Are teamwork and collaboration the same? 9 examples from great companies* [blog]. Nutcache. <https://www.nutcache.com/blog/are-teamwork-and-collaboration-the-same-9-examples-from-great-companies/>
- Archibald, T. N. (2010). *Effect of the Integration of Social Annotation Technology, First Principles of Instruction, and Team-Based Learning on Students' Reading Comprehension, Critical Thinking, and Meta-Cognitive Skills*. <https://diginole.lib.fsu.edu/islandora/object/fsu%3A168354/>
- Baepler, P., Walker, J. D., & Driessen, M. (2014). It's not about seat time: Blending, flipping, and efficiency in active learning classrooms. *Computers & Education*, 78, 227–236. doi:10.1016/j.compedu.2014.06.006
- Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies*, 2(2), 113-115.
- Bonner, A., & Tolhurst, G. (2002). Insider-outsider perspectives of participant observation. *Nurse Researcher*, 9(4), 7-19.
- Brown, M., & Croft, B. (2020). Social annotation and an inclusive praxis for open pedagogy in the college classroom. *Journal of Interactive Media in Education*, 2020(1), 1–8. <https://doi.org/10.5334/jime.561>
- Brummer, J. J. (1985). A Delphi Method of Teaching Applied Philosophy. *Teaching Philosophy*, 8(3), 207–220. <https://doi.org/10.5840/TEACHPHIL19858381>
- Bryant, J., & Bates, A. J. (2015). Creating a Constructivist Online Instructional Environment. *TechTrends*, 59(2). <https://doi.org/10.1007/s11528-015-0834-1>
- Chen, J., Wang, M., Kirschner, P. A., & Tsai, C. C. (2018). The Role of Collaboration, Computer Use, Learning Environments, and Supporting Strategies in CSDL: A Meta-Analysis. *Review of Educational Research*, 88(6), 799–843. <https://doi.org/10.3102/0034654318791584>
- Chiu, T. K. (2021). Student engagement in K-12 online learning amid COVID-19: A qualitative approach from a self-determination theory perspective. *Interactive Learning Environments*, 1-14.
- Cole, A. W., Lennon, L., & Weber, N. L. (2021). Student perceptions of online active learning practices and online learning climate predict online course engagement. *Interactive Learning Environments*, 29(5), 866-880.
- CORE Education. (2022). *Collaboration*. https://core-ed.org/en_NZ/free-resources/ten-trends/2017-ten-trends/collaboration/
- Coman, C., Tiru, L. G., Mesesan-Schmitz, L., Stanciu, C., & Bularca, M. C. (2020). Online teaching and learning in higher education during the Coronavirus pandemic. *Sustainability*, 12, 10367-10391.

- Du, J., Fan, X., Xu, J., Wang, C., Sun, L., & Liu, F. (2019). Predictors for students' self-efficacy in online collaborative groupwork. *Educational Technology Research and Development*, 67(4), 767–791. <https://doi.org/10.1007/S11423-018-9631-9>
- Dumford, A.D., & Miller, A.L. (2018). Online learning in higher education: exploring advantages and disadvantages for engagement. *Journal of Computing in Higher Education*, 30, 452–465. <https://doi.org/10.1007/s12528-018-9179-z>
- El Mansour, B., & Mupinga, D. M. (2007). Students' positive and negative experiences in hybrid and online classes. *College Student Journal*, 41(1).
- Elrod, R. (2016). Tinkering with teachers: The case of 3D printing in the education library. *Education Libraries*, 39(1). <https://educationlibraries.mcgill.ca/article/view/11>
- Espasa, A., Mayordomo, R. M., Guasch, T., & Martinez-Melo, M. (2022). Does the type of feedback channel used in online learning environments matter? Students' perceptions and impact on learning. *Active Learning in Higher Education*, 23(1), 49-63.
- Freisthler, B., et al. (2021). Understanding at-the-moment stress for parents during COVID-19 stay-at-home restrictions. *Social Science & Medicine*, 279, 1-8.
- Franks, B. A. (2021). Introduction: Education and teacher preparation during the COVID-19 pandemic: Coping, adaptation, and innovation. *Journal of Curriculum, Teaching, Learning and Leadership in Education*, 6(1), 1-5.
- Garcia, E., & Weiss, E. (2020). *COVID-19 and student performance, equity, and U.S. education policy: Lessons from pre-pandemic research to inform relief, recovery, and rebuilding*. Economic Policy Institute. <https://files.epi.org/pdf/205622.pdf>
- Garrison, D. R., & Anderson, T. (2003). *E-Learning in the 21st century: A framework for research and practice*. London: Routledge/Falmer.
- Hanover Research. (2021). *Impacts of makerspaces on student engagement*. Research Priority Brief. <https://static1.squarespace.com/static/603d46f0dde1340721c06c86/t/622f9dc4f3037e780eea68c2/1647287748745/Impact+of+Makerspaces+on+Student+Engagement.pdf>
- Hasan, N., & Khan, N. H. (2020). Online teaching-learning during COVID-19 pandemic: Students' perspective. *The Online Journal of Distance Education and e-Learning*, 8(4), 202-213.
- Hou, H. T., & Wu, S. Y. (2011). Analyzing the social knowledge construction behavioral patterns of an online synchronous collaborative discussion instructional activity using an instant messaging tool: A case study. *Computers & Education*, 57(2), 1459-1468.
- Hsu, C.-C., & Sandford, B. A. (2007). The Delphi technique: Making sense of consensus. *Practical Assessment, Research, and Evaluation*, 12(10), 1-7.
- Jalongo, M. R. (2021). The effects of COVID-19 on early childhood education and care: Research and resources for children, families, teachers, and teacher educators. *Early Childhood Educational Journal*, 49, 763-774.
- Johnson, T. E., Archibald, T. N., & Tenenbaum, G. (2010). Individual and team annotation effects on students' reading comprehension, critical thinking, and meta-cognitive skills. *Computers in Human Behavior*, 26(6). <https://doi.org/10.1016/j.chb.2010.05.014>
- Kalir, J. H. (2020). Social annotation enabling collaboration for open learning. *Distance Education*, 41(2), 245–260. <https://doi.org/10.1080/01587919.2020.1757413>
- Kawasaki, Y., Sasaki, H., Yamaguchi, H., & Yamaguchi, Y. (2008). Effectiveness of Highlighting as a Prompt in Text Reading on a Computer Monitor. *WSEAS International Conference on Multimedia Systems and Signal Processing*.
- Kawase, R., Herder, E., & Nejd, W. (2009). A comparison of paper-based and online annotations in the workplace. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 5794 LNCS, 240–253. https://doi.org/10.1007/978-3-642-04636-0_23/COVER
- Keeney, S., Hasson, F., & McKenna, H. P. (2001). A critical review of the Delphi Technique as a research methodology for nursing. *International Journal of Nursing Studies*, 38, 195-200.
- Kim, K.-J., & Bonk, C. J. (2006). The future of online teaching and learning in higher education: The survey says.... *EDUCAUSE Quarterly*, 29(4), 22-30.
- Kim, M. S. (2013). Technology-Mediated Collaborative Learning Environments for Young Culturally and Linguistically Diverse Children: Vygotsky Revisited. <https://doi.org/10.1080/00071005.2012.745480>, 61(2), 221–246. <https://doi.org/10.1080/00071005.2012.745480>
- Koh, E., & Lim, J. (2012). Using online collaboration applications for group assignments: The interplay between design and human characteristics. *Computers & Education*, 59(2), 481-496.
- Koohang, A., Paliszkiwicz, J., Goluchowski, J., & Nord, J. H. (2016). Active learning for knowledge construction in e-learning: A replication study. *Journal of Computer Information Systems*, 56(3), 238-243.
- Kuo, Y.-C., Walker, A. E., Schroder, K. E. E., & Belland, B. R. (2014). Interaction, internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *The Internet and Higher Education*, 20, 35-50

- Lei, S. I., & So, A. S. I. (2021) Online teaching and learning experiences during the COVID-19 pandemic – A comparison of teacher and student perceptions. *Journal of Hospitality & Tourism Education*, 33(3), 148-162. DOI: 10.1080/10963758.2021.1907196
- Linstone H.A. & Turoff M. (1975) *The Delphi Method. Techniques and Applications*. Addison-Wesley, Reading, Massachusetts.
- Mahmood, S. (2021). Instructional strategies for online teaching in COVID-19 pandemic. *Human Behavior and Emerging Technologies*, 3(1), 199-203.
- Maushak, N. J., & Ou, C. (2007). Using synchronous communication to facilitate graduate students' online collaboration. *Quarterly Review of Distance Education*, 8(2), 161-169, 189.
- McLoughlin, C., & Oliver, R. (2000). Designing learning environments for cultural inclusivity: A case study of indigenous online learning at tertiary level. *Australasian Journal of Educational Technology*, 16(1).
- Mendenhall, A., & Johnson, T. E. (2010). Fostering the development of critical thinking skills, and reading comprehension of undergraduates using a Web 2.0 tool coupled with a learning system. *Interactive Learning Environments*, 18(3). <https://doi.org/10.1080/10494820.2010.500537>
- Montelongo, R. (2019). Less than/more than: Issues associated with high-impact online teaching and learning. *Administrative Issues Journal: Connecting Education, Practice, and Research*, 9(1), 68-79. DOI: 10.5929/9.9.1.5.
- Moore, M. G. (1989) Editorial: Three types of interaction. *American Journal of Distance Education*, 3(2), 1-7.
- Moore, S., Trust, T., Lockee, B., Bond, A., & Hodges, C. (2021). One year later ... and counting: Reflections on emergency remote teaching and online learning. *EDUCAUSE Review*. <https://vtechworks.lib.vt.edu/handle/10919/107501>
- Muirhead, B. (2004). Encouraging interaction in online classes. *International Journal of Instructional Technology and Distance Learning*, 1(6), 45-50. <http://www.itdl.org/DistEdReader.pdf#page=82>
- Nokelainen, P., Miettinen, M., Kurhila, J., Floréen, P., & Tirri, H. (2005). A shared document-based annotation tool to support learner-centered collaborative learning. *British Journal of Educational Technology*, 36(5), 757-770. <https://doi.org/10.1111/J.1467-8535.2005.00474.X>
- Novak, E., Razzouk, R., & Johnson, T. E. (2012). The educational use of social annotation tools in higher education: A literature review. *Internet and Higher Education*, 15(1). <https://doi.org/10.1016/j.iheduc.2011.09.002>
- Novak, E., & Wisdom, S. (2018). Effects of 3D printing project-based learning on preservice elementary teachers' science attitudes, science content knowledge, and anxiety about teaching science. *Journal of Science Education and Technology*, 27(5), 412-432.
- Okoli, C., & Pawlowski, S. D. (2004). The Delphi method as a research tool: An example, design considerations and applications. *Information & Management*, 42(1), 15-29.
- Peimani, N., & Kamalipour, H. (2021). Online education and the COVID-19 outbreak: A case study of online teaching during lockdown. *Education Sciences*, 11(72), 1-16.
- Quezada, R. L., Talbot, C., & Quezada-Parker K. B. (2020). From bricks and mortar to remote teaching: A teacher education program's response to COVID-19. *Journal of Education for Teaching*, 46(4), 472-483. <https://doi.org/10.1080/02607476.2020.1801330>
- Salas-Pilco, S. Z., Yang, Y., & Zhang, Z. (2022). Student engagement in online learning in Latin American higher education during the COVID-19 pandemic: A systematic review. *British Journal of Educational Technology*, 53(3), 593-619.
- Samuel, R. D., Kim, C. M., & Johnson, T. E. (2011). A study of a social annotation modeling learning system. *Journal of Educational Computing Research*, 45(1). <https://doi.org/10.2190/EC.45.1.f>
- Schellens, T., van Keer, H., & Valcke, M. (2005). The impact of role assignment on knowledge construction in asynchronous discussion groups: A multilevel analysis. In *Small Group Research* (Vol. 36, Issue 6). <https://doi.org/10.1177/1046496405281771>
- Schiffman, S., Vignare, K., & Geith, C. (2007). Why do higher-education institutions pursue online education? *Studies*, 4, 5.
- Smeda, N., Dakich, E., & Sharda, N. (2014). The effectiveness of digital storytelling in the classrooms: A comprehensive study. *Smart Learning Environments*, 6. <https://doi.org/10.1186/s40561-014-0006-3>
- Stephens, G. E., & Roberts, K. L. (2017). Facilitating collaboration in online groups. *Journal of Educator Online*, 14(1).

- Tseng, H., Wang, C., Ku, H., & Sun, L. (2009). Key factors in online collaboration and their relationship to teamwork satisfaction. *Quarterly Review of Distance Education*, 10(2), 195-206.
- Unluer, S. (2012). Being an insider researcher while conducting case study research. *Qualitative Report*, 17 (58), 1-14.
- VanLone, J., Panse-Barone, C., & Long, K. (2022). Teacher preparation and the COVID-19 disruption: Understanding the impact and implications for novice teachers. *International Journal of Educational Research Open*. <https://doi.org/10.1016/j.ijedro.2021.100120>
- Vieira, A. C. L., Vidal, M., Menassol, J.-B., Mateus, T. L., Santos, A. S., Durieux, J.-P., & Oliveira, M. D. (2022). ANIPHI: An innovative pedagogical platform based on the Delphi method to support animal welfare teaching. *PLOS ONE*, 17(11), e0277189. <https://doi.org/10.1371/JOURNAL.PONE.0277189>
- Vuopala, E., Hyvönen, P., & Järvelä, S. (2016). Interaction forms in successful collaborative learning in virtual learning environments. *Active Learning in Higher Education*, 17(1), 25-38.