Annotated Peer Bibliography, David Arendale, Publications deals with study group sessions online, 70 citations, revised May 17, 2023

Alberte, J. L., Cruz, A., Rodriguez, N., & Pitzer, T. (2012). *PLTL in pajamas: Lessons learned.* Conference Proceedings of the Peer-led Team Learning International Society Inaugural Conference, Brooklyn, NY. www.pltlis.org/wp-content/uploads/2012%20Proceedings/Alberte-2012.docx

Peer-Led Team Learning (PLTL) in the Biology Department at Florida International University (FIU) incorporates the use of "cyber" learning (cPLTL). Using laptops and cameras, students and Peer Leaders communicate in real time, fulfilling the requirements of the standard model of PLTL. Participants are trained in the use of required software and technology. Initial observations indicate that students perform at least as well in cPLTL as in traditional workshops. Students who cannot or will not attend in-person PLTL workshops are able to take advantage of the boost. FIU is successfully moving toward cPLTL institutionalization alongside the in-person model. Real-time, interactive participation is a cornerstone of PLTL. In cPLTL, this is facilitated through the use of webcams, headsets with microphones, and personal document cameras. Students can borrow these materials directly from the PLTL office if they do not personally own the materials. There are no additional costs incurred for the students. Most students already have webcams and microphones. Even though many computers and webcams have built-in microphones, it is best to use a microphone that is directly attached to a headset, in order to reduce feedback, background noise, and the "echoing effect." To facilitate the real-time sharing of student work, personal document cameras are used. This is particularly important when the learning objectives of the workshop module include the understanding of mathematics or the manipulation of chemical equations. (Using the document cameras is extremely beneficial, but it is not an absolute requirement in order to have a successful cPLTL workshop.) The iPEVO P2V USB personal document cameras were used at IUPUI and FIU (Mauser et al., 2011). We recommend the establishment of a stable in-person PLTL program before attempting to develop a cyber PLTL program. Any program attempting to implement PLTL for the first time faces a number of pragmatic and pedagogical issues that will only be confounded if attempting to implement a cyber-based system(solely or concurrently). Once established it would be far easier to maneuver the technological landscape of cPLTL. During initial implementation of cPLTL, experienced PLs are used to conduct the cyber workshops. These PLs were chosen because of their experience and ability to properly conduct a workshop. This allowed the staff to focus more on technological issues. Starting with only a handful of PLs and PLTL sections is important in learning how to manage, structure, and build a PLTL program.

Alcocer, M., falabella, L., Lange, A., Smith, N., & Feeley, M. (2023). Supplemental online resources improve political methods education. *Political Science Education and the Profession*. doi: https://doi.org/10.33774/apsa-2023-5l9fg.

Mastery of knowledge and skills taught in introductory research methods courses is increasingly important for undergraduate political science majors, yet many students struggle in these courses. Online Supplemental Instruction (OSI) may offer a time- and cost-efficient means of supporting these students. However, we know little about the efficacy of these resources in general, or specifically in political methods education. This paper introduces an original OSI resource, "Foundations of Quantitative Research in Political Science," which includes content on key concepts and application of statistical methods to political problems. Utilizing a pre-registered within-subject experimental design, we find that access to this resource significantly improves student learning. To our knowledge, this study is the first to estimate the causal effects of OSI in political science, and specifically in a political methods course. Moreover, the research design is easily replicated, fair, controls for student-specific characteristics, and generates a large number of observations.

Alden, E. (2018). The changing role of Supplemental Instruction in the digital age *Communicating chemistry through social media* (pp. 139-150): ACM Publications

Supplemental Instruction (SI) was first implemented in 1973 at the University of Missouri-Kansas City. The program began as simple peer assisted study sessions lead by former students who had succeeded in historically difficult courses. Over the course of three years we have observed the evolution of the SI model at Central New Mexico Community College through the integration of the SI leader into non-traditional, flipped classrooms, as well as in the online classroom. Through the use of social media platforms and applications the SI session can now take place virtually anywhere. The SI model has come a long way from improving student retention and success and can now promote group collaboration, improve study skills, and encourage thinking beyond just problem solving. We propose a two-semester model that would allow students to successfully complete the general chemistry series in a hybrid learning environment with retention and success rates comparable to that of an in-person chemistry course.

Amka;o, T. a., Murphy, C., & Hakim, T. (2022). Sustaining STEM student learning support and engagement during COVID-19. *Community College Journal of Research and Practice, 46*(1-2). doi:

https://doi.org/10.1080/10668926.2021.1973612.
https://www.tandfonline.com/doi/epdf/10.1080/10668926.2021.1973612?needAccess=true&role=button.
This paper examined how an HSI-STEM grant project at one such college responded, confronting challenges of the transition to an all-online environment head-on and tapping its unexpected benefits. With a focus on STEM student services and programs, two aspects of the situation are analyzed and studied. Facilitating Innovation: STEM administrators had to think outside the box and employ extra effort to continue providing support services such as Supplemental Instruction and Counseling Services to ensure success for their students. We attempt below to identify key issues and obstacles met along the way and how they were addressed: How did peer Supplemental Instruction (SI) Leaders, trained for a classroom setting, modify their approach and engage students through virtual-classroom-supplemented instruction? How did academic counselors incorporate non-verbal communication and document-sharing in their outreach and interaction with their students? How did faculty and staff guide two-year-long student research projects during the pandemic? What sort of challenges did they face and how were they overcome? Looking Ahead and Moving Forward: What started as a shocked reaction in the face of a dizzying crisis had to be transformed, and urgently, into an effective, necessity-dictated response in service of continued STEM teaching-and-learning advancement. Some of the changes adopted through the pandemic may now be pleasantly irreversible. What impact did access to, and experience with, online educational technology has on existing learning processes and support systems? How effective these efforts were? What are the long-lasting effects of implemented change on traditional ways of doing business?

Arendale, D. R. (2020). Lessons learned in 2020 about postsecondary online peer assisted learning (PAL) groups from previous research publications and recent survey of PAL program administrators: University of Minnesota-Twin Cities.www.doi.org/10.13140/RG.2.2.28551.62881
This publication identifies lessons learned from moving traditional face-to-face peer study groups to online operation. Two sources were consulted. First, previous publications concerning online peer study groups were studied to identify approaches, equipment and software used, and reports of effectiveness. Second, during May 2020 administrators involved with managing peer assisted learning (PAL) programs were invited to complete an online survey concerning their experiences with operating online in response to the Covid-19 pandemic. Just to be clear, this report does not advocate that all the items within it need to be implemented to have a quality online program. Just because a listed item is only referenced by one publication or survey respondent, that does not make it less valuable than items listed by numerous publications and survey respondents. It is the wise discernment by individual PAL program directors of which items are relevant and fit the cultural and institutional context and availability of time and resources for their program. Think of this report as an education practice buffet with a wide range of choices.

Arendale, D. R. (2020). Lessons learned in 2020 from taking postsecondary peer assisted learning programs online: Raw survey data: University of Minnesota-Twin Cities. www.doi.org/10.13140/RG.2.2.15129.85609
In early May 2020, invitations to complete a brief survey on postsecondary peer-assisted learning (PAL) programs and their operation online in response to Covid-19 were posted to several national and international email listservs. Directors from 45 programs completed the survey. Since the survey was anonymous, it is impossible to know the institutional type and their locations. It is a reasonable guess that most respondents were from the U.S. with others from Australasia, Europe, and North America. As promised, the survey results are presented as they were received without data analysis. It is with deep gratitude to the program directors for taking time from the busiest time in the academic term in the middle of this pandemic to share valuable information with our world community of PAL professionals. Their comments were candid and honest about the things that went well and those that did not. Considering that the move to online was accomplished without warning, no time for preparation, and under incredible stress, I marvel at what was done all things considered.

Arendale, D. R. (2020). Postsecondary peer assisted learning programs offered online: 2020 annotated bibliography: University of Minnesota-Twin Cities. www.doi.org/10.13140/RG.2.2.18485.29928
This topical annotated bibliography is drawn from a larger database of peer-assisted learning (PAL) programs available at https://www.arendale.org/peer-learning-bib Major national and international models in the bibliography of nearly 1600 citations are: (a) Accelerated Learning Groups (ALGs), (b) Emerging Scholars Program (ESP), (c) Peer Assisted Learning (PAL), (d) Peer-Led Team Learning (PLTL), (e) Structured Learning Assistance (SLA), (f) Supplemental Instruction (SI), and (g) Video-based Supplemental Instruction (VSI). Some programs are also known by other names such as PASS for the SI Program. Check back throughout the year since the database is frequently updated. Only two of these models provided research studies or implementation information for providing their program online: Peer-Led Team Learning (also known as cPLTL or Cyber PLTL), and Supplemental Instruction/PAL/PASS (also known as iPASS, OPAL, OPASS, and OSI). These publications provide examples from North America, Europe, and Australasia.

When available, a weblink is provided so that they can be downloaded.

Avena, J., Sabella, M. S., Barker, A., Hendrickson, S. M., Langdon, L., Van Duzor, A. G., & Otero, V. K. (2020). Leveraging the experience and expertise of Learning Assistants in remote learning spaces. *APS Forum on Education Newsletter* (Summer), 5-26. https://engage.aps.org/fed/resources/newsletters/newsletter-archive/summer-2020#Leveraging.

As classes quickly moved online during Spring 2020, students, staff, and faculty in all types of institutions, at all levels, found themselves adapting to novel online learning spaces. Those who incorporate active learning in their classes, encourage group work, and promote conceptual sense making to engage communities of learners needed to be reflective, thoughtful, and creative in constructing these new spaces. The Learning Assistant Alliance (LAA) recognized that undergraduate Learning Assistants (LAs) were immediately providing crucial support for faculty and students in these new spaces, and leveraged its Alliance member expertise to develop a set of resources to assist in LA supported classes (https://sites.google.com/view/laa-elearning/).

Beaumont, T. J., Mannion, A., P, & Shen, B. O. (2012). From the campus to the cloud: The online Peer Assisted Learning Scheme. *Journal of Peer Learning, 5*(1), 1-15. www.files.eric.ed.gov/fulltext/EJ1154814.pdf.

This paper reports on an online version of Peer Assisted Study Sessions (PASS), also known as Supplemental Instruction (SI), which was tested in two subjects in the University of Melbourne in 2011. The program, named the Online Peer Assisted Learning (OPAL) scheme, was implemented with the aims of extending the benefits of a successful peer learning program to students other than those who attend face-to-face sessions and contributing to scholarship on the viability of online peer learning with reference to student interest, leader and participant perspectives, and the suitability of synchronous communication platforms. Qualitative research led to mixed findings. Although OPAL was considered to be a viable online peer learning program by leaders and participants, multiple challenges were encountered. With reference to literature on related initiatives and the use of synchronous online learning platforms in higher education, this paper provides an account of the establishment and progress of the initiative, before presenting an analysis of its strengths and weaknesses and a series of recommendations for researchers and practitioners who are interested in online adaptations of face-to-face peer learning programs. A number of platforms were considered by the project leaders, including Google Docs, DimDim, Open Meetings, Sakai, Adobe Connect, Elluminate, and Wimba. Research into the programs was conducted by means of inquiries, software research and trials, and reviews of literature on the use of synchronous platforms in higher education (Huijser & Kimmins, 2006; Huijser, Kimmins & Evans, 2008; Park & Bonk, 2007a; Park & Bonk, 2007b; Karabulut & Correia, 2008). Based on our analysis, we found Google Docs did not offer sufficient functionality on its own, and we envisaged difficulties in managing security and log-ins. DimDim had been bought out by Salesforce and was no longer taking new registrations. Open Meetings and Sakai were open source offerings that needed to be hosted locally and would have required more investment and preparation to deliver than a small scale trial could justify. This left three strong options with similar functionality: Elluminate, Adobe Connect and Wimba. All platforms offer break-out rooms, video, voice and chat functions together with whiteboards and the ability to upload documents. Further investigation revealed that the University of Melbourne had current licences for Adobe Connect which played a role in its selection as the platform we would use. The only significant variation between the training of the OPAL leaders and the PASS leaders was that the OPAL leaders were given training in use of Adobe Connect for OPAL over the last half-day of the two-day training. In this separate session, they practised using the software and role-played sessions using the platform. Additionally, OPAL leaders received a two hour ‘refresher’ and practice session just before semester began. During semester, leaders were provided with a range of support materials. These included the FBE PASS handbook, a simple guide to Adobe Connect, a guide for tutoring using Adobe Connect, and Adobe Connect trouble-shooting materials. In addition to the provision of these materials, the FBE OPAL leaders met with a PASS supervisor every week until Week Five of semester when it was determined that meeting every two to three weeks would be sufficient. In Engineering, OPAL and PASS leaders met their PASS supervisor every teaching week of semester as both programs were new. OPAL leaders of both faculties were supported to discuss their experiences with each other and exchange anecdotes, concerns and tips in the face-to-face meetings. Leaders were also emailed on a weekly basis to elicit their support needs and significant experiences. All leaders reported that material took longer to address in OPAL than in PASS. While this could be partly related to software lag and connection difficulties, reduced progress was also experienced when these problems were minimal and groups were small. One participant noted that if a question was posed in PASS, students could readily indicate when they had an answer, while in OPAL students often waited to see other responses, particularly when those responses were required as text. The general lack of visual clues available in this online environment caused by the participants’ invisibility to OPAL leaders is also likely to have contributed to this overall delay. Additionally, or perhaps as a result of this, participants reported that OPAL sessions often ran over time. Other studies have

noted similar issues in relation to the pace at which content can be addressed.

Beckmann, E. A., & Kilby, P. (2008). On-line, off-campus but in the flow: Learning from peers in developmental studies. *Australasian Journal of Peer Learning, 1*, 61-69. www.ro.uow.edu.au/ajpl/vol1/iss1/8.

At the Australian National University, peer learning is a key for improved student learning outcomes for those enrolled in the Master of Applied Anthropology and Participatory Development (MAAPD) program .Online discussions support peer learning and provided opportunities for more shared engagement in critical thinking about issues of concern raised through the courses. An online collaboration learning environment called Alliance was employed to provide a more full collaborative learning environment. Using best principles from the Peer Assisted Learning Strategies (PALS) program that used traditional face-to-face student discussions, Alliance employed a variety of learning tools for online collaboration. Threaded discussions were a key element for developing meaningful online learning. It was critical to form students into smaller work teams that had more accountability regarding their continuous participation. These discussions needed structure and also an assigned facilitator to help guide the discussion and prompt participation, much in the same way as the student facilitator was key for the face-to-face PALS sessions.

Berg, L., & Lindgren, C. (2021). Technology and education: The attitudes of distance students towards Supplemental Instruction online. In A. Strømmen-Bakhtiar, R. Helde & E. Suzen (Eds.), *Supplemental Instruction: Organisation and leadership, volume 3* (pp. 101-118). Munster and New York: Waxmann.www.www.waxmann.com/index.php?eID=download&buchnr=4326.

Students taking net-based courses often find themselves somewhat isolated (Lehman & Conceição, 2013) from both their peers and their instructors. This can explain why they may not complete a course or not perform as well as expected. Supplemental Instruction (SI), initially set up to help struggling university students, is now a well-known system of student-led group work (Dawson, van der Meer, Skalicky, & Cowley, 2014,) that is a potential method for dealing with online students' feelings of isolation and enabling them to achieve the same positive results as campus-based students (Hizer, Schultz, & Bray, 2017). This chapter analyses students' attitudes towards SI online. The chapter begins by outlining the similarities between so-called high-risk courses and distance courses. It then discusses students' attitudes towards SI in an online setting, based on a survey of online language students. The chapter concludes with suggestions on how to adapt SI for an online setting, considering the possibilities and restrictions imposed by virtual meetings.

Carter-Hanson, C., & Gadbury-Amyot, C. (2016). Implementing Supplemental Instruction online to create success in high-stakes coursework for pre-doctoral dental students. *Supplemental Instruction Journal, 2*(1), 53-75. www.info.umkc.edu/si/wp-content/uploads/2016/09/siJ-Volume-Two-Issue-One.pdf.

There is a critical shortage of culturally diverse dental practitioners in the United States. In addition, many underrepresented minority (URM) and disadvantaged students have difficulty with the course material needed to pursue a dental degree. One strategy for helping students achieve higher grades and persist in difficult course work is the implementation of Supplemental Instruction (SI). The purpose of this study was to describe the outcomes of using SI online for the first time as part of the University of Missouri-Kansas City, School of Dentistry's (UMKC-SOD) Admissions Enhancement Program (AEP). The AEP program was designed to provide URM and disadvantaged pre-dental students with increased academic skills training in Biology, Chemistry, Organic Chemistry, and Math via online modules. Students met with their SI Leader three times per week at a specified time in a synchronous format to review course material, problem solve, and work collaboratively with fellow classmates. Twelve URM and disadvantaged students participated in the AEP from 2011 to 2014 for a total of 48. Success in the AEP was measured by an increase the student's Dental Admission Test (DAT) score and admission to dental school. At the end of each year's program, students completed a survey regarding all aspects of the AEP. The study found that AEP students who were admitted to dental school had a significantly higher DAT score than those students who were not admitted. Students also reported that the required time for SI sessions and test taking instruction helped them prepare for the DAT. Over 72% of students responded favorably that SI contributed to their success in the AEP and to taking the DAT. Students reported that attending the SI sessions helped them work through problems in the course material. This study found evidence that SI is a viable strategy for helping URM and disadvantaged students be successful in high stakes courses needed to move forward and pursue health profession degrees. SI sessions were conducted using Blackboard Collaborate, a synchronous two-way audio-video platform allowing online users to "meet" in real time. Prior to starting the online modules, students and SI Leaders completed an online training session for navigating the Blackboard Collaborate interface. Upon completion of the training sessions, students were given access to the module material 24/7.

Coulson, E. J. A., & Grimaldi, A. (2022). Lessons learned in virtual Supplemental Instruction: Enhanced engagement to support FSG leader transformation. 358-369. www.scholar.google.com/scholar_url?url=www.members.aect.org/pdf/Proceedings/proceedings21/2021i/21_

09.pdf&hl=en&sa=X&d=15274990898976659952&ei=QZcNYpXZCYTyyATDt5X4BQ&scisig=AAGBfm3EI5InbwY1jejuxhcaA3gOdtJufg&oi=scholaralrt&html=&pos=0&folt=kw.

This paper explores virtual teaching and learning innovations in Facilitated Study Group (FSGs) delivery at the University of Toronto Mississauga (UTM). To increase access and representation in an already successful in-person Supplemental Instruction (SI) program, we seized the opportunity during the COVID-19 pandemic to create new alternatives by introducing Virtual Facilitated Study Groups (VFSGs). We have since introduced hyflex options in peer-led programs that include a combination of both face-to-face (F2F) and online SI Instruction. With new format options in our program, we recognized the need to re-examine and reflect on the metrics used for measuring outcomes and impact. Supported by the Institute for the Study of University Pedagogy at UTM where SI is administered, a "virtual cineplex" FSG platform was developed to offer a unique and efficient access point for students to network, congregate, and self-select new variations and opportunities in FSG programming. Prior to the pandemic, a specialized 12-week undergraduate experiential academic course, EDS325: Supplemental Instruction in Higher Education, had already been introduced to enrich and deepen the training of FSG leaders (FSGLs). The course is experiential in nature and requires a 100 hour internship in FSG instruction. This one-of-a-kind for-credit course engages FSLs in SI theory and scholarship while supporting postgraduate outcomes with a focus on transferable leadership skills and professional learning. In the winter of 2020, EDS325 made its debut as an online course and is now offered in both virtual and in-person formats. This paper tells the story of several lessons learned in hyfex program expansion as we reimagine the multimodal and multiplatform future of SI.

Crowley-Cyr, L., & Hevers, J. (2021). Using Peer Assisted Learning to improve academic engagement and progression of first year online law students. *Journal of University Teaching & Learning Practice, 18*(1), 1-17. www.ro.uow.edu.au/cgi/viewcontent.cgi?article=2391&context=jutlp.

The results of this pilot study are encouraging and add to objective knowledge about the Meet-Up program and its relationship with online students' social and academic engagement, and potential improvement in course progression and retention. A secondary outcome is this study's contribution to existing knowledge of the broader relationships between group culture and the usage of learning analytics, potentially leading to improved ability to use student data to stimulate greater student engagement and teaching and learning outcomes. That said, the results must be framed in light ofsome limitations identified in the current study that will be reviewed as the project moves into the next phase. The feedback in this study, coupled with the engagement and progression statistics, puts forward a plausible case that students who participated in Meet-Up benefited from attending. In fact, it can be suggested this customised Meet-Up program assisted in each of the performance indicators and helped improve the course overall. The Meet-Up participants also expressed their desire for the expansion of the program to other law courses to help reinforce their problem-solving skills. More broadly, the COVID-19 pandemic has led to most universities developing some form of online delivery of their courses. It is hoped that this customised Meet-Up program will become a valuable tool for all those engaged in online education.

Dawson, P. J. (2010). *Examining how an online mentoring model may support new Supplemental Instruction leaders.* (Ph.D. dissertation), University of Wollongong, Wollongong, Australia. www.ro.uow.edu.au/theses/3208/

This study investigated online mentoring as a method of supporting inexperienced, geographically-dispersed Supplemental Instruction Leaders (SILs). Supplemental Instruction (SI) is an academic support program that employs successful senior students as SILs to facilitate regular peer learning sessions. Over 250,000 tertiary students attend SI each year worldwide (Arendale, 2002). Students who attend SI are more likely to succeed in their studies, achieve higher grades, and be retained at their institutions (Martin &Arendale, 1993). The Australian higher education sector has a need for initiatives like SI that support the success of non-traditional students (Bradley, Noonan, Nugent, & Scales, 2008); however such programs can be difficult to implement in multi-campus institutions (Winchester & Sterk, 2006). In this study, online mentoring was examined as a method of addressing some of the difficulties in supporting inexperienced SILs who are geographically isolated. There is minimal research literature about the use of mentoring or community to support SILs, and none addressing the problem of supporting geographically dispersed SILs. Online mentoring and community models have been used successfully in other contexts to support novices that are geographically isolated from potential mentors and their peers. SILs are different from mentees in most mentoring literature; traditional mentees are either career employees or students being mentored for their academic success. In this study, SILs are being supported for a part-time, fixed-term role that few intend to continue as a career. The following research questions were investigated: Research Question 1: What models are appropriate for mentoring geographically-dispersed Supplemental Instruction Leaders? Research Question 2: In what ways does participation in an online SIL support program impact on mentors, mentees and community members? The study consisted of two phases, each addressing the corresponding research question. In Phase 1, an exploratory qualitative study was conducted into the development of an online mentoring model for geographically-dispersed SILs. A new theoretical framework was developed from

Social Learning Theory (Bandura, 1977) and Social Exchange Theory (Emerson, 1976; Homans, 1958) to inform the design of the model. This framework assisted in understanding how mentoring happens, and why mentors and mentees might participate in it. In Phase 2 the model was investigated twice using a qualitative, multiple-case study methodology. There were 30 participants from six campuses of five Australasian universities in the first study, and 67 participants from 27campuses of 25 academic institutions from three continents in the second study. Data were analyzed using a deductive approach based on the theoretical framework. Key findings of this research were: A model for the mentoring of geographically-dispersed SILs. An understanding of the impacts of the model on participating SILs. Role modeling was found to be the component of mentoring most used for SIL development; this is interesting given Ensher, Heun and Blanchard's (2003) proposition that "role modeling may be the function of mentoring that is least efficiently done in a virtual setting" (p. 273). A set of design variables for the development and expression of mentoring models. These variables address an identified need in the literature for clarity in academic communications about mentoring. A set of design variables for the development and expression of mentoring models. These variables address an identified need in the literature for clarity in academic communications about mentoring. This research has significance for online mentoring and higher education in general, and more specifically, the support of geographically-dispersed, part time staff, such as SILs and university tutors or teaching assistants.

Dawson, P. J., Lockyer, L., & Ferry, B. (2007). *Supporting first year student supporters: An online mentoring model for Supplemental Instruction* Conference Proceedings of the Annual Pacific Rim First Year Conference, Australia. www.academia.edu/attachments/42685842/download_file?st=MTU3ODY4NTU1NCw3My4zNy4yNTUuMjAxLDQwOTQ5MQ%3D%3D&s=email&ct=MTU3ODY4NTU1NCwxNTc4Njg1NTcwLDQwOTQ5MQ==

Supplemental Instruction (SI), or Peer Assisted Study Sessions (PASS) as it is commonly known in Australia, involves experienced senior student Peer Leaders who provide regularly scheduled peer learning sessions with students enrolled in university courses. Commonly implemented on first year subjects, the sessions integrate "how to learn" with "what to learn", helping students achieve better grades and helping raise student retention rates. This paper discusses the challenges of supporting SI Leaders who are geographically dispersed across multiple campuses and considers the theoretical and empirical literature that informs the development of an online mentoring model.

Donald, W. F., & Ford, N. (2022). Fostering social mobility and employability: The case for peer learning. *Teaching in Higher Education*, 672-678. doi: https://doi.org/10.1080/13562517.2022.2145467. https://www.tandfonline.com/doi/epdf/10.1080/13562517.2022.2145467?needAccess=true&role=button.

Higher education institutions continue to face challenges in fostering social mobility and preparing their students for the world of work. The COVID-19 pandemic exacerbated these challenges via disruption to education and reduced opportunities for work-integrated learning. Framing this as our point of departure, we propose that peer learning can play an integral part in reducing the attainment gap by promoting learner autonomy. Our essay uses the example of Supplemental Instruction to highlight the benefits and challenges of peer learning. We end with a call for empirical research and knowledge sharing to advance peer learning in an impactful way.

Dreyfus, A. E., Fraiman, A., Montes, M. O., Hudson, R., Ortega, F. M., Muniz, J., . . . Vu, N. (2021). Peer leading small group discussion during COVID-19. *Advances in Peer-Led Learning, 1*(1), 56-67. doi: doi.org/10.54935/apll2021-01-06-55. www.doi.org/10.54935/apll2021-01-06-55.

Peer-led workshops in General Chemistry at the University of Texas Permian Basin (UTPB) were affected by COVID-19 restrictions during the 2020-2021 academic year. Most Peer-Led Team Learning (PLTL) workshops were conducted in person, but with the difference that protocols of distancing had to be observed, and a few were conducted online, so adjustments were necessary to prepare Peer Leaders to conduct their workshops in both types of settings. The facets of the modified PLTL program were supported by the online preparation for facilitation and chemistry content. The results of an examination of critical incidents (Brookfield, 1995) are shared here. This qualitative examination of Peer Leaders' experiences was undertaken because of its exploration of formative events. Through the responses to several rounds of questions about their experiences, Peer Leaders acknowledged the reality of dealing with Covid-19 restrictions as well as their preparation via a weekly online seminar. This paper, co-authored with Peer Leaders, examines the process of online training and facilitating workshops during the Fall 2020 and Spring 2021 semesters at UTPB.

Eklund, M. A., Eklund, A., & Leick, B. (2021). An essay on the effects of web-based platforms and Supplemental Instruction in accounting education. In A. Strømmen-Bakhtiar, R. Helde & E. Suzen (Eds.), *Supplemental Instruction: Student learning processes, volume 2* (pp. 103-122). Munster and New York:

Waxmann.www.www.waxmann.com/index.php?eID=download&buchnr=4325.

During the uncharted time, such as the coronavirus (COVID-19) pandemic, e-learning has become more important than ever. Drawing on the tenet of the connectivism learning theory, this chapter discusses digital transition and Supplemental Instruction in education, especially in accounting education. A printed questionnaire was administered to the students who enrolled in introductory accounting courses at one of the American public universities. Descriptive statistics, independent t-test, and ANOVA were employed to examine student perceptions of the web-based platform (WBP) – a digital homework platform – and SI and to test the differences between the groups. In line with prior research, although 49% of the students perceive SI as a helpful service, voluntary participation in SI is low (30%). 20% out of this 30% attended the SI maximum of three times during the semester. Even though 52% find WBPs time-consuming activity, 59% prefer WBPs to traditional paper-and-pencil homework, and 87% find WBPs helpful. In simpler terms, students have a positive perception of WBPs but a neutral perception of SI. For the independent t-test and ANOVA, it is found that there is no significant difference between the groups' mean values. It indicates that respondent age, gender, class standing, and prior accounting knowledge do not create any significant perception difference. Even though the results are not generalizable for all blended accounting education, the study still contributes to the online education literature by exploring and investigating the status quo in the undergraduate introductory accounting courses at one of the American higher institutions. Thus, it opens the door to generalizable future research on digital learning and SI in the accounting discipline. The results also serve as a foundation for continuous theoretical advancement and decision base for instructors and policymakers in higher education

Emenike, M. E., Schick, C. P., Van Dezor, A. G., Sabella, M. S., Hendrickson, S. M., & Langdon, L. S. (2020). Leveraging undergraduate Learning Assistants to engage students during remote instruction: Strategies and lessons learned from four institutions. *Journal of Chemical Education, 97*(7). doi: https://doi.org/10.1021/acs.jchemed.0c00779. https://pubs.acs.org/doi/pdf/10.1021/acs.jchemed.0c00779.

As chemistry courses across the country transitioned to remote instruction during the Winter/Spring 2020 term because of the COVID-19 pandemic, teaching teams with undergraduate Learning Assistants (LAs) faced unique challenges to maintain active, collaborative, and inclusive class experiences. While technology access and limitations presented challenges, the technology available through learning management systems, group text-based messaging apps, and video conferencing enabled instructors and LAs to offer synchronous sessions during normally scheduled class time, delivery of asynchronous content, and continued student support. In this article, the collective experiences from general and organic chemistry courses taught with LAs at four institutions are described. Challenges, successes, and lessons learned at these institutions are summarized based on four themes: technology with general remote learning, changes in course structure teaching with LAs, changes in the ways LAs interact with instructors and students, and changes in the lives of the LAs. In many cases, LAs were essential to student success in these novel learning spaces.

Feder, E., Khan, I., Mazur, G., Vernon, T., Janke, T., Newbrough, J., . . . Varma-Nelson, P. (2016). Accessing collaborative online learning with mobile technology in Cyber Peer-Led Team Learning. www.er.educause.edu/articles/2016/4/accessing-collaborative-online-learning-with-mobile-technology-in-cyber-peer-led-team-learning.

Using mobile devices in online collaborative learning models offers many potential advantages for students and faculty. However, while the technology can reduce costs and increase mobility for students, replacing traditional devices with mobile devices can result in a loss of functionality. To address this functionality loss and investigate workarounds, a group of researchers at Indiana University-Purdue University Indianapolis tested mobile platforms for use in the institution's Cyber Peer-Led Team Learning model. The study found three platforms that offer a viable choice for institutions looking to implement online PLTL programs. Our cPLTL program uses Adobe Connect to create meeting rooms for its small online workshops; it also requires participants to have the following technologies: a personal computer (preferably with a high-speed internet connection through an Ethernet cable); Point 2 View USB document camera; a microphone; and a webcam. Adobe Connect, which IUPUI's cPLTL workshops already used, proved to be a leading competitor among the tested platforms, which also included Fuze, WebEx, BigBlueButton, VSee, and Blackboard Collaborate. Our research team's comprehensive comparison of platforms suggests that institutions consider Zoom and Adobe Connect when implementing mobile devices in online collaborative learning, as both preserve the four most critical features on various devices.

Finlay, K., & Mitchell, M. Z. (2017). *Evaluating the effectiveness of online vs. face-to-face Supplemental Instruction in introductory biology courses*. University of Regina. Canada. www.uregina.ca/ctl/assets/docs/pdf/ptls-2015-2016/Finlay,%20Kerri%20-%20PTLS%20Final%20Report.pdf

Our study found very little difference in the real and perceived differences when SI was offered live face-to-face, live

online, and recorded online. Quantitative data: We found a significant positive correlation between students' final grades and their attendance at SI sessions of all types. In BIOL111, final grades were 5-6% higher for those students who attended more than 3 SI sessions (averaged 73% at both Regina and Saskatoon sites) compared to those who did not attend any SI sessions (67% in Saskatoon and 68% in Regina). Similarly, in BIOL110, students who attended more than 3 online SI sessions received an average of 6% higher final grades (73% at both sites) compared to students who did not attend any SI sessions (67% at both sites). Surprisingly, even those students who only accessed recorded SI sessions received 4% higher final grades than those students who did not, at all sites. Qualitative data: overall, students were very positive about the benefits of SI, in any format. In the survey data, where "strongly agree" is coded as a 5, and "strongly disagree" is coded as a 1, the average responses to all of the questions ranged from 4.2 to 4.5 indicating high agreement with all statements provided. We did not find any difference in agreement with the statements when the SI was offered online vs. face-to-face, and students found many benefits even from accessing the previously recorded sessions.

Finney, K., Musil, O., Tram, A.-L., & Trescott, S. (2018). *Standard Operating Protocol Virtual Supplemental Instruction*. San Diego State University. San Diego, CA. www.docs.google.com/document/d/1wqqrdSdsLTvRCStwutoLMWyCH2Xz8vznjU1OLm11Sx8/edit?ts=5c7fff6b#

This document provides the procedures for conducting an online SI session and making it available for students to watch in the future. The Zoom software is used to record the online session. Extensive editing occurs afterwards of the video by breaking it into modules.

Hargreaves, J., Ketnor, C., Marshall, E., & Russell, S. (2022). Peer-assisted learning in a pandemic. *International Journal of Mathematical Educaiton in Science and Technology*. doi: doi.org/10.1080/0020739X.2021.2008036. www.www.tandfonline.com/doi/epub/10.1080/0020739X.2021.2008036?needAccess=true.

Peer-Assisted Learning (PAL) schemes typically involve student volunteers (PAL Leaders) designing and delivering sessions that support groups of students in lower years with their studies. This paper discusses three different PAL schemes, within Mathematics degrees at Sheffield Hallam University (a Post-92 University) and The University of York (a Russell Group University), which took place entirely remotely during the Covid-19 pandemic. In this paper, we explore the challenges and benefits of remote PAL schemes via the three case studies, from both staff and student perspectives. There are aspects of PAL in a pandemic that we would (or would not) take forward to a blended or in-person approach in the future. In particular, we found that, while students and staff alike are looking forward to in-person contact to provide them with interactions and easier methods of communication, the remote provision for peer support has real value in terms of accessibility and inclusivity. Furthermore, integrating technology enhanced learning into in-person sessions can provide added value.

Hite, R. L., Childers, G., Gottlieh, J., Velasco, R., Johnson, L., Williams, G. B., . . . Dwyers, J. (2021). Shifts in Learning Assistants' self-determination due to COVID-19 disruptions in calculus II course delivery. *International Journal of STEM Education, 8*, Article 55. https://stemeducationjournal.springeropen.com/counter/pdf/10.1186/s40594-021-00312-0.pdf?pdf=button%20sticky.

Background The Learning Assistant (LA) model with its subsequent support and training has evidenced significant gains for undergraduate STEM learning and persistence, especially in high-stakes courses like Calculus. Yet, when a swift and unexpected transition occurs from face-to-face to online, remote learning of the LA environment, it is unknown how LAs are able to maintain their motivation (competence, autonomy, and relatedness), adapt to these new challenges, and sustain their student-centered efforts. This study used Self-Determination Theory (SDT) to model theoretical aspects of LAs' motivations (persistence and performance) both before and after changes were made in delivery of a Calculus II course at Texas Tech University due to COVID-19 interruptions. Results Analysis of weekly written reflections, a focus group session, and a post-course questionnaire of 13 Calculus II LAs throughout Spring semester of 2020 showed that LAs' reports of competence proportionally decreased when they transitioned online, which was followed by a moderate proportional increase in reports of autonomy (actions they took to adapt to distance instruction) and a dramatic proportional increase in reports of relatedness (to build structures for maintaining communication and building community with undergraduate students). Conclusions Relatedness emerged as the most salient factor from SDT to maintain LA self-determination due to the COVID-19 facilitated interruption to course delivery in a high-stakes undergraduate STEM course. Given that online learning continues during the pandemic and is likely to continue after, this research provides an understanding to how LAs responded to this event and the mounting importance of relatedness when LAs are working with undergraduate STEM learners. Programmatic recommendations are given for enhancing LA preparation

including selecting LAs for autonomy and relatedness factors (in addition to competence), modeling mentoring for remote learners, and coaching in best practices for online instruction.

Hizer, S. E., Schultz, P. W., & Bray, R. (2017). Supplemental Instruction online: As effective as the traditional face-to-face model? *Journal of Science Education and Technology, 26*(1), 100-115.

Supplemental Instruction (SI) is a well-recognized model of academic assistance with a history of empirical evidence demonstrating increases in student grades and decreases in failure rates across many higher education institutions. However, as college students become more accustomed to learning in online venues, what is not known is whether an SI program offered online could benefit students similarly to SI sessions that occur in face-to-face settings. The in-person (traditional) SI program at California State University San Marcos has demonstrated increases in grades and lower fail rates for courses being supported in science and math. Students enrolled in four biology courses who participated in online SI received increases in academic performance similar to the students in the courses who attended traditional SI. Both the online and traditional SI participating students had higher course grades and lower fail rates as compared to students who did not participate in either form of SI. Self-selection, as measured by past cumulative college grade point average, did not differ between students who attended either form of SI or who did not attend. Student perceptions of online SI were generally positive and appeared to offer an alternative path to receive this valuable academic assistance for some students. Overall, results are promising that the highly effective traditional model can be translated to an online environment.

Hughes, A., Watson, R. & Boggs, C. (2008). *The Online Dilemma: Student Perceptions of Online Supplemental Instruction for General Microbiology.* Conference Proceedings of the World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education.

Supplemental Instruction (SI) is a model that has been used to enhance instruction for several decades and has seen a significant increase in popularity. Prior to the spring semester of 2008, the University of Wyoming only conducted SI in face-to-face settings. In the spring of 2008, the General Microbiology course at the university held online SI sessions. For these sessions, students were asked to read a popular non-fiction novel and discuss it online with the other students. At the end of the semester, students were given a survey. Data at the end of the study indicated that the students perceived the exercise as beneficial, enhanced their understanding of course material, and were able to relate the information to real-word applications.

Huijser, H., & Kimmins, L. (2005). *PALS online and community building: A contradiction in terms?* Conference Proceedings of the 22nd annual ASCILITE Conference, Brisbane, Australia.

At the University of Southern Queensland (USQ), Peer-Assisted Learning (PAL) is a modified version of the Supplemental Instruction (SI) model. PAL is used to build community for the online learners. The paper reviews examples of implementing online mentoring and suggestions for improved service tot he students. Some of the suggestions included periodic face-to-face PAL sessions to offset the social isolation of the online learning activities and also to provide online photographs and short background narratives about the PAL facilitators to help acquaint them with the students participating online.

Huijser, H., & Kimmins, L. (2006). *Developing a peer-assisted learning community through MSN Messenger: A pilot program of PALS online*. Unpublished manuscript. University of Southern Queensland. Southern Queensland, Australia.

At the University of Southern Queensland (USQ), Peer-Assisted Learning (PAL) is a modified version of the Supplemental Instruction (SI) model. PAL is used to build community for the online learners. The paper reviews examples of implementing online mentoring and suggestions for improved service to the students. MSN Messenger is used as the venue for communication between the PAL facilitator and the students in the class.An economics and a data analysis class were selected for the study. The pilot program was evaluated using qualitative measures. While the online component helped to build community among the students, the initial academic outcomes appeared to be limited. The researchers encourage others to reproduce the experiment and seek to find more effective uses of the technology.

Huijser, H., Kimmins, L., & Evans, P. (2008). Peer assisted learning in fleximode: Developing an online learning community. *Australasian Journal of Peer Learning, 1*, 51-60. www.ro.uow.edu.au/ajpl/vol1/iss1/7

At the University of Southern Queensland in Australia use an adaptation of Peer Assisted Learning Strategy (PALS) to support online learners. This version of PAL is named Meet-Up. Since 2006 MSN Messenger has been used to serve these distance learning students. This paper describes the use of Wimba software within an institution-wide Moodle learning management system. Use of these enhancements provides a chat function, sharing of PowerPoint slides, and document sharing. This more comprehensive suite of learning tools provides more interactivity and more content sharing that the earlier use of instant messaging alone.

Janke, T., & Varma-Nelson, P. (2014). *Cyber Peer-Led Team Learning (PLTL).* Conference Proceedings of the World Conference on Educational Media and Technology,, Tampere, Finland. www.learntechlib.org/primary/p/147479/

This paper describes the challenges and opportunities of adapting a high-impact face-to-face pedagogy to an online environment. At Indiana University-Purdue University Indianapolis (IUPUI), USA, Cyber Peer-led Team Learning (cPLTL) was developed by adapting Peer Led-Team Learning (PLTL) to an online environment. PLTL is a model of teaching that preserves the lecture and replaces recitation in science courses with a weekly two-hour problem solving session called a workshop. In this project, an online, synchronous, collaborative environment for conducting PLTL workshops was created by using web-conferencing software coupled with a two-camera-per-learner configuration. As in PLTL workshops, six to eight students in cPLTL workshops are guided by a peer leader through problem-solving activities for two hours. Learning gains in cPLTL were similar to those seen in PLTL. Discussed here is the development of cPLTL as well as adoption at other institutions.

Jimenez, R. (2018). *Implementing an online Supplemental Instruction program.* Conference Proceedings of the Society for information Technology & Teacher Education Conference.

This paper will offer an Online Supplemental Instruction (OSI) Implementation framework that higher education institutions can use to implement their own OSI program. The paper will review traditional SI program structures, the theoretical underpinnings supporting SI programs, and the foundations of OSI. The theoretical frameworks reviewed include constructivism, active learning theory and Tinto's theory of student persistence. In addition, a review of the OSI Implementation Framework is introduced. The OSI implementation framework is explained and how it can be used by higher education institutions to develop their own OSI program. Constructivist learning environments and TPACK influences that inform the OSI Implementation framework are discussed. Finally, recommendations and conclusions about the OSI Implementation Model will be discussed. This includes student training to support their needs in using online environments and in developing a "train the trainer" program and ongoing support for the student leaders (SILs) that will be leading SI/OSI sessions.

Jimenez, R. (2018). *Supporting STEM college student success via traditional and online Supplemental Instruction: A mixed-methods causal comparative study.* (Ph.D. dissertation), New Jersey City University.

The goal of this causal-comparative, mixed methods study was to measure the degree of success that Supplemental Instruction (SI) promotes success and retention. The overarching goals of SI are to improve student grades, reduce attrition, and increase student retention in a science, technology, engineering, and math (STEM) field. The study encompassed a review of traditional SI program structures, the theoretical underpinnings supporting SI programs, and the foundations of Online Supplemental Instruction (OSI). Theories used to frame the study included constructivism, active learning theory, and Tinto's theory of student persistence. An OSI pilot was conducted in the Fall 2017 semester and discussed in terms of its implementation and the data collected. The quantitative and qualitative data collection procedures were discussed, and the analyzed results were compared to the existing literature. Finally, recommendations and implications to the field and future OSI implementations were discussed.

Kartsonaki, E., Bailey, C., & Lawrie, G. A. (2015). *iPass: Online collaborative peer-assisted study support.* Conference Proceedings of the The Australian Conference on Science and Mathematics Education (formerly UniServe Science Conference). www.openjournals.library.sydney.edu.au/index.php/IISME/article/view/8855/9076

Peer-assisted learning is a powerful strategy to assist students to both develop effective study skills and to apply formative feedback in self-regulated learning. In this study, existing successful face-to-face PASS learning activities have been translated into a virtual mode of delivery to enhance parallel online learning experiences. The model and template for the implementation and delivery of a cyber-peer-led team-learning (cPLTL) environment has been adopted from the initiative of Professor Pratibha Varma-Nelson [Smith et al, 2014]. Virtual iPASS sessions are hosted through the Adobe Connect tool which represents a platform that can enable a single PASS leader to synchronously guide up to 10 first-year chemistry students through collaborative study exercises. This technology enables students in the online PASS group to share their work with each other and with their leader while they are located in their preferred environment including their homes. An objective of offering a virtual PASS option was that it would enrich the on-campus experience by enabling peer support access for students who could not, or who preferred not to, engage in the face-to-face contact sessions. Translation of activities involved consideration of the format of the tasks and the training of the iPASS leaders in facilitation of the sessions to deliver an inclusive environment. Evaluation of the effectiveness of iPASS has been achieved by the comparison of a trial pilot iPASS group in parallel with a traditional face-to face PASS contact session. Consent was sought from participating students for researchers to record and characterise the nature of their interactions with their leader(s), provision of

feedback and engagement with activities. Factors that must be considered for online peer support include students' technological literacy and group composition. The outcomes of this trial will be shared in this presentation.

Kennedy, N. S., & Masuda, A. M. (2021). Exploring new PLTL modalities, forging new alliances. *Advances in Peer-Led Learning, 1*(1), 44-54. doi: doi.org/10.54935/apll2021-01-05-44. www.doi.org/10.54935/apll2021-01-05-44.

This essay focuses on rethinking and reimagining elements of a PLTL program, and on the new modalities to meet challenges of online undergraduate mathematics courses and rising demands for flexible student support. It examines advantages and challenges as found in the Integrated PLTL and Virtual Peer-Led Mathematics Study Groups, including issues such as meeting protocols, and the selection and training of peer leaders. Finally, it discusses an alliance with the college's mathematics education program, which allows the PLTL program to draw on senior prospective teachers to co-organize and facilitate virtual study groups supporting undergraduate mathematics courses.

Kim, Y., Ong, C. I. W., & Fung, F. M. (2023). Supplementary discourse - Forming an online learning community with asynchronous discussions. *Journal of Chemical Education, 100*(2), 496-506. doi: https://doi.org/10.1021/acs.jchemed.2c00553. https://pubs.acs.org/doi/pdf/10.1021/acs.jchemed.2c00553.

The use of social media platforms to promote social interaction in a digital classroom is a common approach used by many educators. However, implementing such a platform is met with many challenges, the biggest being student shyness and reluctance in participating publicly. In this paper, we introduce the Supplementary Discourse (SD) model, inspired by the Supplementary Instruction (SI) model, where the goal is to promote student–student interactions in an online space. The SD model is also applied in an introductory organic chemistry course using Discord, a channel-based social media platform. By engaging students with tutors and discussion questions, we successfully catalyzed the formation of a student learning community, with the Discord server accumulating an average of 86 messages per week in a 13-week period, with students commenting that they felt less intimidated to ask questions in the server.

Leon, S., Turchannova, A., Perez, E., Cervantes, I., & Rodarte, F. (2015). *Developing hybrid PLTL workshoops for an intermediate programming course.* Conference Proceedings of the 2015 Peer-Led Team Learning International Society, Richardson, Texas. www.pltlis.org/wp-content/uploads/2018/03/2015-Leon.pdf

PLTL online workshops are utilized as supplemental material for CS 1: Intro to C++, the introductory programming course at the University of Houston-Downtown. These workshops have been shown to positively affect student performance in the course. Students who are pursuing a degree or minor in Computer Science subsequently enroll in CS 2: Data Structures and Algorithms. Face-to-face workshops have been offered for this course since Spring 2014, but have garnered only inconsistent attendance from students. We propose a change in the way CS 2 workshops are delivered, with the dual aim of increasing attendance and impact by incorporating proven techniques from CS 1 workshops. The new approach will include both face-to-face and online workshops. We hope to widen the scope of ideas introduced to CS 2 students and to provide more thorough training in the applications of course concepts.

Malm, J., & Fredriksson, J. (2021). Digital tools in Supplemental Instruction (SI). In A. Strømmen-Bakhtiar, R. Helde & E. Suzen (Eds.), *Supplemental Instruction: Digital technologies, volume 1* (pp. 19-27).www.www.waxmann.com/index.php?eID=download&buchnr=4324

This chapter focuses on digital tools and software programs used in SI. It combines a case study for the SI program at Lund University with an international overview. The digital tools are divided into categories based on where they are used in SI. Digital tools for SI leaders are usually tools for communication with participants between sessions (e.g., Facebook, Messenger, WhatsApp). It also includes sharing good practices, learning activities, and problems that invite discussion using platforms like Google drive, apps for leaders with learning strategies, session planners, and Q & A help for challenges that may occur in sessions. There is a huge variety of software programs and apps that can be used to enhance the SI participants' learning experiences. These tools (e.g., jeopardy, Kahoot, memory) target retrieval and/or reflection practices course material to improve memorization and understanding. SI supervisors or coordinators also use digital tools to manage the SI program. Typical tasks can be to track attendance at SI sessions (e.g., Tutortrac, EAB Navigate, Google sheets), information exchange between supervisors (e.g., list-serves at regional SI centers), administer SI-programmes (e.g., Canvas, Microsoft Teams, Blackboard), create evaluation surveys (e.g., Surveymonkey, Qualtrics,Google forms), store leader training videos and promotions (e.g., Youtube playlists), and document observations (e.g., Notability, One Note). Online SI, using video conferencing/teaching platforms like Zoom, Blackboard collaborate, and WebEx, is a relatively new form of SI created to address the needs of students in distance learning and students that have difficulties attending traditional SI sessions on campus. Online SI is still in its infancy, and its potential and efficiency are yet to be

determined. Due to more education going online because of the Coronavirus, there are a huge amount of experiences and data being collected on online SI, which may provide answers about its usability.

Malm, J., Ody, M., Eriksson, H. E., Fairclough, I., Helde, R., Oakley, M., . . . Olesen, A. W. (2022). How have Supplemental Instruction-Peer Assisted Study Sessions (SI-PASS) programmes adapted during the Coronavirus pandemic? : Studies from four Higher Education Institutes in Ireland, Norway, the UK and Sweden. . *Student Engagement in Higher Education Journal, 4*(2), 24-44. https://sehej.raise-network.com/raise/article/view/1152.

In this paper we look at the adaption of SI-PASS programmes during the Coronavirus pandemic drawing from four Higher Education Institutions (HEIs) as case studies: The National University of Ireland (NUI) Galway in Ireland, Nord University in Norway, Lund University in Sweden and the University of Manchester in the UK. The paper focuses on how SI-PASS programmes adapted during the pandemic and also on the role of SI-PASS in student engagement in an extraordinary time. Here, attention is given to the numerous challenges that the SI-PASS teams have faced. For instance, how to engage students in an online environment or in a face-to-face setting with social distancing, training student leaders to hold online sessions, support of leaders, and enhancing the student participants' learning experience. Attention is also given to the potential benefits of online SI-PASS and lessons learned that can be incorporated in post-pandemic SI-PASS programmes.

Martin, M. E., & Davidyan, A. (2021). Implementing an undergraduate Learning Assistant Program tailored for remote instruction. *Journal of Microbiology & Biology Education, 22*(1). doi: https://doi.org/10.1128/jmbe.v22i1.2463. https://journals.asm.org/doi/full/10.1128/jmbe.v22i1.2463.

The inclusion of undergraduate learning assistants (LAs) on the teaching team of a course is a high-impact practice that benefits the teaching team, students, and LAs themselves. LAs are undergraduate students who have taken the course previously and support student learning through facilitated discussion and problem-solving. Unfortunately, in the quick pivot to emergency remote instruction and lacking an online model for LA programs, some instructors temporarily discontinued or scaled down their LA programs. This report describes the recruitment, training, and roles of LAs who were engaged to support a high-enrollment, interactive lecture course delivered by emergency remote instruction. This case study can serve as a model to inform the implementation of a robust online LA program.

Mauser, K., Sours, J., Banks, J., Newbrough, J., Janke, T., Shuck, L., . . . Varma-Nelson, P. (2016). Cyber Peer-Led Team Learning (cPLTL): Development and implementation. *Educause Review*. www.er.educause.edu/articles/2011/12/cyber-peerled-team-learning-cpltl-development-and-implementation.

Given the proven success of peer-led team learning, an experiment explored whether cyber Peer-Led Team Learning (cPLTL) could achieve similar success, especially in STEM fields. Results indicated that cPLTL students achieve at the same level as PLTL students in General Chemistry courses. cPLTL workshops eliminate the ongoing need for physical classroom spaces. Students can be effective partners with faculty in improving educational practice. The type and amount of student interaction with major socializing agents on campus - faculty and their peers - determine the impact of college on students. Much of the research on postsecondary education links the quality of peer interactions directly to student learning outcomes and satisfaction with the college experience and Alexander Astin went so far as to suggest that "peers are the single most potent source of influence".

Maxwell, M. C. (2022). *Exploring the educational and psychological impacts of Peer-Led Team Learning and Cyber Peer-Led Team Learning.* (Ph.D. dissertation), Syracuse University, Syracuse, NY.

Peer Led Team Learning (PLTL) is a well-studied active learning model that is associated withimproved educational outcomes for students. The introductory biology course at Syracuse University (SU) has a well-established PLTL program, and published research stemming from this program has shown that PLTL has positive impacts on the short- and long-term retention of underrepresented minority (URM) students in STEM. However, there are additional data regarding potential benefits of the PLTL program for women and first-generation college students that have yet to be published. In this thesis, I present previously unpublished data indicating that women and first-generation college students who participated in PLTL were more likely to be retained in STEM majors than their counterparts who did not participate in PLTL, and that participating in PLTL is associated with diminished feelings of imposter syndrome, which were more common among participants who identified as women. Due to constraints imposed by the COVID-19 pandemic, the introductory biology course and its associated PLTL program transitioned to an online format during the Fall 2020 semester. This provided an opportunity to explore the impacts of the newly developed and comparatively less understood variation of PLTL, cyber Peer Led Team Learning (cPLTL), among different groups of students. We found that participating in cPLTL was associated with improved academic achievement and retention and that this trend held true when looking specifically at women, first-generation

college students, and URM students. Cumulatively, this work shows that both PLTL and cPLTL are associated with improved educational outcomes in terms of academic achievement and retention for underserved groups of students. There are several psychological benefits the program may provide to students that may be a mechanism by which PLTL improves educational outcomes, such as increased motivation, increased sense of belonging, or reduced feelings of imposter. Together, these findings support the use of PLTL and cPLTL as active learning strategies to improve the effectiveness and equity of STEM education

Maxwell, M. C., & Wiles, J. R. (2022). Cyber Peer Led Team Learning (cPLTL) supports marginalized groups, including women, in science, technology, engineering, and mathematics (STEM). *Bioscene: Journal of College Biology Teaching, 48*(1), 10-16. http://files.eric.ed.gov/fulltext/EJ1350834.pdf.

Peer Led Team Learning (PLTL) is an active learning model that is particularly effective for improving the academic achievement and retention of students who have been marginalized in Science, Technology, Engineering, and Mathematics (STEM), such as women, and members of underrepresented minority groups. Cyber Peer Led Team Learning (cPLTL) is a recently developed variation of PLTL that has been transitioned from a face-to-face environment to a synchronous online setting. Studies have found that PLTL and cPLTL students earned comparable educational outcomes in terms of standardized final exam scores and final course grades. Given the benefits of PLTL for marginalized students and the similarities of cPLTL to PLTL, we were interested in understanding the impact that cPLTL had on marginalized groups, including women, in an introductory biology course at a large, research-intensive institution. We found evidence that participating in cPLTL improves the retention of marginalized groups in STEM, and that student perceptions of cPLTL are generally high, especially for women. Participating in cPLTL may have several additional benefits, such as increased motivation, feelings of belonging, comfort in asking questions, and understanding of course content.

McDowell, T. R., Schmittzehe, E. T., Duerden, A. J., Cernusca, D., Collier, H., & Woelk, K. (2019). A student-choice model to address diverse needs and promote active learning. *Journal of Science Education and Technology, 28*, 321-328.

A student-choice model course redesign was used to counteract a large increase in student enrollment, improve the quality of instruction, and preserve student success. This model is an instructional technique that allows students to choose how to engage in a course. Using this model in a first-semester college-level general chemistry course, online options were created to augment the traditional face-to-face course. The traditional lecture time was reduced from 3 to 2 h per week while the traditional recitation time was increased from 1 to 2 h per week. The recitation component was also transitioned from a supplemental lecture session into a problem-solving active-learning component. A mandatory rotation between face-to-face and online options at the start of the semester was necessary to assist students in making an informed choice about what options best fit their needs. Pre- and post-redesign student performance data (2008–2016) and post-redesign student enrollment data (2012–2016) were evaluated. Course performance was maintained and often improved in post-redesign years, and was generally equivalent in the different course combinations.

Mendoza, D. F., & Kerl, E. (2021). Student perceived benefits of embedded online peer tutors. *The Learning Assistance Review, 26*(1), 52-73. http://files.eric.ed.gov/fulltext/EJ1317160.pdf.

In fall of 2017, the Center for Academic Program Support at the University of New Mexico revamped its Online Learning Assistant (OLA) Program, which focuses on embedding undergraduate peer tutors in multidisciplinary fully online courses. Students who had an OLA during the Spring 2020 and Fall 2020 semesters, were surveyed to better understand the perceived benefits of having this type of support in their courses. Survey results showed that by engaging with the OLA, students felt their coursework improved, they were more confident in the material, and engaged more in the course. This study should be of interest to learning center practitioners, faculty, and researchers focused on online academic support.

Miller, D. A. (2006). *Helping students understand technical calculus via an online learning supplement and group learning*. Unpublished manuscript. West Virginia University. Morgantown, WA. www.math.unipa.it/~grim/21_project/21_charlotte_MillerDavidPaperEdit.pdf

This report describes an adaptation of the traditional Supplemental Instruction (SI) for online learners. This experiment was for students enrolled in a technical calculus course. This version of SI was voluntary for the students. Students that participated in the study performed significantly higher than non-participants, were motivated to learn, and had a positive attitude towards calculus, their perceptions on how the discussion sessions and the online SI sessions helped them to perform better in the course. The name for this adaptation of SI was called Technical Calculus Learning Supplement (TCLS).

Ng, R., Kaur, A., Farina, S., Mohamed, S., Latif, A., & Ramli, B. (2009). E-mathematics : pre-instructional and supplement instruction and their impact of student's online participation and final exam score. *AAOU Journal, 4*(1), 27-36.

Open University Malaysia (OUM), Malaysia's first open and distance learning with over 70.000 students, offers more than 51 programs to-date. More than 90% of its students are working adults who are unable to leave their jobs or families behind to pursue their dream of getting a degree. The blended learning approach adopted by OUM provides the flexibility for working adult's to obtain the required paper qualification and to upgrade their knowledge. One of the important elements of blended learning is the use of online discussion forum where learning takes place beyond classroom. Mathematics, a traditionally difficult course, forms part of the prerequisite for students to obtain a business degree at OUM. The adult learners at OUM generally have left school for at least five years and most of them have low grades in Mathematics at O' Level. Thus it is a big challenge for these adult learners to undertake a Mathematics course via online with minimum Face-to-Face contact with their tutors. This paper focuses on the implementation of pro-instruction workshop and Supplemental Instruction to find its impact on student's online participation and exam results of 88 students. The contents of the online forum were also analyzed using a 34-item instrument derived from the Community of Inquiry model. Results obtained showed that there was a strong correlation between workshop participation and final exam score. Independent samples t-test conducted showed that there was a significant difference between the mean score of online discussion ratio and final examination between participants attached to a tutor conducting the workshop and extended coaching compared to participants attached to another tutor using the normal teaching guide. The means COI score obtained for mathematics between the two tutors indicated that there is a difference in the teaching and cognitive presence but almost similar in the social presence.

Ng., R., Kaur, A., & Latifah, A. L. (2009). *Online Supplemental Instruction: An alternative model for the learning of mathematics. .* Conference Proceedings of the International Conference on Information,, Kuala Lumpur, Malaysia.

More than 90% of Open University Malaysia (OUM)'s learners are working adults who are unable to leave their jobs or families behind to pursue their dreams of getting a degree. The blended learning mode adopted by OUM provides the flexibility for working adults to obtain their paper qualifications and to upgrade their knowledge. Mathematics, a traditionally difficult course, forms part of the pre-requisite for learners to obtain a business degree at OUM. The adult learners at OUM generally have left school for at least five years and most of them have low grades in Mathematics at O' Level. Thus it is a big challenge for these adult learners to undertake a Mathematics course via online with minimum Face-to-Face contact with their tutors. This paper proposes an alternative model of learning mathematics known as Online Supplemental Instruction (OSI) model which involves three components; pre-tutorial workshop, online mentoring, and online video support. The research which involved 132 learners under the tutorship of two tutors was carried out to find the impact of the model on learners' online participation and final exam score. The contents of the online discussion forum were analyzed using a 34 item instrument derived from the Community of Inquiry (COI) model. Learners' online participation behavioral pattern was also analyzed. Results obtained showed that there was a strong correlation between learners who have participated in the OSI model of learning and their online participation and final exam score.

Nikolic, S., & Nicholls, B. (2017). *Exploring student interest of online peer assisted learning using mixed-reality technology.* Conference Proceedings of the International Conference on Interactive Collaborative Learning

Supplementary Instruction, also known as Peer Assisted Study Sessions (PASS), is a popular program supporting the educational development of students in a collaborative setting. Flexibility of delivery has been explored for a number of reasons including: work and family commitments; distance from campus; and integrating regional and transnational satellite campuses. Previous studies have found attempts to undertake online delivery of PASS lacking in student interest and have been restrained by the technology. This study attempts to build upon this research by investigating student interest and the suitability of using a mixed reality technology called iSee, based on video avatars within a 3D virtual world. Consistent with previous studies student interest was low, converting a planned quasi-experimental study into a simulation. The simulation suggests that the technology was suitable for online collaboration, with effective communication of course content between participants and a good sense of presence. This suggests this trial may gain greater student interest if undertaken within institutions offering predominantly online, distance education.

Omodan, B. I., & Ige, O. A. (2021). Re-constructing the tutors-tutees relationships for better academic performance in universities amidst Covid-19 new normal. *Mediterranean Journal of Social Sciences, 12*(2). doi: www. .org/10.36941/mjss-2021-0010. www.richtmann.org/journal/index.php/mjss/article/view/12440.

In the past, the success of Supplemental Instruction (Tutorial Sessions) depends on the tutors and tutees' physical and social relationships. However, the assumption exists that when there are no physical connections

between the duos may affect their social interrelationships, impeding the success and intention of SI in the University classrooms. This study, therefore, investigates the current relationships amidst new normal towards SI and students performance. The study is underpinned by attachment theory to unravel the extent, importance and shortcomings of the assumed change in the relationship between the understudied. The study is guided by the Transformative Paradigm (TP) and Participatory Research (PR) to identify the possible dichotomies in their relationships. Purposive selection method was used to select five tutors and five tutees in a selected university in South Africa. Online (WhatsApp, email, and telephonic) interview was used to collect data from the participants. The data were subjected to thematic analysis. The result showed that that; struggles with the use and lack of Internet-of-Things and unstructured work-hours were the significant challenges that affected online tutorial sessions. On the other hand, the study also found out that students need ICT training and devices, including motivation for performance. Therefore, we recommend that training of ICT and provision of devices alongside strong motivation should be ensured.

Otero, V. K. (2020). *Learning Assistants take compassionate leadership online during difficult times*. Colorado State University-Bolder. Bolder, CO. https://www.colorado.edu/education/2020/04/13/learning-assistants-take-compassionate-leadership-online-during-difficult-times

In addition to providing a short history of the LA Model, the author talks about how the LA Model responded to COVID-19 and a shift to online learning. Not surprisingly, Learning Assistants are leading the charge of creating meaningful, compassionate online experiences for students during the COVID-19 crisis. They are supported by mentors and a course on teaching and learning, and they have formed an interdisciplinary community ofLearning Assistants from all over the world who are supporting students and faculty during the online transition.

Phelan, L., Baker, S., Cooper, G., Horton, T., Whitling, S., Hodge, P., . . . McBain, B. (2022). Putting the PASS in class: Peer mentors' identities in science workshops on campus and online. *Journal of Peer Learning, 14*(1), 21-36. https://ro.uow.edu.au/ajpl/vol14/iss1/3.

In this paper, we analyse the introduction of peer mentors into timetabled classes to understand how in-class mentoring supports students' learning. The peer mentors in this study are high-achieving students who previously completed the same course and who were hired and trained to facilitate Peer Assisted Study Sessions (PASS). PASS gives students the opportunity to deepen their understanding through revision and active learning and are typically held outside of class time. In contrast, our trial embedded peer mentors into classes for a large (~250 students) first-year workshop-based course. We employed a participatory action research methodology to facilitate the peer mentors' co-creation of the research process. Data sources include peer mentors' journal entries, student cohort data, and a focus group with teaching staff. We found that during face-to-face workshops, peer mentors role-modelled ideal student behaviour (e.g., asking questions) rather than acting as additional teachers, and this helped students to better understand how to interact effectively in class. The identity of embedded peer mentors is neither that of teachers nor of students, and it instead spans aspects of both as described using a three-part schema comprising (i) identity, (ii) associated roles, and (iii) associated practices. As we moved classes online mid-semester in response to the COVID-19 pandemic, mentors' identities remained stable, but mentors adjusted their associated roles and practices, including through the technical aspects of their engagement with students. This study highlights the benefits of embedding mentors in classrooms on campus and online.

Pittenger, A., & LimBybliw, A. L. (2013). Peer-Led Team Learning in an online course on controversial medication issues and the US healthcare system *American Journal of Pharmaceutical Education, 77*(7), Article 150. doi: 10.5688/ajpe777150. www.ajpe.org/doi/abs/10.5688/ajpe777150.

Objective. To implement peer-led team learning in an online course on controversial issues surrounding medications and the US healthcare system. Design. The course was delivered completely online using a learning management system. Students participated in weekly small-group discussions in online forums, completed 3 reflective writing assignments, and collaborated on a peer-reviewed grant proposal project. Assessment. In a post-course survey, students reported that the course was challenging but meaningful. Final projects and peer-reviewed assignments demonstrated that primary learning goals for the course were achieved and students were empowered to engage in the healthcare debate. Conclusions. A peer-led team-learning is an effective strategy for an online course offered to a wide variety of student learners. By shifting some of the learning and grading responsibility to students, the instructor workload for the course was rendered more manageable.

Prior, J. (2004). *Development of PAL Online: An analysis of the first part of a two-stage trial*. Unpublished manuscript. Oxford Brookes University.

This report abstract describes the use of Peer Assisted Learning (PAL) at Oxford Brookes University (England) in the

Business School. PAL is an adaption of the Supplemental Instruction (SI) program. The researcher are studying the impact with online academic support though the use of PAL leaders. Their role would be slightly different with a shift towards being more interventionist and less of a facilitator. This trial will form the first stage of a two stage trial. Stage two will be the implementation of online discussion on a large core module next term. The ultimate aim of the research is to develop a model for PAL online that covers areas such as site design, PAL leader training and support, the needs of both participant and leaders and the potential benefits for both groups.

R., L. J. B. (2022). *Effectiveness of mandatory online Supplemental Instruction in an introductory cell and molecular biology course.* (Ph.D. dissertation), University of Nevada, Reno, Reno, NV. https://scholar.google.com/scholar_url?url=https://scholarworks.unr.edu/bitstream/handle/11714/8350/Lau_unr_0139D_13900.pdf%3Fsequence%3D1%26isAllowed%3Dy&hl=en&sa=X&d=6311829942282155602&ei=zY3dY8CAAfzIsQKWmJjoDg&scisig=AAGBfm335k-C6BFr3MkpIg7SHDVDxtfYJg&oi=scholaralrt&html=&pos=1&folt=cit

The purpose of this study is to assess the effectiveness of a mandatory online supplemental instruction program in an introductory cell and molecular biology course at a community college in Northern Nevada. To accomplish this, the study focused on the dependent variable of course GPA, and the issuance rate of “D” or “F” letter grades and withdraws for students who enrolled in sections which used mandatory online supplemental Instruction. The theoretical framework of Vincent Tinto’s departure theory and Steve Astin’s student involvement theory guided this quantitative study. To accommodate this study, sections of introductory cell and molecular biology were re-designed to fit mandatory supplemental instruction into the weekly schedule. Student course GPA differences were assessed using the non-parametric Mann-Whitney U test. Student demographics and environmental demographics, including mandatory supplemental instruction attendance, were assessed using a multiple linear regression model. A chi-square test of independence was used to identify any relationship between students who earned a D, F, ii or withdrew from the course, and their participation in mandatory supplemental instruction. Results indicate that students who enrolled in sections of introductory cell and molecular biology which incorporated mandatory supplemental instruction had significantly higher course GPA scores as compared to their counterparts. It was further identified that the number of sessions attended is directly proportional to a student’s GPA. These findings were strongest in traditionally disadvantaged populations suggesting that mandatory supplemental instruction is an effective way to bring equitable education to our systems of higher education.

Randloff, J. D., Maybee, C., Slebodnik, M., & Pelaez, N. (2014). *Why are we doing this? The role of personal relevance in developing biological information literacy using cyber Peer-led Team Learning*. Paper presented at the Impact Purdue, West Lafayetter, IN. www.docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1010&context=impsymposium.

Student-centered learning necessitates that students engage with an array of materials to develop their own understandings, often requiring students to find and critically engage with biological information. This project describes a course (BIOL 131; Biology II: Development, Structure and Function of Organisms) that utilizes cyber Peer-led Team Learning (cPLTL) as a student-centered approach to enhance students’ biological information literacy. Emphasizing the social aspects of learning, students work together in small groups led by a peer mentor using online meeting software. Scaffolded across the first half of the semester, students were given information literacy focused questions as part of a weekly problem set, beginning with finding images or videos on the Internet to eventually examining experiments to understand what kind of evidence biologists use to solve problems. In the cPLTL environment, students teach one another to be critical and consider ethical guidelines in using biological information. In the second half of the semester, the students applied what they had learned to create academic posters. The first iteration of the redesigned course was successful in making Biol 131 more student-centered and did enhance students’ biological information literacy. However, a review of the small group sessions revealed some students did not make the connection between the weekly information literacy questions and developing a greater understanding of how biological information holds personal relevance. In the next iteration of the course, efforts will be made to reframe the information literacy component to emphasis students’ engagement with biological information in personally relevant ways.

Rawson, R., & Rhodes, C. (2022). Peer-assisted learning online: Peer leader motivations and experiences. *Journal of Peer Learning, 15*, 32-47. https://ro.uow.edu.au/ajpl/vol15/iss1/4.

This research explores the different types of motivation that inspired students to engage in an online peer-assisted learning (PAL) leader role. An interdisciplinary online PAL pilot programme at a university in the United Kingdom was reviewed to investigate the experience and perceptions of voluntary online PAL leaders. The purpose of the study was to address a paucity in knowledge about the motivations for this role, specifically from an online perspective, and to guide future online PAL leader recruitment. A thematic analysis of

in-depth qualitative semi-structured interviews was used to determine emerging and relevant themes. Three research questions guided the interviews, and findings are presented in response to these questions. Findings indicate that different types of intrinsic and extrinsic motivation were key reasons for engaging in the online PAL leader role. The participants expressed an altruistic and empathic approach towards volunteering. Potential personal benefits motivated their participation, including improved study skills, transferable skills, and the possibility of an award. These motivations fell into two significant themes: the awareness of personal gain and the emergence of a desired version of self. Recommendations are made for the recruitment and training of online PAL leaders and the logistics of the scheme to ensure it is well advertised, accessible, endorsed by academic staff, and combines synchronous and asynchronous modes. It is hoped that this research will be valuable given the shift to online study and blended learning in response to and as an outcome of the COVID-19 pandemic and the value placed on interactive virtual spaces to minimise isolation.

Rockefeller, D. J. (2003). An online academic support model for students enrolled in Internet-based classes [Dissertation, University of North Texas, 2000]. *Dissertation Abstracts International, 63*(09), 3095.

This doctoral dissertation from the University of North Texas describes a research study that examined the effectiveness of an experimental Supplemental Instruction (SI) program that utilized computer-mediated communication (CMC) rather than traditional SI review sessions. During the Spring 1999 semester, six sections of an introductory computer course were offered via the Internet by a suburban community college district in Texas. Using Campbell and Stanley's Nonequivalent Control Group model, the online SI program was randomly assigned to four of the course sections with the two remaining sections serving as the control group. The students hired to lead the online review sessions participated in the traditional SI training programs at their colleges, and received training conducted by the researcher related to their roles as online discussion moderators. Following recommendations from Congos and Schoeps, the internal validity of the groups was confirmed by conducting independent t-tests comparing the students' cumulative credit hours, grade point averages, college entrance test scores, and first exam scores. The study's four null hypotheses were tested using multiple linear regression equations with alpha levels set at .01. Results indicated that the SI participants earned better course grades even though they had acquired fewer academic credits and had, on average, scored lower on their first course exams. Both the control group and the non-SI participants had average course grades of 2.0 on a 4.0 scale. The students who participated in at least one SI session had an average final course grade of 2.5, exceeding their previous grade point average of 2.15. Participation in one SI session using CMC was linked to a one-fourth letter grade improvement in students' final course grades. Although not statistically significant, on the average, SI participants had slightly better course retention, marginally increased course satisfaction, and fewer student-initiated contacts with their instructors.

Rokusek, B., Moore, E., Waples, C., & Steele, J. (2022). Impact of Supplemental Instruction frequency and format on exam performance in Anatomy and Physiology. *HAPS Educator, 26*(2), 5-13. doi: https://doi.org/10.21692/haps.2022.013. http://files.eric.ed.gov/fulltext/EJ1361206.pdf.

Supplemental instruction (SI) has been shown to be effective in increasing student success in a wide variety of disciplines. Our study investigated the impact of the number of SI sessions attended on student success on exams and the effectiveness of remote SI compared to face-to-face (FTF) SI. Data were gathered for nearly 1,200 students enrolled in the first semester of a sophomore-level anatomy and physiology course at the University of Nebraska at Kearney (UNK). The number of SI sessions each student attended, if any, prior to each exam was compared to exam performance. Results for 2013 – 2017 demonstrated that attending even one SI session had a positive impact on exam performance, and an increase in exam performance was seen with additional SI attendance up to three sessions prior to each exam. We took advantage of the remote SI offered in the Fall of 2020, due to COVID-19, to investigate a potential effect of delivery format on SI effectiveness. There was no difference in exam performance for students attending SI FTF (2019) compared to students attending remote SI (2020), while attending SI in either format was associated with better exam scores. Our study is unique in examining the effectiveness of SI attendance at the level of individual exam performance and adds to the body of evidence that SI, whether FTF or remote, is effective in improving student success.

Rowe, J. A. (2019). *Synchronous and asynchronous learning: How online Supplemental Instruction influences academic performance and predicts persistence.* (Ph.D. dissertation), Capella University.

While Supplemental Instruction (SI) programs have garnered wide support in educational research literature and adoption in higher education, the impact of Online Supplemental Instruction (OSI) remains unknown. Using the theoretical framework of social cognitive theory, this study compared the impact of synchronous OSI and asynchronous OSI on academic performance, and in terms of how OSI predicts persistence. The goal was two-fold: to consider if similar academic and persistence benefits predicted from SI extend to OSI, and to investigate how academic performance and persistence of students listening to asynchronous recordings

might differ from students attending live synchronous OSI sessions. An ANOVA procedure was used to investigate academic performance, and a logistic regression procedure was used to investigate persistence to test two hypotheses with a sample of 1727 (N = 1727) online graduate students. Results were significant for both synchronous and asynchronous groups, indicating that OSI is comparable to SI in terms of having a positive impact on academic performance when compared to students with no OSI exposure. Persistence results were significant for OSI as a whole and specifically for students who attended synchronous OSI.

Servin, C., Pagel, M., & Webb, E. (2023). *An authentic Peer-Led Team Learning program for community colleges: A recruitment, retention, and completion instrument for face-to-face and online modality* Conference Proceedings of the 54th ACM Technical Symposium on Computer Science Education https://dl.acm.org/doi/pdf/10.1145/3545945.3569851

The Peer-Led Team Learning (PLTL) teaching model has been widely applied in several four-year institutions in STEM areas, including Computer Science. Although only a few two-year colleges have adopted similar teaching models, the number of contact hours and interaction between peer leaders and students are limited, and the implementation of an authentic PLTL model is constrained by students' schedules and location accommodation. The propelled migration from face-to-face to online classes during the COVID-19 pandemic surfaced dissemination and implementation of such model alternative. The PLTL model was implemented for the fundamentals of Computer Science, i.e., CS 1, 2, and 3, where peer leaders learned pedagogical techniques, designed, implemented, and proctored programming activities for the three courses online. In this paper, we report the experience of the PLTL model applied to a computer science program in a community college. Experience includes the peer leaders' growth in disseminating material to their peers and how this model measures course performance, recruitment, retention, and completion.

Shaw, C. S., & Holmes, K. E. (2014). Critical thinking and online Supplemental Instruction: A case study. *The Learning Assistance Review, 19*(1), 99-119.

A wealth of research is available regarding Supplemental Instruction (SI); however, a dearth exists regarding Online Supplemental Instruction (OSI) and critical thinking. This case study explored what was assumed to be known of critical thinking and investigated the extent to which critical thought was promoted within a university's OSIonline program. Survey and persistence data indicated the university's OSI program was successfully facilitating critical thinking. However, after conducting online session observations, based upon the Paulian critical thinking theory and the adoption of Bloom's taxonomy as a critical thinking model, the case investigation revealed the initial assumption was flawed

Smith, J., Wilson, S. B., Banks, J., Zhu, L., & Varma-Nelson, P. (2014). Replicating Peer-Led Team Learning in cyberspace: Research, opportunities, and challenges. *Journal of Research in Science Teaching, 51*(6), 714-740. doi: 10.1002/tea.21163. www.onlinelibrary.wiley.com/doi/10.1002/tea.21163/full.

This quasi-experimental, mixed methods study examined the transfer of a well-established pedagogical strategy, Peer-Led Team Learning (PLTL), to an online workshop environment (cPLTL) in a general chemistry course at a research university in the Midwest. The null hypothesis guiding the study was that no substantive differences would emerge between the two workshop settings. Students in the PLTL (n = 220) condition were more satisfied with their workshop and earned statistically significantly higher course grades, yet earned comparable standardized final exam scores. They also had lower incidence of students' earning D or F course grades or withdrawing from the course (DFW rates) than students in the cPLTL setting (n = 175). Interviews with 10 peer leaders and 2 faculty members, as well as discourse analysis of workshop sessions, revealed more similarities than differences in the two conditions. The final exam scores and discourse analysis support the null hypothesis and use of both face-to-face and synchronous online peer-led workshops in early science courses. In cPLTL, six to eight students and a trained peer leader participate in the virtual workshop session by logging into a web-conference, such as an Adobe Connect meeting. After logging in, each participant shares his or her webcam, microphone, and USB document camera. With guidance from the peer leader, the students complete problem sets, case studies, or other course-related content. The document camera share window permits students to observe one another's work, make comments, and provide peer guidance. Students may also form small groups and meet in virtual rooms to collaborate before reuniting with their full groups to discuss problems. Throughout the session, the peer leader maintains the ability to observe and interact with all participants. The cPLTL setup is similar to that of a two-way audiovisual data and document cameras, PictureTele, that enabled students at different locations to view student work with a document camera, but the statistics course Brown and Kulikowich (2004) studied did not include peer-facilitated collaborative group work. Similarly, the Interwise synchronous e-learning system utilized by the Open University of Hong Kong provided audio of classmates and visuals of shared files, but provided neither webcam view of classmates as they worked in partnership nor collaborative problem-solving activities (Ng, 2007). The cPLTL synchronous online workshop environment utilizes a combination of common web conferencing service user interface components (Mauser et al., 2011;

McDaniel et al., 2013), including: 1. Participant's list—displays the names of all participants who enter the room. This list permits the peer leader to identify who enters or exits the room during the session. 2. Audio/video sharing window—enables all participants in the workshop to see and hear each other during the virtual session. 3. Chat window—enables peer leaders to share instructions or web links to educational resources for activities. It can also be used as an alternate method of communication if a technical glitch were to occur with headsets, microphones, or web-cameras. 4. Presentation window—enables each student to share his or her own work with the document camera while viewing the work of all other participants at the same time. This setup allows for an environment in which students can collaboratively engage in problem-solving. 5. Two cameras—the principal technology component of cPLTL is the capacity to use two cameras simultaneously. The document camera displays each participant's work while web-camera captures the real-time image of the student. 6. Recordings—the peer leaders are trained to automatically record all cPLTL sessions, providing a valuable resource for faculty, peer leaders, students, and researchers. 7. Constant access to workshop recordings—students have access to the recordings of their workshop sessions, so they can review conversations any time.

Spangler, S., & Shah, K. (2022). Students' perception of assurance, utilization of a pilot program: Synchronized online discussions. *Issues in Information Systems, 23*(4), 111-118.

The IRB-approved research focuses on information technology students' (n=23) perceptions of comfort, confidence, and utilization of the pilot program to understand its value. The study questions the usefulness of academic instructors in higher education at a Southeastern Atlantic University's model to employ online synchronized lectures in LMS systems. The goal of the program focused on reducing anxieties and distance separation from online learners. The researchers' observations cannot be generalized to state that synchronized virtual appearances create an increase or propensity for online student retention. However, the research highlights positive student perceptions of comfort, confidence, and utilization of the program, like the use of embedded librarian program. Additionally, the findings indicate parallel considerations of students' perceptions of embedded programs and suggest limited notes of perceived greater levels of self-efficacy. Furthering, the researchers disclose a larger need for a cross-generational quantitative study and note the geographical limitations, socio-economic constraints, and technology gaps limitations create the inability to generalize the study to a larger population.

Spaniol-Mathews, P., Letourneau, L. F., & Rice, E. (2016). The impact of online Supplemental Instruction on academic performance and peristence in undergraduate STEM courses. *Supplemental Instruction Journal, 2*(1), 19-32. www.info.umkc.edu/si/wp-content/uploads/2016/09/siJ-Volume-Two-Issue-One.pdf.

Though demonstrated as an effective strategy for enhancing academic performance and course persistence in higher education, traditional Supplemental Instruction (SI) relies on face-to-face interaction in a classroom setting. Consequently, students who have other obligations or feel apprehensive in a group setting often cannot attend traditional SI sessions. This paper focuses on an innovative alternative to traditional SI: an online SI program currently being implemented at Texas A&M University-Corpus Christi (TAMUCC). This paper describes TAMUCC's online SI program and discusses results from a pilot study that compared the STEM course performance and persistence of TAMUCC undergraduates (N=585) randomly assigned to SI groups (i.e., traditional SI or online SI) in the spring semester of 2015. Online SI is essentially the same as traditional SI, except that SI Leaders and participants interact through a personal computer or other hardware device instead of in a face-to-face environment (Boggs, Heaney, Kramer, & Williams, 2011). SI Leaders ask questions and share content such as study guides, exercises, videos, PowerPoint presentations, and other documents on the virtual whiteboard. SI Leaders and participants communicate with one another by using a microphone and headset or by typing, which allows participants to receive feedback and communicate with the SI Leader without being constrained to a particular location. Moreover, because online SI sessions are recorded, students can view them anytime and as many times as they wish. Although a relatively recent phenomenon and not nearly as well studied as traditional SI, online SI models have been shown to have certain advantages over traditional sessions. Painter, Bailey, Gilbert, and Prior (2006) note that online SI allows students access to supplemental materials anytime, anywhere. Students who are anxious about speaking or solving problems in front of others may find online SI appealing because they are not surrounded by other students. Online SI sessions can be recorded and viewed multiple times for students who missed a session or need additional support. Moreover, even when the hardware, software, and technical support are suitable, students sometimes lack the requisite computer-literacy skills or technology (e.g., microphones and cameras) to fully engage in online SI sessions. Finally, in the online environment, SI Leaders may encounter difficulties managing students that would not occur in a traditional SI setting. For example, maintaining student attention can be challenging due to the students' ability to easily leave and reenter the discussion. In addition, SI Leaders may encounter communication issues with subjects such as math and chemistry because these disciplines utilize unique symbols that can be difficult to use in a digital format.

Taksa, I., & Goldberg, R. (2004). Web-delivered Supplemental Instruction: Dynamic customizing of search algorithms to enhance independent learning for developmental mathematics students. *Mathematics and Computer Education, 38*(2), 152-164.

Supplemental Instruction (SI) was modified for web delivery to increase its use and effectiveness of results for students. The focus was on serving developmental math students at the City University of New York.

Thirukumar, L., Siew, L. L., Hui, L. H., Pamidi, N., & Kadirvelu, A. (2021). *Online peer teaching in medical school during a pandemic period: A reflection.* Conference Proceedings of the 13th International Conference on Computer Supported Education. www.www.scitepress.org/Papers/2021/104736/104736.pdf

Peer-teaching has been rapidly adopted throughout higher education institutions, including medical schools, to provide students with a diverse learning environment and to enhance academic development. Peer assisted study session (PASS) is a peer-teaching program implemented in Monash University Malaysia and was conducted virtually during the COVID-19 pandemic. Perspectives from the viewpoint of peer tutors during the pandemic period are presented in this paper. Throughout the year, peer tutors were confronted with the unique challenges of teaching virtually. Various factors which contribute to changes in the dynamics of groupbased discussions in online classes are discussed. On online platforms, students are graced with more privacy and freedom, a double-edged sword that can translate into reduced student engagement. Nonetheless, the practical skills acquired by adapting to the abrupt switch from on-campus to online peer-teaching can be employed in our future practice as health professionals.

Varma-Nelson, P., & Banks, J. (2013). PLTL: Trackng the trajectoryh from face0to0face to online environments. In T. Holme, M. Cooper & P. Varma-Nelson (Eds.), *Trajectories of chemistry education innovation and reform* (pp. 95-110): American Chemical Society

Over the past three years, an interdisciplinary team of investigators, led by Varma-Nelson, has worked to adapt the Peer-Led Team Learning (PLTL) instructional model to a cyber-environment (aka cPLTL). PLTL is a pedagogy that preserves the lecture and replaces the course recitation with a weekly two-hour workshop in which six to eight students work collaboratively to solve challenging problems under the guidance of a peer leader. cPLTL is the “cyber” evolution of PLTL to an online format. The team’s work represents a new direction for educational research and expands the knowledgebase on teaching science, technology, engineering and mathematics (STEM) concepts, while using technology as an educational tool. With funding from the National Science Foundation (NSF) and the Next Generation Learning Challenges (NGLC) initiative, the team is examining cPLTL’s impact on student performance. Analysis of course grades and standardized exam scores has shown cPLTL’s positive impact on educational outcomes. This chapter traces the evolution of a pedagogy developed for the face-to-face classroom environment to an online platform. Specifically, it outlines the rationale that led to the development of cPLTL; describes how technology was integrated into the PLTL model; summarizes its effectiveness, outcomes, and lessons learned; and speculates on the future use of cPLTL.

Varma-Nelson, P., Newbrough, R., Banks, J., Janke, T., Shuck, L., Zhu, L., . . . Smith, J. (n.a.). Cyber Peer-Led Team Learning: Taking the classroom experience online. *Online Learning Consortium*. www.secure.onlinelearningconsortium.org/effective_practices/cyber-peer-led-team-learning-taking-classroom-experience-online.

Peer-Led Team Learning (PLTL) is a model of teaching that preserves the lecture and replaces recitation in science courses with a weekly two-hour session. During these interactive sessions (workshops), six to eight students work as a team to solve carefully constructed problems under the guidance of a peer leader. Web conferencing software makes it possible to adapt this face to face pedagogy to a synchronous online environment. This led to the development of cyber Peer-Led Team Learning (cPLTL). Preliminary data gathered through our implementation of cPLTL at IUPUI indicates that it is possible for students to engage in productive problem solving under the guidance of a peer leader in a synchronous online environment via web conferencing software. cPLTL methods engage students as active participants, not passive recipients, in online activities that involve complex problem solving, working collaboratively, communicating effectively, and fostering self-directed learning. Indiana University-Purdue University Indianapolis (IUPUI), Purdue University (PU) at West Lafayette in Indiana, and Florida International University (FIU) are participating as a consortium to test the transportability of Cyber Peer-Led Team Learning (cPLTL) developed at IUPUI. The model has been studied and is showing positive impact on student learning in introductory chemistry. Purdue and Florida International Universities (FIU) were selected as replication sites because they have the infrastructure and the interest necessary for introducing cPLTL into their introductory biology courses. Peer-Led Team Learning (PLTL), the face-to-face predecessor to cPLTL, has proven to be a high-impact pedagogy in the Science Technology, Engineering, and Mathematics (STEM) disciplines (Gafney & Varma-Nelson, 2008; Gosser, Kampmeier & Varma-Nelson, 2010). This project has made it accessible in the

online

Watts, H., Makis, M., & Billingham, O. (2015). Online Peer Assisted Learning: Reporting on practice. *Journal of Peer Learning, 8*(1), 85-104. www.ro.uow.edu.au/ajpl/vol8/iss1/8/.

Peer Assisted learning (PAL) in-class is well-established and flourishing in higher education across the globe; nevertheless, interest is growing in online versions and is reflected by a number of pilot schemes. These programs have responded to perceived and actual needs of students and institutions; they have explored the available software packages and have begun to create a bank of learning through academic publications, institutional reports, evaluations, and SINET listserv discussions. This paper examines existing online PAL practice from Australia, Canada, the UK and the USA, and focuses on synchronous modes. We discuss (a) the context, mode, and scope of online PAL, and (b) implementation considerations. Despite some “teething problems” of these pilots we are convinced by the early and so far limited explorations highlighted here that online PAL can make a significant contribution to learners in higher education by improving engagement through the flexibility afforded by the online space.

Weidler-Lewis, J., Pierce, D., & Walter, C. (2013). *Conflicting discourses: An examination of "time" in online learning courses facilitated by Learning Assistants.* Conference Proceedings of the EdMedia 2013-World Conference on Educational Media and Technology, Victoria, Canada. https://www.learntechlib.org/primary/d/112037

The Colorado Learning Assistant Program is an innovative experiential learning program to improve Science, Technology, Engineering, and Math (STEM) education in undergraduate classrooms. Successful STEM undergraduates are hired to facilitate small-group interactions, attend a pedagogy seminar, and participate in a learning community. Until recently, this program has only been in a face-to-face environment. This paper examines the implementation of this program in online STEM courses. A major challenge implementing this program online is the conflicting discourses of "time" between the instructors, students, and learning assistants.

Williams, D. P. (2022). vPBL: Developing a facilitated remote approach to Problem Based Learning. *Journal of Chemical Education, 99*(4), 1642-1650. doi: https://doi.org/10.1021/acs.jchemed.1c01068. https://pubs.acs.org/doi/pdf/10.1021/acs.jchemed.1c01068.

A classroom based Problem Based Learning (PBL) activity was adapted to run as a remote activity during the COVID-19 pandemic using an approach described as virtual Problem Based Learning (vPBL). vPBL is based on (i) identification of a suitable learning platform that supports collaborative working in a way that mimics the classroom based activity and provides additional flexibility for teams to work together, and (ii) adaptation of the problem structure to provide additional time for students to work together and additional facilitated support where needed. Student performance and self-reported levels of transferrable skills development in the vPBL activity were as good as they were in the PBL version of the same activity. Furthermore, the transition to vPBL appears to have no negative impact on student learning and development. Although there was evidence to suggest students in the vPBL cohort collaborate between sessions to a similar extent as their colleagues who learnt primarily through interactive online lectures, there was evidence of greater use of some collaborative digital learning tools (audio and video chat and desktop and file sharing) in the vPBL cohort.

Wilson, S. B., & Varna-Nelson, P. (2019). Characterization of first-semester organic chemistry Peer-Led Team Learning and Cyber Peer-Led Team Learning students’ use and explanation of electron-pushing formalism. *Joournal of Chemical Education, 96*(1), 25-34. doi: 10.1021/acs.jchemed.8b00387.

The purpose of this parallel convergent mixed methods study was to characterize organic chemistry students’ expression of electron-pushing formalism skills who had participated in peer-led team learning (PLTL) and cyber Peer-Led Team Learning (cPLTL), a synchronous online version of Peer-Led Team Learning (PLTL) workshops. A new electron-pushing formalism analytic framework was developed from a review of the literature in addition to analysis of students’ interview artifacts, using a constant-comparison process. Utilization of this new electron-pushing formalism analytic framework for coding student interview artifacts revealed that cPLTL students were significantly less likely to successfully draw the product suggested by the curved arrows than their PLTL classmates. Implications for instructors are suggested, including encouraging students to verbally explain their rationale while drawing mechanisms as well as optimizing graphical collaborative learning activities for online learners.

Wilson, S. B., & Varna-Nelson, P. (2021). Implementing Peer-led Team Leanring and Cyber Peer-Led Team Learning in an organic chemistry course. *Journal of College Science Teaching, 50*(3), 44-50. www.digital.nsta.org/publication/?m=12081&i=687685&p=44.

Peer-Led Team Learning (PLTL) is a small-group, collaborative problem-solving model that has significantly increased student performance in a variety of chemistry undergraduate courses and other STEM courses.

Cyber Peer-Led Team Learning (cPLTL), an online adaptation of PLTL, has been effective in general chemistry courses, but this study was the first to evaluate the impact of implementing cPLTL in an organic chemistry course. Organic chemistry is a pivotal course in the curriculum of several science majors and preparation for health professions schools. Therefore, it is important to assess an academic intervention with the possibility of improving course performance and retention of science, technology, engineering, and mathematics (STEM) majors. In this study, the course performance and student perceptions from four "comparison group" PLTL and cPLTL sections were analyzed. The results of this study support the hypothesis that implementation of PLTL/cPLTL programs increases both students' performance and perceived learning gains in an organic chemistry course. Moreover, this study demonstrates that a typically face-to-face active learning intervention can be successfully transitioned to an online setting

Woolrych, T., Zaccagnini, M., Stephens, M., Stace, M., Middleton, R., Stephen, M., . . . Kornhoff, A. (2018). *Peer Assisted Study Sessions (PASS) Online: Investigating the impact of an online format across different first year university subjects.* Conference Proceedings of the 2018 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE), Wollongong, NSW, Australia. www.ro.uow.edu.au/cgi/viewcontent.cgi?article=5571&context=sspapers

As the demand for flexible learning increases, it is important to explore and expand online learning opportunities, especially in student supported learning. Peer Assisted Study Sessions (PASS) is a student led academic support program designed to help students transition into university and increase student retention. PASS is offered in traditionally challenging first year core subj ects. Due to increased popularity of PASS, along with limited space and time availability, a synchronous online format (Blackboard Collaborate) was piloted in three first year University of Wollongong (UOW) subjects in the faculties of Business, Nursing, and Psychology. The aim was to test the effectiveness of the online delivery of PASS by comparing student final grade outcomes from online cohorts with face-to-face (F2F) modes, and those students who had not attended PASS. Results demonstrated that students who attended PASS obtained significantly higher marks compared to students that did not attend PASS. Final grade outcomes for F2F versus online also varied between subjects. The different result profiles for the three subjects suggests there may be different drivers for student success in the online space. This paper presents these findings providing consideration of different factors that may influence student success, with directions for future research.

Young, J. D., & Lewis, S. E. (2022). Evaluating Peer-Led Team Learning integrated into online instruction in promoting general chemistry student success. *Journal of Chemical Education*. doi: doi.org/10.1021/acs.jchemed.1c01118. www.doi.org/10.1021/acs.jchemed.1c01118.

This study seeks to examine the effectiveness of peer-led team learning (PLTL) pedagogy when it is implemented in an entirely online environment. Past evaluations of PLTL have demonstrated the effectiveness of this approach when used with in-person teaching, but an online environment is expected to pose unique challenges to students, and therefore, the past work may not generalize to an online environment. The study implemented PLTL within four classes of second-semester general chemistry each offered online. The classes were evaluated in reference to six classes of the same course, also taught exclusively online, that relied primarily on didactic instruction. The evaluation showed the average score for students with online PLTL ranged from 0.15 to 0.20 standard deviations better than students with online didactic across the tests and final exams and that this difference was partially explained by past performance. Further, online PLTL students had a higher likelihood of earning a passing grade in the class which corresponded with a lower proportion of students failing and a lower proportion of students withdrawing from the course. The results indicate that PLTL was an effective instructional technique within an online modality at the research setting.

Zvoch, K., Letourneau, L. F., & Spaniol-Mathews, P. (2023). The effect of Supplemental Instruction on STEM course performance. *American Journal of Distance Education*. doi: https://doi.org/10.1080/08923647.2023.2165355.

This study investigates the relative impact of online delivery of supplemental instruction (SI) to undergraduate students enrolled in STEM courses at a large, four-year, Hispanic Serving Institution (HSI) in the southern United States. A multi-condition, randomized trial comparing the relative performance of in-person to online SI was implemented across 20 classroom-based courses over six academic semesters. Application of multilevel ordinal regression models to data obtained from implementation of two experimental conditions revealed that students assigned to in-person SI had higher final course grades than their online SI counterparts, but only when the online SI condition did not include access to the session recordings. These results suggest that synchronous online delivery of SI can be as efficacious as in-person SI when supplemented with asynchronous course resource supports. Implications for the design and future testing of SI models are discussed.