

RESEARCH ARTICLE

An operational solution to supplemental instruction session design and quality control

Hunter Sowell¹ , Lindsey M. McInturff² , Sarah P. Collier² 

¹ Department of Pharmacy, University of Louisville Hospital, Louisville, Kentucky, United States

² Lipscomb University College of Pharmacy, Nashville, Tennessee, United States

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Correspondence

Sarah P. Collier
Lipscomb University College of Pharmacy
Nashville
Tennessee
United States
sarah.collier@lipscomb.edu

Abstract

Background: Supplemental Instruction (SI) is a peer-led academic support program and form of pre-remediation assistance. One challenge to SI adoption is the absence of session design recommendations and mechanisms of quality control. Herein, a data-informed operational framework is presented resulting in consistent weekly session design and an increase in collaboration between SI leaders and their course faculty. **Methods:** Sessions in the fall of 2020 were hosted on Zoom in support of a Microbiology and Immunology course. Greater than 44% of program year one (PY1) students voluntarily attended an SI session. Pre-and post-quiz assessments used Mentimeter, an audience polling platform. **Results:** A mean of 25.2% aggregate performance improvement was found between the pre-quiz and post-quiz assessment data. **Conclusion:** The quiz assessment results immediately informed personalised content review during each session and empowered feedback integration between the peer leader and faculty. The framework described improves a well-established program and is widely adaptable to any course offering.

Introduction

Supplemental Instruction (SI) is an established academic support program created to address issues of student attrition in historically difficult courses by refocusing academic support from an individual student to any student in a course (Arendale, 1994; Blanc & Martin, 1994). Frequently referred to by the pseudonyms peer-assisted learning (PAL), peer-led tutoring, or peer-assisted study sessions (PASS) (Dawson *et al.*, 2014; Nwaesei & Liao, 2022), SI leverages near-peer leaders to facilitate study sessions in a casual group setting. SI programs and session structures are easily adaptable to any course size with implementation over the past five decades in larger undergraduate STEM didactic courses (Blanc & Martin, 1994; Burkholder *et al.*, 2021) as well as in professional health education (Hurley *et al.*, 2003; Sammaraiiee *et al.*, 2016; Sawyer *et al.*, 1996; Varshney & Mason, 2019).

Schools and colleges of pharmacy were early adopters of SI programs in response to emergent issues of attrition and assisting students with academic risk (Fjortoft, 1993; Maize *et al.*, 2010; Nwaesei & Liao, 2022). Pharmacy-related SI sessions improve understanding of course content, improve grades, and reduce the risk of failure (Micallef & Slater, 2018; Spivey *et al.*, 2021). Despite the established benefits of SI programs in pharmacy education, a consensus on SI session design and best practices for execution remains unexplored. SI or other peer-led study sessions describe variability in perceived attendee benefit as well as programmatic and session design formats (Collier *et al.*, 2022; Mosley *et al.*, 2013; Varshney & Mason, 2019). Additionally, the assessment of session effectiveness independent of which strategies are used in SI sessions (e.g., self-assessment methods, active learning, and technology integration) is a present gap in the landscape of SI literature. Anecdotally, faculty may hesitate to invite an outside voice in the instruction of their students for fear of inspiring

misunderstandings, yet neither faculty nor peer leaders are equipped with a consistent and collaborative communication plan.

Lipscomb University College of Pharmacy provides SI support to PY1 and program year two (PY2) student pharmacists in the didactic pharmaceutical sciences coursework (Microbiology and Immunology; Anatomy and Physiology; Pharmaceutical and Medicinal Chemistry; and the Pharmacology sequence). Peer leaders are nominated by course coordinators based on their previous course performance and are modestly compensated for designing, preparing, and facilitating SI sessions. Peer leaders work closely with the course faculty to remain current on active student needs in the classroom environment. Communication between peer leaders and faculty is critical and serves as the quality control between academic years as the peer leaders do not actively audit the course. While program administration and peer leader orientation are managed centrally, best practices around SI session design, evaluation of session success, and feedback for future incorporation into the classroom are lacking. Peer leaders autonomously host sessions each week with varying degrees of guiding input from teaching faculty mixed with their past experiences in the course and personal preferences in classroom settings. Therefore, this study aims to report on a data-informed operational approach to weekly peer-led SI session design in a pharmacy context.

Methods

The Lipscomb University Institutional Review Board approved the retrospective, quality improvement project as an exemption. It offers a traditional, four-year doctor of pharmacy program. SI session design involves weekly 90-minute review sessions via Zoom led by a near-peer student leader. The institutional infrastructure provided the Zoom and “Pro” Mentimeter account access. The unique attendance from voluntary attendees was summed by session for the entirety of SI offerings supporting the fall 2020 Microbiology and Immunology PY1 course. The SI session schedule for this course included ten standard sessions and three exam review sessions during one semester. The Mentimeter pre-quiz assessment results informed the priority topics requiring review during the live session followed by a paired Mentimeter post-quiz assessment to conclude the session. Mentimeter poll scores were accessed in aggregate per session and analysed in Excel sheets.

Results

An operational framework was designed and implemented in the fall 2020 academic semester prioritising communication and collaboration between the peer leader and teaching faculty corresponding to a PY1 Microbiology and Immunology course (Figure 1).

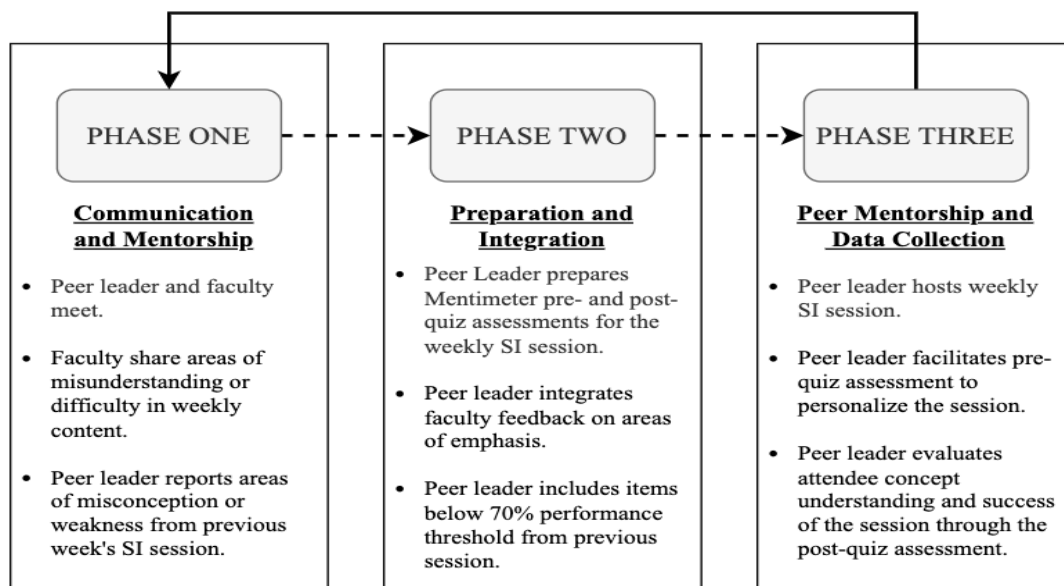


Figure 1: SI session operational framework

Divided into three phases, the framework served as the scaffolding for each weekly SI session. In Phase One, the peer leader and faculty member met to evaluate the previous SI session data and prepare for the upcoming session emphasising Communication and Mentorship. The peer leader identified areas of content weaknesses and misconceptions among attendees from the past SI session via the outgoing Mentimeter poll. Empowered with these formative data, the faculty member was able to specifically address misconceptions promptly in the subsequent class meeting. In return, new concepts or perceived student difficulties from the classroom environment requiring emphasis by the peer leader were communicated by the faculty member.

In Phase Two, the peer leader applied faculty feedback to the weekly session design with a focus on Preparation and Integration. A paired pre-and post-quiz assessment was designed using Mentimeter, an interactive audience polling platform, for equitable and accessible use of a learner's device (phone, tablet, or computer). Additionally, Mentimeter was selected to increase participant engagement via a "gamified" active-learning strategy in a remote environment. Approximately 17 items in multiple-choice format were included in the paired pre-and post-quiz assessments. The peer leader also prepared an abbreviated slide presentation based on new lecture materials and areas of emphasis identified by the faculty member.

The peer leader executed the planned activities in Phase Three by hosting the remote SI session with the goal of Peer Mentorship and Data Collection. Participants entered the Zoom meeting and were guided to Mentimeter.com with the instruction to complete the pre-quiz assessment. Session attendees were allotted 15 minutes to engage with the pre-quiz assessment without a preview of aggregate responses or an item-by-item explanation. In response to the observed pre-quiz assessment performance, the peer leader personalised the 50-minute didactic explanation. Session attendees were encouraged to openly discuss concepts and ask content questions from their peer leader during this time. The SI session concluded with attendees reattempting the paired items in the post-quiz assessment with active peer leader explanations, offering concept study strategies, and peer mentorship. The post-quiz assessment captured a timely change in performance relative to the baseline and guided peer leader reflection on session success. A pre-determined item performance threshold (70% aggregate pass rate) was applied. Items that fell below the threshold informed areas of additional explanation and classroom support needed from the faculty member. Additionally, these items were included in the subsequent SI session's post-quiz assessments to support ongoing concept review.

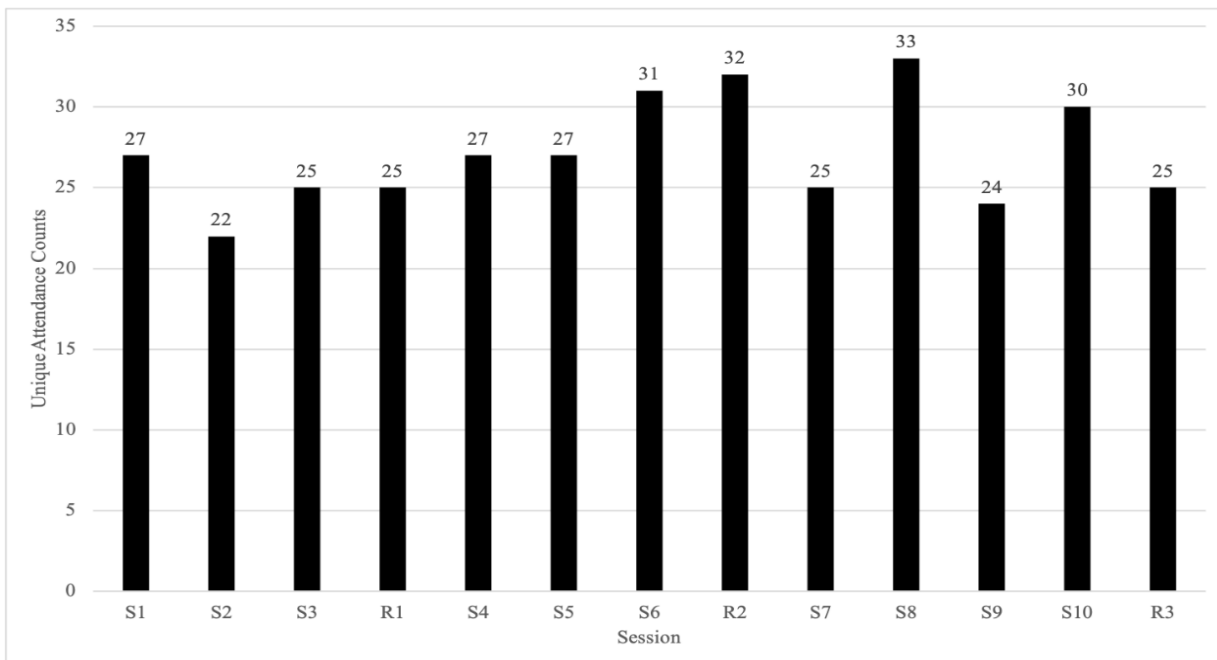
The Microbiology and Immunology SI session characteristics from the fall of 2020 are described (Table I). Ten regular academic sessions were held throughout the 18-week semester with three exam review sessions. Over 44% of the PY1 cohort attended one or more SI sessions in support of the Microbiology and Immunology course with 27 students attending a session on average. The pre-and post-quiz assessments posed approximately 17 questions to balance the time spent in the session on the audience polling platform.

Table I: Summary of SI session characteristics

Item	Quantity
Number of SI sessions per academic semester	10
Number of exam review sessions	3
% of PY1 cohort who attended \geq 1 SI session	44 (%)
Item	Average (range)
Pre- and post-quiz assessment items posed per session	17.4 (15-23)
Number of students in attendance per session	27 (22-33)
Session duration	90 minutes

Consistent weekly attendance was observed among PY1 learners throughout the semester. While the academic semester structure observes a block exam schedule, learner attendance remained above 20 students per session. While a transient increase in the number of attendees occurred at the academic semester midpoint (Figure 2) between block exam one and exam two, this growth trajectory was not sustained.

The paired pre-and post-quiz assessments served as the central mechanism for real-time data collection and guided session personalisation (Figure 3). Deployed at regular SI sessions in the semester (excluding exam review weeks), pre-quiz assessment performance was 60.7% on average (\pm 9% SD; 49% to 77% range). Following the personalised didactic portion of the SI session, participants were challenged with the same items appearing on a post-quiz assessment. A marked improvement was observed each week in pre-quiz assessment performance among session attendees. The post-quiz assessment performance average was 85.9% (\pm 4% SD; 79% to 94% range). Overall, an average 25.2% increase in attendee performance was noted between pre-and post-quiz assessments across the semester supporting a positive impact on student concept understanding.



Regular weekly SI academic sessions are noted by 'S#' whereas review sessions in preparation for the three summative block exams are noted by 'R#'.
Figure 2: Virtual SI session attendance across the fall 2020 academic semester

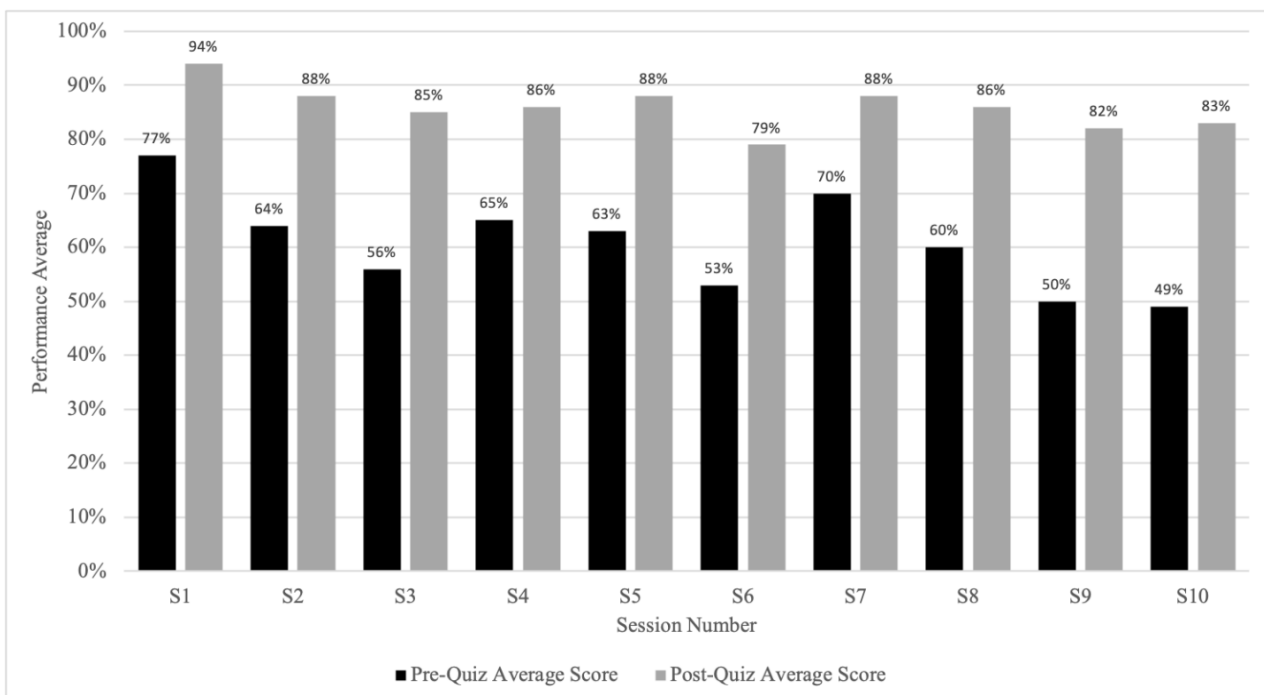


Figure 3: Attendees' performance averages by SI session in the fall 2020 semester

Interestingly, while learner attendance behaviours were consistent throughout the academic semester, learner engagement in the active learning portion was variable (Table II). The mean participation by item was evaluated for each session. The frequency of

participation in the pre-quiz assessment at the start of the session ranged from 75% to 94.8% of individuals present whereas the post-quiz assessment range exhibited 48.3% to 91.4% of participation. Also noteworthy is the absence of complete attendee

participation during the semester in the paired assessments. These data suggest that at a maximum, 25% of session attendees are allocating time to attend a remote study session yet may not be achieving the full benefit of participation.

Table II: Student pharmacist participation in pre- and post-quiz assessment by session

Session number	Total number of attendees	Mean participant number per question in pre-quiz assessment (range)	Mean participant number per question in post-quiz assessment (range)
S1	27	22 (21-23)	22 (21-22)
S2	22	17 (13-18)	18 (17-19)
S3	25	24 (22-25)	22 (19-22)
S4	27	22 (20-24)	23 (19-24)
S5	27	24 (24-25)	25 (21-27)
S6	31	24 (21-25)	24 (20-26)
S7	25	21 (20-24)	18 (14-19)
S8	33	26 (24-27)	26 (21-27)
S9	24	20 (18-21)	16 (13-18)
S10	30	25 (20-27)	15 (12-16)

Discussion

The operational approach presented aims to scaffold weekly SI session design and offer an efficient approach that prioritises data-driven assessment and personalized academic support for the learners in a PY1 Microbiology and Immunology course. Mentorship and collaboration between the peer leader and faculty member, as guided by the framework, enabled timely improvements at weekly SI sessions as well as in the classroom. Learners voluntarily joined the SI sessions and engaged with up to a maximum of 90% completeness in the pre-and post-quiz assessments hosted on the Mentimeter platform despite the session being hosted in a remote setting.

Importantly, the Microbiology and Immunology SI offering was one of three available weekly SI offerings that a learner was likely to attend in support of the PY1 curriculum. Therefore, if learners are allocating 90 minutes up to three nights per week to attend SI sessions for multiple courses, it is even more critical that SI sessions are delivered well and are a valuable return on their time investment. To this point, the fall 2020 Microbiology and Immunology course evaluations

explicitly mentioned the utility and value of SI attendance for this course, an outcome of the SI session design framework. The connection between SI session performance or attendance and a learner's course performance remains unexplored in this work limited by the deidentified nature of the pre-and post-quiz assessment data and study design. It is equally important to acknowledge the limitation of this study being conducted in a single college of pharmacy and with a limited sample size.

A significant and overarching challenge for SI programs is the measurable definition of success. Conventionally, the correlation between learner SI attendance and final course grades was the standard; however, this measure is challenged by the many variables surrounding learner motivation as well as the impact of active learning and modern pedagogies. Moreover, it ignores the evaluation of SI session effectiveness by defaulting to a learner's course grade when the goals of the individual SI sessions may be unfulfilled due to a lack of assessment. The operational framework herein addresses these concerns through intentional collaboration between peer leaders and faculty members to support learners in a course and promptly address observed concept misunderstandings with a unified voice. SI session assessment is also a benefit of the post-quiz assessment results over baseline in this approach. Not only can a peer leader reflect and measure the impact of the session related to concept understanding but the faculty and peer leader collaborative team can use these data to assess SI session strategies and topical issues related to active learners in the classroom.

Many factors are likely to influence a learner to utilize SI. In this study, 44% of first-year student pharmacists attended at least one SI session in support of the fall 2020 Microbiology and Immunology course. While SI academic support programs aim to create a smaller and casual review experience, as compared to a regular course meeting, SI sessions can morph into a cross-section of the classroom environment. Unfortunately, learners' feelings of safety to articulate misunderstandings may be compromised as the needs differ between higher and lower performers. Yet, the framework proposed allows for a data-informed approach to address this concern as item performance on the pre-quiz assessments ground the session and the peer leader is prepared to pivot content explanation based on participants' needs. SI session attendance trends are important to relate to the block exam structure in the context of this work. While SI session attendance in this dataset trended over 20 students per session, attendance is not an appropriate indicator of SI session success. Rather, increases in attendance exhibit dependency on the summative block exam schedule where SI sessions may be more heavily utilised for exam

preparation. Therefore, student motivations for attending SI may be of greater value to understanding.

Also important is the observation that session attendance does not equate with learner engagement. As observed, a subset of learners who voluntarily dedicate time to join a remote SI session yet remain passive within the session is quite curious. Participant engagement failed to reach 100% in any SI occurrence (Table II). This inspires the question of whether students who voluntarily attend, but incompletely participate still benefit. While the described framework centres on the academic needs of the learners present, SI has many secondary values such as peer mentorship and community building among learners. It is possible that self-assessment supported by the design strategy may not be important to PY1 learners in the first semester of their professional career or does not appeal to their individual learning preferences. Equally, the fear of missing out phenomenon or “FOMO” (Przybylski *et al.*, 2013) is another viable consideration as a motivation for passive SI attendance whereby hearing what peers say or ask holds greater value for an individual attendee. Therefore an additional area of exploration needed is the generational influences on the learner with an academic support benefit in mind.

Conclusion

The findings from this retrospective quality improvement study support the development of an integrated method that leverages formative pre- and post-quiz assessment data to inform timely peer-led learner support. Secondly, the framework nurtures intentional collaboration between the peer leader and course faculty to inform instructor-led clarification of outstanding misconceptions. The framework is based on the integration of technology tools that can be easily adapted across other courses and institutions and is not exclusive to Microbiology and Immunology courses in a college of pharmacy.

Conflict of interest

There is no conflict of interest.

Source of funding

The authors have no financial relationships or sponsorships to disclose.

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