american physiological society

ADVANCES IN PHYSIOLOGY EDUCATION

Adv Physiol Educ 48: 69–79, 2024.
First published November 30, 2023; doi:10.1152/advan.00211.2023

EDUCATION RESEARCH

Innovative Self-directed, Problem-oriented, Lifelong learning, Integrated Clinical case Exercise (SPLICE) modules promote critical thinking skills, early clinical exposure, and contextual learning among first professional-year medical students

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Abstract

Medical education is undergoing various transformations to promote a more personalized and contextual way of learning. In light of this, the innovative "Self-directed, Problem-oriented, Lifelong learning, Integrated Clinical case Exercise" (SPLICE) modules were designed, implemented, and evaluated for medical students in the first professional year as a strategy for early clinical exposure in a collaborative and self-directed way of learning. This is a mixed methods study involving first-year medical students. Students were divided randomly into the control and the intervention groups. Six SPLICE modules were administered to the intervention while the control group followed the traditional curricula. The educational outcome was compared using an end-of-module assessment. In addition, 13-item and 8-item questionnaires were administered to students to evaluate the SPLICE and plenary sessions on a 5-point Likert scale. Furthermore, students' feedback was obtained on a 10-point rating scale and in in-depth small-group interviews. The majority of students perceived that the SPLICE module improved their communication and encouraged meaningful, active learning. Students found the plenary sessions to be well organized, with sufficient interaction with professionals. Students also gave excellent scores for feedback on SPLICE modules, demonstrating the effectiveness of the innovation. In terms of test scores used in assessing learning outcomes, the intervention group outperformed the control group ($P < 0.0001$). The innovative SPLICE curriculum facilitated early clinical exposure and active self-directed learning. Students perceived SPLICE modules to be highly helpful in terms of promoting meaningful learning and the future application of knowledge.

NEW & NOTEWORTHY The very essence of this innovative "Self-directed, Problem-oriented, Lifelong learning, Integrated Clinical case Exercise" (SPLICE) curriculum is the team-based learning of integrated pre-, para-, and clinical learning objectives right from the first professional year of study serving as an early clinical exposure. This unique way of learning creates a holistic educational environment by combining both academic and professional development thereby empowering the next generation of physician leaders to take autonomy of their own learning strategies and emerge as competent lifelong learners.

active; contextual learning; early clinical exposure; lifelong learning; self-directed learning

INTRODUCTION

Medical education has witnessed a paradigm shift in recent years with unique and innovative strategies that transform the conventional teaching, learning, and assessment trends into more meaningful and effective practices in an evidence-informed manner (1). Considering the pitfalls of conventional curricula, recommendations have been made to enhance the quality of training for medical students in such a way that it promotes professional development with necessary competencies. Six fundamental graduate medical education competencies have been described by the Accreditation Council for Graduate Medical Education, which include medical comprehension, caring for patients, systems-based practice, pragmatic education and development, strong interpersonal abilities and communication, and professionalism (2). To achieve this, many reforms have been made to promote active and self-directed learning in medical education, but teacher-centered and passive methods of learning such as large-group didactic lectures are still practiced as the standard mode of educational delivery in the majority of medical schools (3).

The goal of medical education is to train students to emerge as competent health professionals who can offer high-quality patient care with compassion by mastering the knowledge and skills required in medical professions (4). Thus with the recognition of the large learning gap between gaining theoretical

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Submitted 29 September 2023 / Revised 31 October 2023 / Accepted 27 November 2023

knowledge and practical application, the component of early clinical exposure (ECE) has been introduced in medical schools worldwide and in India, as revised in the Competency-Based Medical Education Curriculum by the National Medical Commission (5). The predominant purpose of exposing students to clinical knowledge early in their education is to build a comprehensive understanding of medical concepts and humanities so that they are holistically trained in every aspect of offering quality healthcare. The key elements of ECE include the integration of clinical subjects with basic sciences, patient encounters, and ethics related to doctor-patient including humanistic care and empathetic communication (5). Focussing on the first component, case-based, video-based, and simulation-based approaches are adopted to integrate clinical competencies into core preclinical subjects.

The introduction of case-based learning (CBL) into preclinical subjects is now a requirement of the undergraduate medical curriculum as a part of formal teaching and assessment. The effectiveness of CBL has also been evaluated in many instances, and highly optimistic feedback has been received both from students as well as faculty (6–9). However, the effectiveness of teaching does not stop with only exposing the students to the clinical context. An efficient learning environment fosters collaborative and active learning where students are intrinsically motivated to learn and are guided by facilitators who provide timely and effective feedback in a constructive manner (10, 11). Following the pedagogical principles, learning is no longer a monotonous instruction but a self-directed approach to enhance critical thinking and lifelong learning (12). In light of this, many innovations in medical education have been introduced to promote self-directed learning and collaborative team-based learning with results reinforcing the effectiveness of such student-centered approaches (13–15).

Despite numerous innovations being introduced into medical education, there exists a gap in uniformly integrating all principles of learning. Attempts can be made to integrate pre-, para-, and clinical subjects including professional development into a single, standard, and student-centered comprehensive strategy. This should be valid, reliable, and feasible in terms of teaching, learning, and assessing the intended educational outcomes. Also, it can be implemented in all phases of medical education starting with ECE in the first year and reinforcing the concepts of basic sciences during clerkship. To this rationale, the innovative "Self-directed, Problem-oriented, Lifelong learning, Integrated Clinical case Exercise" (SPLICE) modules were designed and implemented for medical students in their first professional year to promote critical thinking skills, ECE, and contextual learning. To the best of my knowledge, this innovation is the first of its kind to integrate all subjects of medicine right from the first professional year of medical education incorporating a wide range of pedagogical foundations. The hypothesis is that students will perceive SPLICE to be effective and that there will be a significant improvement in students' performance when compared to traditional lecture-based teaching.

MATERIALS AND METHODS

Study Design

The study used mixed-method study design.

Study Setting

The study was conducted at Panimalar Medical College Hospital and Research Institute, Chennai, Tamil Nadu, India.

Study Participants

In this study, the students from the first professional year of Bachelor of Medicine and Bachelor of Surgery (MBSS) were randomly divided into two groups. The control group (*group A*; $n = 74$) followed the conventional classroom teaching with large-group lectures, and the intervention group (*group B*; $n = 74$) was tested with the SPLICE modules. Among the intervention group, the participants were divided into 15 small groups of 5 participants each. Each group was allotted a facilitator to guide and facilitate the learning of students.

Conceptualization of SPLICE

A time-based curriculum, often teacher-centered and reliant on large-group lectures and lengthy written assessments, can inadvertently foster ineffective teaching and passive learning (16, 17) This approach tends to result in reduced retention of information, information overload, lack of integration across topics, limited clinical exposure, and absence of immediate and effective feedback (18, 19).

Recognizing these challenges, the SPLICE innovation has been introduced as a potential solution. This approach is designed to transform traditional education by empowering students to take charge of their learning, focus on real-world problem solving, and foster lifelong learning habits through the integration of clinical case exercises (20). It seeks to address the limitations of the traditional teaching approach by transitioning to a student-centered learning environment. A student-centered learning environment promotes active engagement, independence, motivation, personalized learning, collaboration, critical thinking, real-world application, ownership of learning, lifelong learning, and empowerment (21, 22). This shift aims to promote active and contextual learning, which are considered critical in medical education (23). This approach also fosters collaboration and reflective thinking among students and is designed to provide timely and valuable feedback to enhance the overall educational experience (24).

This innovation has been designed with evidence-informed strategies. The primary goal is to foster active and contextual learning, which can be achieved through the implementation of case-based learning collaboratively and reflectively. This approach is not only expected to enhance students' learning experiences but also improve their retention of knowledge and application skills. Crucially, the provision of immediate and effective feedback by mentors plays a pivotal role in this process. This feedback loop is instrumental in guiding students, helping them understand their strengths and areas for improvement, and ensuring that their learning journey remains dynamic and adaptive. Furthermore, the team-based approach to learning is expected to improve their interpersonal skills. This collaborative environment will encourage effective communication, teamwork, and the development of essential skills that are not only valuable in academic settings but also in their future careers. This concept behind SPLICE is drafted as a conceptual framework following Bordage et al. (25): "Conceptual frameworks to guide research and development (R&D) in health professions education" (Fig. 1).

Designing SPLICE Modules

The SPLICE modules were designed by integrating clinical subjects with the core subjects of the first professional MBBS to promote ECE, critical thinking, and contextual learning. Six topics were selected and delivered as traditional lectures to *group A* and as SPLICE modules to *group B*. Each SPLICE module was intricately designed by integrating the topics with pre-, para-, and clinical competencies. All the specific learning objectives in each subject were clearly defined in the modules. The topics for six SPLICE modules were as follows: *1*) "bronchial asthma," *2*) "coronary artery disease" (CAD), *3*) "chronic obstructive pulmonary disease" (COPD), *4*) "hemolytic anemia," *5*) "nutritional anemia," and *6*) "systemic hypertension."

Implementation of SPLICE

The SPLICE modules were implemented in *group B* and traditional lectures were delivered to *group A*. Students in

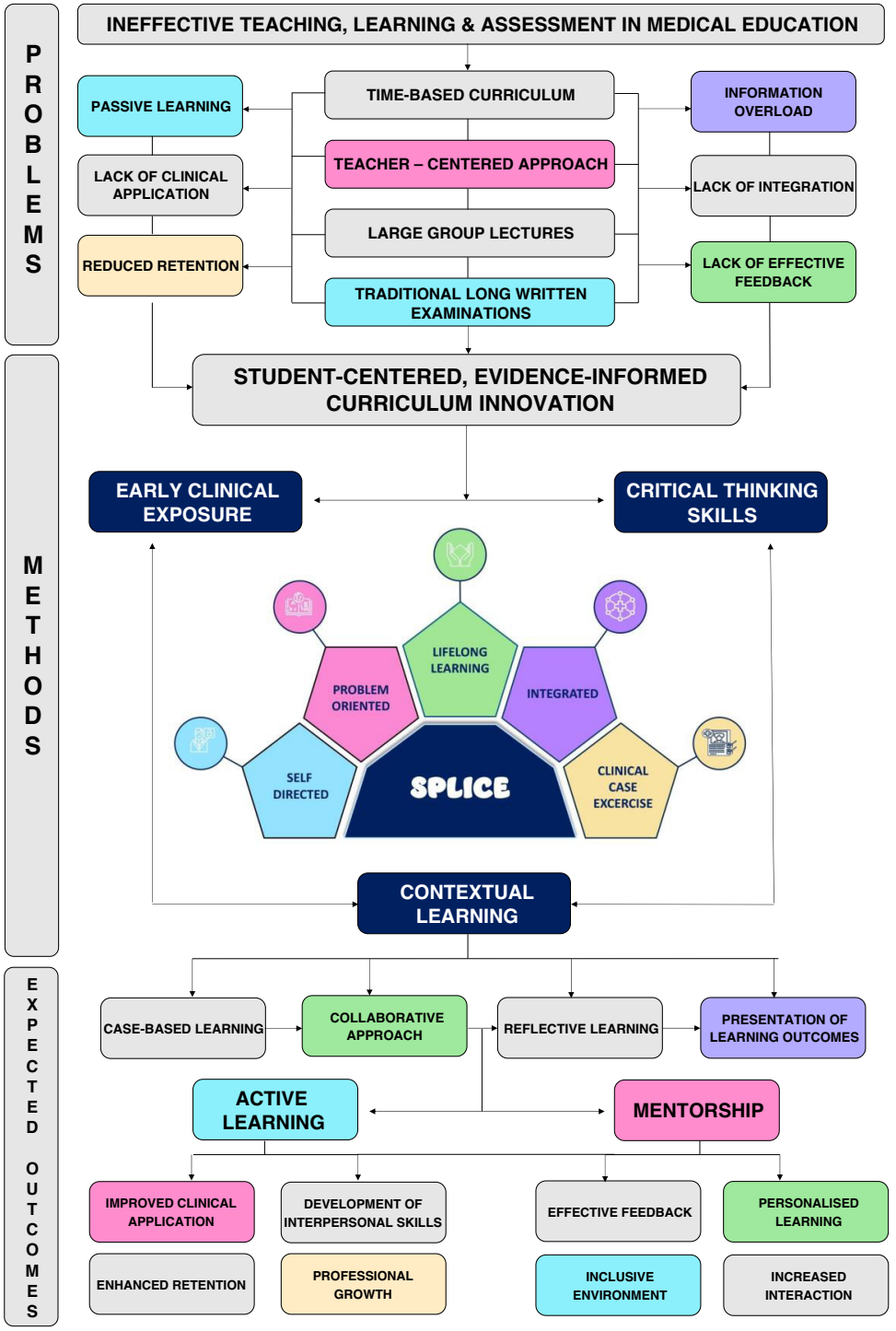

Figure 1. Conceptual framework for "Self-directed, Problem-oriented, Lifelong learning, Integrated Clinical case Exercise" (SPLICE).

the intervention group ($n = 74$) were divided into 15 small groups. The six modules were distributed one after the other and corresponding topics were covered as lectures to the control group. Each module was followed by a PowerPoint presentation in the plenary session. During this session, students from the 15 small groups within the intervention group collectively discussed, collaborated, and consolidated their learning outcomes within a stipulated time in a self-directed manner. Students were also encouraged to explore materials from many sources. Each team then prepared a PowerPoint presentation to deliver their learning outcomes by adhering to specific guidelines and templates provided to ensure a structured and informative presentation. A leader was assigned for each team to collate all the member's contributions into a single PowerPoint presentation. In the subsequent plenary session, all the students from each group presented their learning outcomes to a panel of expert faculty members. The time for presentation for each group was 15 min. The panel meticulously assessed the content, presentation skills, clarity, and overall impact of the information shared. Importantly, they provided immediate, constructive feedback, creating an interactive and informative feedback loop.

Assessment and Evaluation

The learning outcomes of students were assessed using an end-of-module assessment that was given to the students of both groups (control and intervention). The assessment was a multiple-choice test about the topic of the module and lecture. Both groups attempted the same assessment. The results were later statistically analyzed, and scores were compared between the students in the intervention group and those who were taught using traditional lectures. Later, students in the control group were also trained in the same manner as the intervention group using SPLICE modules. Following this, the evaluation of SPLICE was done by obtaining the perceptions of students toward the effectiveness of the SPLICE modules. Then, the perceptions regarding the usefulness of plenary sessions were obtained. Finally, the students' feedback on SPLICE was collected.

Data Collection

A validated 13-item questionnaire was distributed to the students to obtain their perceptions on the effectiveness of using SPLICE modules to learn on a five-point Likert scale of strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree. In addition, students' perceptions toward the usefulness of the plenary sessions were obtained on an eight-item questionnaire with the same five-point Likert scale. Students' feedback about SPLICE sessions was obtained on a 10-point scale (1: completely unhelpful; 2: mostly unhelpful; 3: unhelpful; 4: slightly unhelpful; 5: neutral; 6: somewhat helpful; 7: helpful; 8: very helpful; 9: extremely helpful: and 10: incredibly helpful). For the qualitative analysis, the view, and opinions of students regarding SPLICE modules were recorded through in-depth small-group interviews. All the responses were recorded, analyzed, and segregated into themes. All the responses were collected anonymously to help protect the privacy and confidentiality of the participants.

Statistical Analysis

All data were statistically analyzed using the Statistical Package for Social Science (SPSS, version 17, for Microsoft Windows). The mean and SD for the continuous variable in the test results were reported using descriptive statistics applying univariate statistics. For analyzing differences in continuous variables, the t test and ANOVA were used. To identify differences in nonnormal distributions, the Mann-Whitney U test and the Krushkall Wallis test were utilized. The significance level was set at $P < 0.05$. The qualitative data obtained from student interviews were analyzed using content and thematic analysis.

Ethical Considerations

This study was approved by the Institutional Human Ethics Committee of Panimalar Medical College Hospital and Research Institute (PMCHRI-IHEC; Approval No. PMCH&RI/IHEC/2021/46; Dated: 22/02/2021). Informed consent was obtained from all the participants. Participation was voluntary, and they were allowed to withdraw from the study at any time. All the responses collected via survey and small-group interviews were anonymous to ensure participants' safety and data were kept confidential.

RESULTS

The learning outcomes were measured using an end-of-module assessment. The scores were compared between the control and the intervention groups. The learning outcomes of all six SPLICE modules, i.e., *1*) bronchial asthma, *2*) coronary artery disease (CAD), *3*) chronic obstructive pulmonary disease (COPD), *4*) hemolytic anemia, *5*) nutritional anemia, and *6*) systemic hypertension was assessed. The control and intervention groups were evaluated with the same assessment questions. Upon statistically analyzing the results, the students who used SPLICE modules greatly outperformed the students who were taught using traditional lectures. The results for all six modules were statistically highly significant ($P < 0.0001$) demonstrating the effectiveness of the innovation. Figure 2 shows the comparison between the academic performances of controls and study subjects. In addition, the effect size of the intervention was calculated and Cohen's d value was found to be 2.92 for bronchial asthma, 4.40 for coronary artery disease (CAD), 4.34 for chronic obstructive pulmonary disease (COPD), 9.69 for hemolytic anemia, 5.57 for nutritional anemia, and 5.10 for systemic hypertension.

In the evaluation of students' perceptions toward SPLICE, students perceived the traditional method of learning to be less beneficial with 86.8% disagreeing that conventional didactic lectures provide sufficient ECE. A total of 90.57% of the students perceived SPLICE sessions to be effective in providing sufficient ECE with 97.17% finding the clinical cases given in the SPLICE sessions to be interesting to them. In addition, 83.96% perceived that the group discussions during SPLICE sessions promoted the active transfer of knowledge, and 88.68% for SPLICE modules to be very helpful in terms of the development of critical thinking. A total of 89.62% of students in the intervention group agreed that SPLICE sessions promoted better comprehension and reasoning of clinically integrated topics with 89.63% perceiving

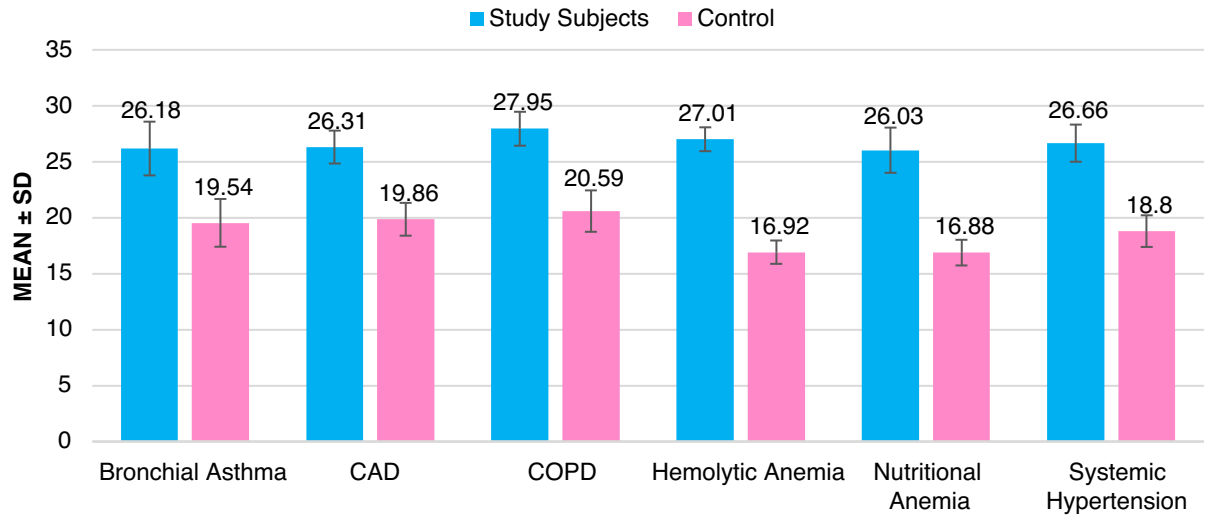

Figure 2. Comparison of the academic performances of controls and study subjects. CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease.

that the SPLICE module was useful in terms of future application of knowledge. Then, 85.85% agreed that the SPLICE modules were helpful in terms of self-assessment of their learning gaps. In addition to this, 89.62% of students perceived the teaching-learning approach using SPLICE sessions in small groups promoted active, independent, and lifelong learning and 88.68% agreed that the SPLICE approach with discussion in small groups was more motivating than lectures. A total of 83.02% of students perceived SPLICE sessions promoted meaningful learning instead of traditional classroom teaching with 94.34% agreeing that SPLICE modules promoted student engagement, teamwork, and communication skills. Furthermore, the role of a teacher (as facilitator) in case-oriented small-group sessions using the SPLICE approach was perceived as an essential component by 84.91% of the students. The evaluation of SPLICE as per the perceptions of students is described in Fig. 3.

The evaluation of the plenary sessions was done with 8 items on a 5-point Likert scale. Most of the students (93.48%) agreed that the objectives had been conveyed to the students by the facilitator. A total of 90.21% agreed that the presentation was audible, 92.40% perceived the presentations to be systematic, and 94.56% agreed that opportunities were given to all the groups for presentation. Also, 90.21% of the students perceived enough opportunity was given to clarify their doubts, and 80.44% agreed that the topics were summarized periodically. In addition, 85.86% of the students agreed that there was good interaction with the experts in the session, and 95.66% agreed that the specific learning objectives were achieved clearly at the end of the session. The evaluation of plenary sessions is given in Fig. 4.

Feedback on the SPLICE sessions was obtained on a 10-point rating scale. The overall rating for SPLICE modules to have been helpful in terms of the development of critical thinking was 7.9. SPLICE modules were rated 8 in terms of future application of knowledge. Also, SPLICE modules were rated 8.2 in terms of sharing knowledge in their group and 8.1 to have been helpful in terms of self-assessment of learning gaps. The overall rating for SPLICE modules in terms of arousing interest in active learning was 8.46. The feedback of students on SPLICE is shown in Fig. 5.

Furthermore, in-depth small-group interviews were conducted to obtain students' views and opinions about SPLICE modules for qualitative analysis. The feedback from students was collected, and thematic analysis was performed to categorize their responses. After analyzing the content, a total of 65 responses were obtained. These 65 responses were categorized into 6 different themes as follows: SPLICE for *1*) "early clinical exposure" (14), *2*) "self-directed learning" (10), *3*) "active learning" (9), *4*) "mentorship" (7), *5*) "effective feedback" (13), and *6*) "interpersonal skills" (12). Figure 6 represents the thematic analysis and number of responses under each theme. Table 1 shows a few of the responses from students categorized under different themes.

DISCUSSION

The evaluation of SPLICE, an innovative curriculum, revealed impressive results and high student satisfaction. Students found SPLICE sessions effective in providing early clinical exposure, promoting critical thinking, and facilitating active learning. From the results, it is clear that the modules were perceived to be helpful for comprehension, future knowledge application, and self-assessment. The comparison between SPLICE and traditional lectures showed significantly better learning outcomes for students ($P < 0.0001$) using SPLICE. In addition to this, feedback on SPLICE modules indicated their positive impact on developing critical thinking, future knowledge application, knowledge sharing, self-assessment, and motivation to learn. Furthermore, the qualitative feedback highlighted the value of SPLICE in early clinical exposure, self-directed learning, active learning, mentorship, effective feedback, and interpersonal skills development.

From the results of this study, it is evident that most of the students have found SPLICE beneficial in terms of providing early clinical exposure and there was increased interest among the students toward the clinical cases provided. Consistent

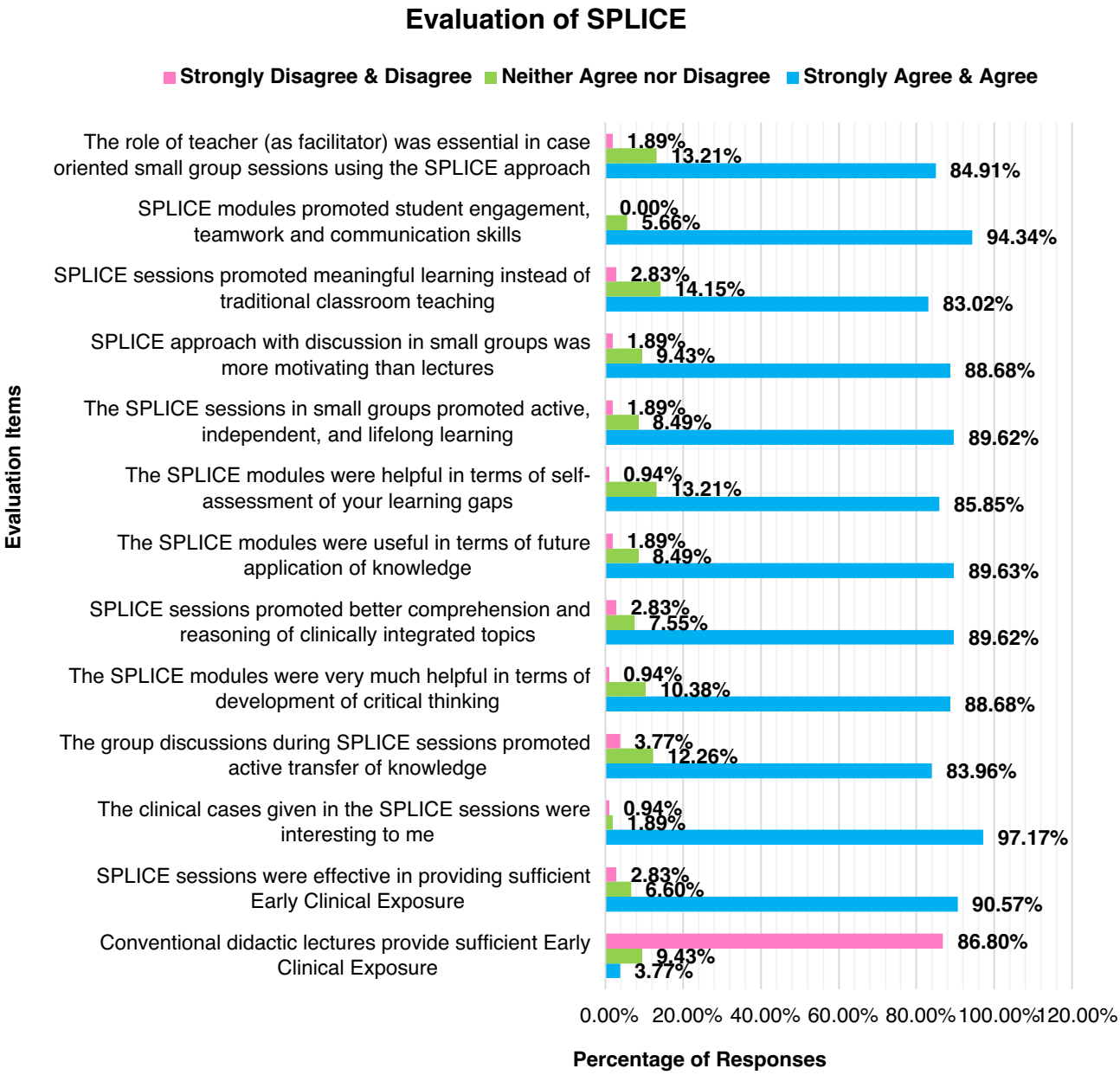

Figure 3. Evaluation of "Self-directed, Problem-oriented, Lifelong learning, Integrated Clinical case Exercise" (SPLICE) modules.

with this interpretation, a teaching-learning intervention that combined didactic lectures with case-based learning and visits to patients has been proven efficient and aroused interest among students in learning endocrine physiology (26). In addition, from the qualitative and quantitative evaluation, students found that SPLICE sessions improved their comprehension, clinical reasoning skills, and future application of knowledge. However, there are views stating that implementation of ECE is a challenging process, that it cannot be a complete replacement for lectures, and that it cannot be introduced to every topic, e.g., anatomy. Blended methods are suggested as alternatives (27). In this study, students have also recognized the role of facilitators to be essential in enhancing their performance. In line with this, an interventional study to analyze the effectiveness of ECE has reported students' satisfaction with instructors and their training during the course. A potential drawback of that study was the large number of students in each team (28). However, this was overcome in this study by grouping students into teams of six. Students perceived learning in small groups was more effective than lectures.

Considering the mode of delivery of learning outcomes, small-group PowerPoint presentations were used at the end of module plenary sessions. An authentic and effective presentation should be engaging and interactive (29). Technically, an ideal presentation should be audible, systematic, and adhere to the specific learning outcomes (30). Consistent with the requirements of an effective presentation, the evaluation of the plenary session in SPLICE revealed that a greater number of students were satisfied with the organization, planning, and delivery of the presentations. Most of the students admitted that there were equal opportunities for all and that the

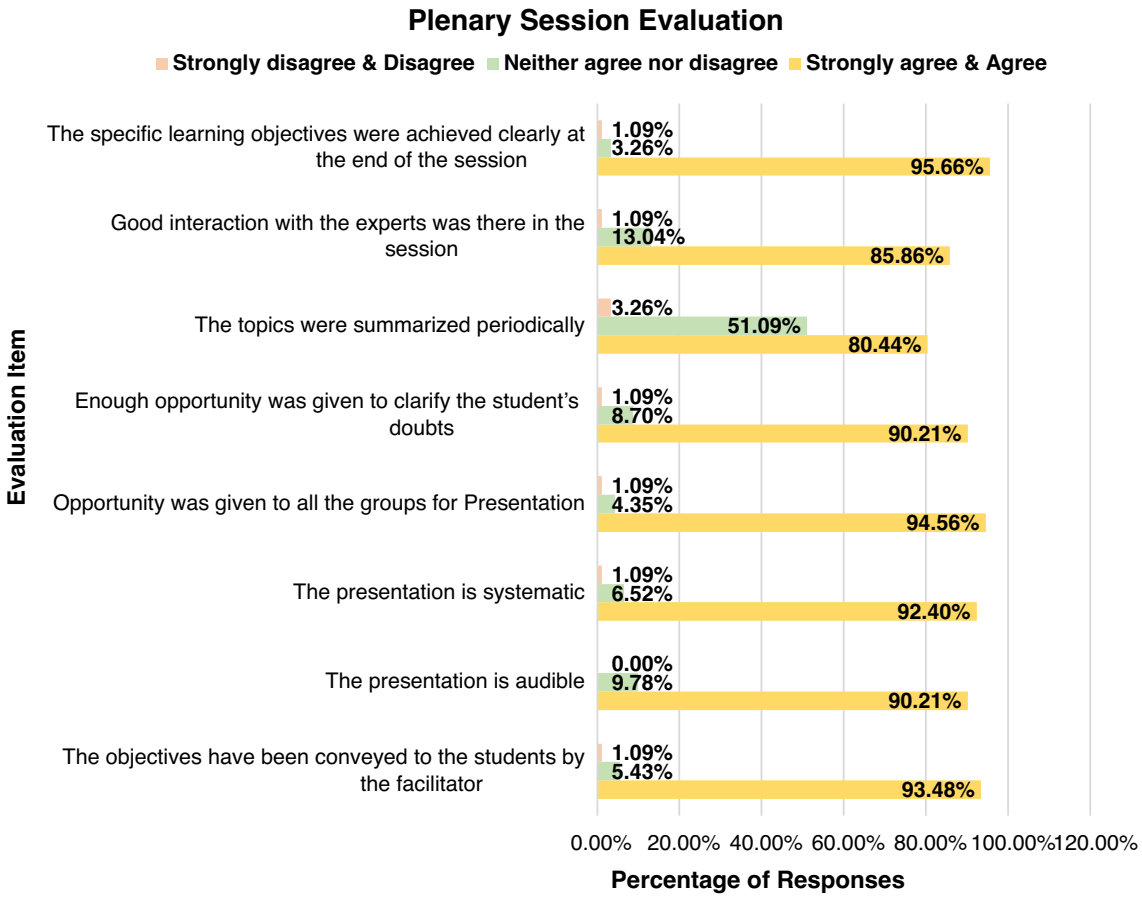

Figure 4. Evaluation of "Self-directed, Problem-oriented, Lifelong learning, Integrated Clinical case Exercise" (SPLICE) plenary sessions.

specific learning outcomes were achieved at the end of the module. The further interpretation made from students' agreement that the facilitators have communicated the objectives to the learners clearly and that there was good interaction with experts providing them with the chance to clarify their doubts and periodic revision of concepts could be the emphasis on the role of students to take responsibility of their own learning with the guidance from the facilitator. This is supported by the findings of another study, which stated that the establishment of a setting where teaching faculty may discuss the proper applications and constraints of different teaching-learning

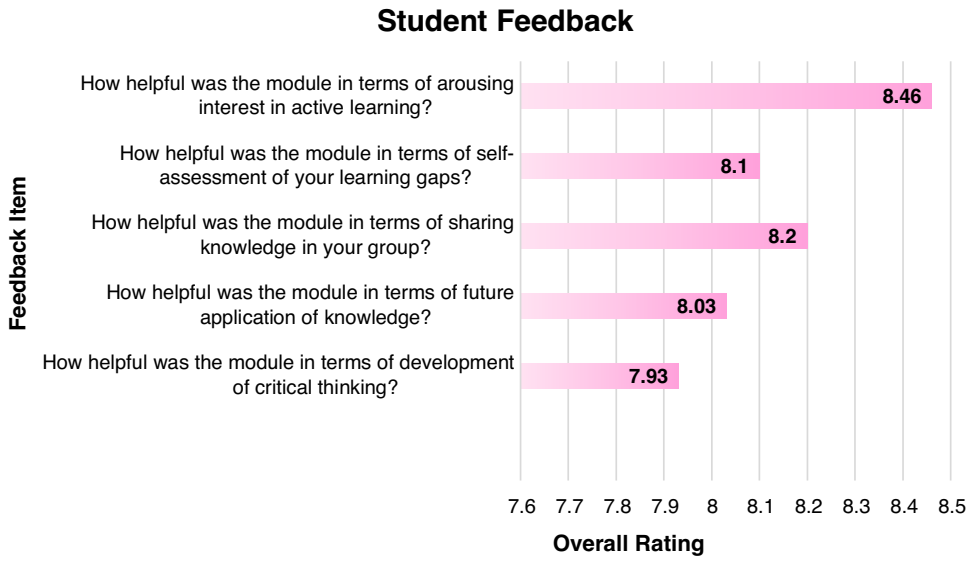

Figure 5. Students' feedback on "Self-directed, Problem-oriented, Lifelong learning, Integrated Clinical case Exercise" (SPLICE).

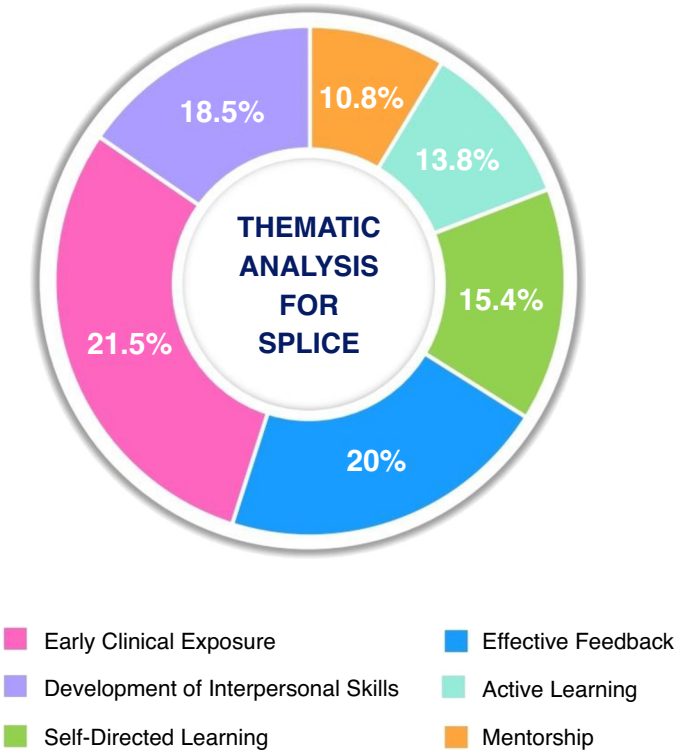

Figure 6. Representation of thematic analysis for "Self-directed, Problem-oriented, Lifelong learning, Integrated Clinical case Exercise" (SPLICE).

methodologies with students may be beneficial for designing effective curricula (31).

An impressive finding of this study is that the statistical analysis of the assessment scores of students of the control and intervention groups revealed highly significant scores in all six modules of SPLICE clearly indicating the effectiveness of this innovation in achieving the learning outcomes and improving the academic performance ($P < 0.0001$). This result was consistent with the evaluation findings of the case-based learning intervention in biochemistry using five test scores where statistically significant results ($P < 0.001$) were obtained. This signifies the sustained effectiveness of case-based and group discussions in promoting active and lifelong learning (32). Similar to the findings of this study, educational interventions in physiology, biochemistry, and other clinical subjects by implementing case-based learning have resulted in significant improvement in academic performance and high student satisfaction (33–35). However, a striking difference in this innovation compared to others is that pre-, para-, and clinical competencies were integrated into one module and comprehensively conducted the SPLICE sessions such that all components of learning in all subjects are achieved. Preclinical competencies in SPLICE cover subjects like anatomy, physiology, and biochemistry, which provide a fundamental understanding of the human body and its functions. Paraclinical competencies in SPLICE pertain to subjects and areas of study that are closely related to clinical practice but not directly involved in patient care. These subjects include pathology, pharmacology, microbiology, and community medicine. Clinical competencies encompass subjects and areas of study that directly involve patient care and clinical practice. The competencies included in the SPLICE modules are from internal medicine.

A notable observation from the results and perceptions of students toward SPLICE is that emphasizing conceptual learning in small groups facilitated by a faculty greatly improves student participation and performance. Students tend to collaborate effectively when they learn on their own and can reflect on their learning. Students in such learner-centered environments have always outperformed others in didactic lectures and have profound subject knowledge (36). While there are discussions that reducing the class size can itself improve student performance and satisfaction and lay the foundation for a more personalized educational experience, it is the combination of smaller classes with effective teaching strategies that truly maximizes its potential for improving academic outcomes (37, 38). This has been proven in this study by calculating effect size. The higher Cohen's *d* value as stated in the results indicates the practical significance of this innovation. Thus designing an outcome-based curriculum and providing the students with the opportunity to explore clinical sciences by integrating them with basic sciences are necessary in the rapidly evolving medical education system to enhance early clinical exposure and make students competent in all aspects of personal and professional growth in a self-directed manner (39).

Based on the results of our study, it is clear that the anticipated outcomes outlined in our conceptual framework (Fig. 1) have been successfully attained. While it is essential to acknowledge that the evaluation of professional and personal growth necessitates an extended timeframe for a comprehensive assessment, it is equally vital to recognize the positive impact on immediate learning outcomes and student engagement. The marked improvement in student performance and the noticeable increase in their active participation and enthusiasm in the learning process serve as tangible proof of the effectiveness of the SPLICE innovation. These findings not only reaffirm the value of our pedagogical approach but also emphasize its potential to profoundly influence the educational landscape. These early findings provide a foundation for ongoing exploration into the long-term effects on students' personal and professional growth, characterized by self-directed, contextual, and lifelong learning using the SPLICE approach, which promises to be equally promising and transformative.

Limitations

A limitation of this study is that this was implemented for only first-year medical students. To improve generalizability, the sample should be diversified to include students from different years, collaborating with multiple institutions, conducting a longitudinal study, using a mixed-methods approach, and including comparison groups. In addition, evaluation of the long-term effects of the SPLICE modules on critical thinking skills and improved clinical performance was not done.

Implications and Recommendations

The prospects of the innovative SPLICE modules in medical education are highly promising. Implementation of SPLICE provides numerous benefits to medical students and

Table 1. *Thematic analyses of students' views on SPLICE*

Students' Views	
SPLICE for early clinical exposure	**SPLICE for self-directed learning**
"SPLICE is a brainchild of our teacher and has given us an opportunity to explore medicine beyond the walls of a usual classroom." "While learning pertaining to clinical aspects, I gain more knowledge about the signs and symptoms of the disease and how to diagnose it." "SPLICE is a masterpiece! We first year students roam in the library with Harrisons, Macleod, Robbins and discuss like pros!!" "SPLICE and the discussion about various clinical scenarios gives a new structure to existing lecture-based monotonous teaching."	"SPLICE has motivated me to explore more regarding the topic, I borrowed more books form library, I searched the internet, I read many articles. I started learning on my own." "When you search for the cause and reasons and then understand..you learn for life, you never forget it, that's what is so special about SPLICE." "I never imagined I could prepare my slides regarding paediatric aspects of nutritional anemia in my first year itself ..but I did it on my own .. kudos to SPLICE." "SPLICE is not just about learning in college, I learnt more by searching many sources even at home which I would have not done if it was just a lecture."
SPLICE for active learning	**SPLICE for mentorship**
"We were able to involve Actively in SPLICE compared to usual boring lectures." "Usually in lectures, we don't feel like listening and especially as a backbencher, I doze off most of the time. . .but in SPLICE I was actively involved and was motivated to do more and learn more." "I would say that I learnt than studied. I can teach effectively what I have learnt to my friends now." "All classes can be conducted as SPLICE to increase participation from students."	"I like the way mentors play a role in SPLICE. They dont instruct us but enhance our learning." "In classroom, I don't ask many doubts to teachers but here I clarified many things with my mentor." "Small group of students with a mentor is more effective than a large lecture." "More than in classroom, approaching the mentors with doubts or clarifications were easier."
SPLICE for effective feedback	**SPLICE for interpersonal skills**
"The way the plenary session was conducted was very systematic and professional." "In the plenary sessions, each and every detail was paid attention to. Every slide was scrutinized and valuable comments were given." "The feedback on our presentation and how to improvise can never be forgotten. We now have the ability to assess the quality of a presentation and point out the errors in it with the feedback which was given to us. It's a lifelong lesson." "The plenary session was the best to evaluate our learning, we could compare with other groups and also learn from other presentations."	"SPLICE has boosted my confidence in communication and made us work together and importantly in a time-framed manner." "SPLICE has improved my ability to present, communicate with others and also take responsibility of my work." "I'm confident to present in front of large audience. SPLICE made me overcome my stage fear." "I used to be very quiet in class..I will not ask doubts also. But SPLICE has changed me..I worked in teams, I asked more doubts to my mentor, and best part is I presented alone on stage with confidence." "SPLICE made us more accountable of our actions. As this is a group activity, contribution of everyone matters and we need to be responsible.

SPLICE, Self-directed, Problem-oriented, Lifelong learning, Integrated Clinical case Exercise.

facilitates their learning. Owing to the highly significant results, the scope of SPLICE can be extended to students of all professional years such that there is continuous reinforcement of concepts and to all students of health professions education to diversify the benefits of SPLICE. Additionally, medical educators can also consider the integration of technology and innovative tools to enhance the learning experience and adapt the modules to the latest trends in medical education. The SPLICE can be conducted virtually and can leverage virtual simulations and online collaboration tools, providing innovative and immersive distant learning experiences that are accessible to all students.

Conclusions

The SPLICE modules have resulted in high student satisfaction and have significantly improved student academic performances. SPLICE modules trained students in analyzing complex clinical cases, integrating information, and making informed and shared decisions, which are crucial traits of healthcare professionals. Moreover, the early clinical exposure and contextual learning provided by SPLICE modules have helped students understand the practical application of theoretical knowledge by connecting theoretical concepts to real-world patient care, facilitating deeper understanding, retention of knowledge, and lifelong learning. The plenary sessions with immediate and effective feedback were considered highly beneficial by students in terms of improving their presentation and communication skills, overcoming stage fear, and encouraging them to actively participate in a team by building confidence and professionalism. Furthermore, SPLICE modules also encouraged self-directed learning, empowering students to take responsibility for their learning and self-assess their learning progression. Overall, our hypothesis has been proven by the significant results and highly positive feedback from students; therefore, SPLICE modules hold significant promise in medical education by equipping the next generation of physician leaders with the skills and knowledge required for successful medical practice in an evidence-informed manner.

DATA AVAILABILITY

Data will be made available upon reasonable request.

ACKNOWLEDGMENTS

I thank Dr. Amanda Chase (Associate Professor of Medical Education) and Dr. Kiran C. Patel (College of Allopathic Medicine)

for constant support, guidance, and mentorship throughout my project.

This innovation has been accepted for Oral Presentation in the International Association of Medical Science Educators Annual Meeting held in Cancun, Mexico between June 10 and 13, 2023.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author.

AUTHOR CONTRIBUTIONS

K.S. conceived and designed research; K.S. performed experiments; K.S. analyzed data; K.S. interpreted results of experiments; K.S. prepared figures; K.S. drafted manuscript; K.S. edited and revised manuscript; K.S. approved final version of manuscript.

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