A Study of Behavior of Applying Knowledge of Learners from the Course SIID 529 Effective Clinical Teaching of Faculty of Medicine Siriraj Hospital, Mahidol University

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Abstract:

Background: SIID 529 is a course at Siriraj Hospital, Mahidol University, designed to enhance clinical teaching skills among medical residents. This study evaluates how learners apply teaching knowledge in practice through self- and peer-assessments. The results aim to inform future instructional strategies and educational policies.

Objective: To assess and compare learners' knowledge application behavior following participation in SIID 529 using self-assessment and peer-assessment tools.

Materials and Method: The study involved 840 participants, including medical residents, fellows, and their colleagues. Two validated questionnaires assessed knowledge application across four domains: clinical supervision, ward rounds, giving feedback, and teaching on the run. A total of 268 self-assessments and 240 peer assessments were collected (response rates: 31.40% and 28.54%). Data were analyzed using descriptive and non-parametric comparative statistics.

Results: Overall knowledge application was rated at a high level (Self-assessment: $\overline{X} = 3.73$; Peer-assessment: $\overline{X} = 3.77$). Statistically significant differences ($p < 0.05$) were observed based on academic year, study status, academic performance, and learning environment. The highest application levels were found among graduates and fellows, especially those from the academic year 2021, while current residents in 2023 reported lower application. Learners with an A+ grade and those in supportive environments showed significantly higher behavior scores.

Conclusion: The SIID 529 course has a substantial impact on enhancing physicians' teaching behaviors. Institutions should support knowledge application by providing structured training opportunities, reducing teaching barriers, and fostering environments that encourage clinical education. These findings support the importance of faculty development for medical educators and suggest areas for future improvement in training programs.

Keywords: Clinical teaching, Learner, Knowledge application, Resident

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Introduction

The course SIID 529: Effective Clinical Teaching is an elective course offered as part of the Graduate Diploma in Clinical Medical Sciences, which has been continuously conducted since 2019 at the Faculty of Medicine Siriraj Hospital, Mahidol University. The course content comprises two components: 1) Theoretical Component; Learner's study online teaching materials from the "Essential Skills for Clinical Teachers" course via the website shee.si.mahidol.ac.th prior to classroom sessions. 2) Practical Component; Classroom-based learning and practice sessions, where learners are divided into small groups to engage in skill-based activities covering: 1) Clinical supervision, 2) Ward rounds, 3) Giving feedback, and 4) Teaching on the run. As many medical residents play significant roles in teaching medical learners and junior residents, they are responsible for transmitting core principles of clinical teaching. Therefore, it is essential that they possess appropriate knowledge and teaching skills, such as questioning techniques, feedback delivery, clinical supervision, time-constrained teaching, interactive teaching, small-group teaching, bedside teaching, ward round instruction, clinical performance assessment, and attitude teaching. Enhancing clinical teaching skills is thus a crucial and beneficial endeavor that can be applied in mentoring junior learners effectively.

Essential clinical teaching competencies such as bedside teaching, effective feedback, clinical supervision, and time constrained "teaching on the run" have been well documented in both Thai and international literature. Bedside teaching, for instance, improves diagnostic skills and is valued by learners and patients alike.[1] A systematic review highlighted that quality feedback, teaching planning, and intrinsic educator traits significantly enhance student learning and patient care.[2] Furthermore, structured "Residents as Teachers" programs in surgical and family medicine residencies foster teaching confidence and long term involvement in education.[3,4] The book Essential Skills for a Medical Teacher emphasizes these domains as foundational for clinical educators.[5] Such global and local evidence supports the need for SIID 529 to systematically equip residents and fellows at Siriraj Hospital with formal clinical teaching skills.

Behavioral studies can be conducted in two ways: 1) Direct observation, and 2) Indirect methods, such as interviews, surveys, or experimental studies. Using questionnaires is considered an appropriate method for studying the behaviors of a large population, including those in remote areas. Moreover, participants can report concealed or sensitive behavioral data.[6] Additionally, Donald L. Kirkpatrick proposed a four-level model for evaluating training programs: 1) Reaction – participants' satisfaction and impressions toward the program 2) Learning – assessment of knowledge gained 3) Behavior – the extent to which behaviors have changed and knowledge is applied in practice 4) Results – impact of the training on the organization.[7] In the SIID 529 course, evaluation at the reaction level is conducted through a satisfaction survey, while learning is assessed through examinations and grading. However, there has not yet been an evaluation at the behavior level to determine whether learners apply the acquired knowledge and skills in their clinical practice. Therefore, this study employs an indirect method of behavioral assessment through questionnaires completed by both learners and their colleagues.

Given the importance of clinical teaching and behavioral evaluation, the researcher is interested in studying the application of knowledge by learners from the SIID 529: Effective Clinical Teaching course at the Faculty of Medicine Siriraj Hospital, Mahidol University. The findings from this study will contribute to effective outcome monitoring, provide evidence-based information for educators to improve instructional activities, and offer valuable insights for administrators in formulating future directions and policies.

Materials and method

Ethical Consideration : This study was approved by the Institutional Review Board (IRB) with the Certificate of Approval (COA) No. Si 527/2024.

1. Research design

Subject : The study population consisted of 1,510 medical residents and clinical fellows who had enrolled in the course SIID 529: Effective Clinical Teaching, Faculty of Medicine Siriraj Hospital, Mahidol University, during the academic years 2019 to 2023.

Sample : A total of 840 medical residents and clinical fellows who had previously completed the SIID 529 course were invited to participate in the study, along with 840 colleagues for peer assessments.

The required sample size was determined using a rule of thumb recommended by Hair et al., suggesting a minimum of 20 participants per observed variable.[8] With four behavioral indicators, the minimum sample was set at 80. To ensure sufficient data for subgroup comparisons using non-parametric tests (Mann–Whitney U and Kruskal–Wallis), and to account for potentially low response rates typical in survey research, the sample size was increased tenfold. This decision was based on Becker and Huselid's findings indicating an average response rate of 6.28% in similar behavioral studies.[9] Consequently, 840 participants were invited to complete the self-assessment and peer-assessment questionnaires.

The minimum acceptable number of participants per group was calculated by proportionally distributing the total sample across academic years and departmental affiliations, following the method suggested.[10] The simple random sampling method was used to select participants within each group, and data collection was concluded once the target number of responses was achieved.

Table 1 Number of Population and Sample Classified by Academic Year

Academic Year	Population (persons)			Sample (persons)		
	Pre-clinical	Clinical	Total	Pre-clinical	Clinical	Total
2019	8	276	284	4	154	158
2020	9	296	305	5	165	170
2021	9	289	298	5	161	166
2022	9	301	310	5	167	172
2023	6	307	313	3	171	174
Total	**41**	**1,469**	**1,510**	**23**	**817**	**840**

Independent variable - General Information of Learners

1. **Academic Year:** 1) 2019, 2) 2020, 3) 2021, 4) 2022, 5) 2023
2. **Department:** 1) Clinical, 2) Pre-clinical
3. **Sponsoring Organization:** 1) Faculty of Medicine Siriraj Hospital, 2) Other hospitals / medical schools, 3) Free train
4) **Study Status:** 1) Studying in the residency program, 2) Studying in the fellowship program,
3) **Graduated**
5) **Academic Performance:** 1) A+, 2) A, 3) B+, 4) B, 5) Cannot recall
6) **The environment that facilitates knowledge application includes:**
1) Facilitates application 2) Does not facilitate application 3) Not sure

↓

Intervention - Course SIID 529 Effective Clinical Teaching

This study focuses on exploring the behaviors of learners in applying knowledge acquired from the course SIID 529: Effective Clinical Teaching, offered by the Faculty of Medicine, Siriraj Hospital, Mahidol University. The course emphasizes the development of teaching skills in a clinical setting through the following key areas: 1) Clinical Supervision 2) Ward Round 3) Giving Feedback 4) Teaching on the Run

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Dependence variable - Learners' Knowledge Application Behaviors

1) **Clinical Supervision:** Learners demonstrate the application of supervision processes through structured teaching approaches, including; Briefing, Clinical practice and Debriefing.
2) **Ward Round:** Learners exhibit behaviors that reflect the application of bedside teaching principles before, during, and after the ward round, including; Deriving teaching points from patient-related data, Ensuring patient comfort and maintaining respect for patients throughout the teaching process, and Creating opportunities for providing feedback to medical learners during or after the round.
3) **Giving Feedback:** Learners apply feedback principles and techniques in clinical teaching, such as; Building a trusting environment and setting shared goals, Providing feedback based on direct observation, Delivering feedback at appropriate times and with consistency, Start with a self-assessment by learners, followed by positive feedback, Give specific negative feedback with a focus on observable behaviors, Provide feedback in an appropriate amount, focusing on key issues that are important and actionable, Offering guidance and jointly planning improvements.
4) **Teaching on the Run:** Learners apply the 1-Minute Teaching, 5-Step Microskills in their clinical teaching practices; 1) Make a commitment, 2) Explore reasons, 3) Teach general rules, 4) Reinforce what was right, 5) Correct mistakes.

Figure 1 Conceptual Framework for the Study

2. Research Instruments

The instrument used in this study is a Questionnaire for Assessing Learners' Knowledge Application Behaviors from the course SIID 529: Effective Clinical Teaching. There are two versions of the questionnaire; 1) Self-assessment Questionnaire 2) Peer-assessment Questionnaire. Each questionnaire consists of three parts:

Part 1: General Information of Respondents

This section includes demographic and background information of the respondents, presented in a checklist format.

Part 2: Knowledge Application Behaviors of Learners

This section evaluates the behaviors related to knowledge application derived from the course content, categorized into four domains; 1) Clinical supervision, 9 items 2) Ward round, 14 items 3) Giving feedback, 10 items and 4) Teaching on the run, 6 items. All items in this section are measured using a 5-point Likert rating scale (interval scale). The scoring criteria for assessing learners' application of knowledge are as follows:

Always used (100% performance), 5 Score.

Almost always used (67–99% performance), 4 Score.

Sometimes used (34–66% performance), 3 Score.

Rarely used (1–33% performance), 2 Score.

Never used (0% performance), 1 Score.

The interpretation of mean scores is based on the class interval width calculation[11] as follows:

1.00 – 1.50 = Very Low Level of Knowledge Application Behavior.

1.51 – 2.50 = Low Level of Knowledge Application Behavior.

2.51 – 3.50 = Moderate Level of Knowledge Application Behavior.

3.51 – 4.50 = High Level of Knowledge Application Behavior.

4.51 – 5.00 = Very High Level of Knowledge Application Behavior.

Part 3: Open-ended Suggestions

This section consists of open-ended questions, allowing respondents to provide comments and additional suggestions freely.

3. Data collection & Quality control

1) A review of relevant literature and textbooks was conducted to explore teaching techniques including Clinical Supervision, Ward Round, Giving Feedback, and Teaching on the Run, as well as previous research studies related to knowledge application behaviors.

2) Study the guidelines and methods for creating questionnaires from textbooks, documents, and research papers, then develop questionnaire. Afterward, have your advisor review the questionnaire.

3) Verify the content validity with three experts, who are specialists in the subject and instructors of the course, including: 1) Rater 1 (clinical education expert), 2) Rater 2 (clinical education expert), and 3) Rater 3 (clinical education expert). Calculate the Item-Objective Congruence (IOC) index for each question using the formula, with an IOC value greater than 0.5 considered acceptable for use. (IOC for the Self-assessment Questionnaire = 0.957 and the Peer-assessment Questionnaire = 0.930).

4) Test the Reliability by administering the revised questionnaire as a tryout with 30 participants who had previously attended the "Essential Skills for Clinical Teachers" training but are not part of the target population. The results will be analyzed to calculate the reliability of the instrument using Cronbach's Alpha Coefficient. This method assesses the

reliability of a research instrument by collecting data from the tryout group once, and a coefficient of 0.8 or higher is considered acceptable[12], as shown in Table 2.

Table 2 Reliability of the Questionnaires

Topic	Questionnaire 1: Self-assessment (Learners)	Questionnaire 2: Peer assessment (Colleagues)
1) Clinical supervision	0.905	0.894
2) Ward round	0.911	0.927
3) Giving feedback	0.950	0.912
4) Teaching on the run	0.934	0.907
Total	**0.935**	**0.972**

5) Data collection was conducted through two formats: paper-based distribution and online questionnaires, as detailed below:

5.1) Paper-Based Distribution: The researcher prepared questionnaire packages with two parts: (1) Self-assessment by the learner and (2) Peer assessment by a colleague, both marked with matching codes to indicate academic year and department. Each package included a return envelope and an instruction sheet emphasizing voluntary participation, submission deadlines, and the choice between paper-based and online formats to prevent duplicate responses. Formal request letters were sent to institutions to assist with distribution and collection.

5.2) Online Format: Emails were sent to participants with academic-year-specific links to the online questionnaires. Participants were instructed to complete the self-assessment first and then forward the peer assessment link to a colleague. The peer respondent was requested to submit the form within three weeks. Participation remained voluntary, with a reminder to choose only one submission method (paper or online) to avoid duplication.

6) Collect and verify the completeness of the questionnaire.

7) The researcher conducts the analysis of the questionnaire.

Statistical analysis

1. Descriptive Statistics:

1) Frequency and percentage were used to analyze the general demographic data of the respondents.

2) Mean and standard deviation were used to analyze the levels of learners' knowledge application behavior, based on self-assessment and peer assessment.

2. Inferential Statistics: Comparative analysis was conducted to examine the differences between learners' knowledge application behavior and their demographic data. Preliminary assumption testing revealed that the dependent variables were not normally distributed. Therefore, non-parametric tests were used the Kruskal-Wallis Test was applied when comparing more than two groups and the Mann-Whitney U Test was applied when comparing two groups.

Results

The researcher received 268 completed questionnaires from learners (Response rate = 31.40%) and 240 completed questionnaires from colleagues of the learners (Response

rate = 28.54%). These response rates were deemed acceptable based on the sample size calculation, and data collection was stopped. Regarding the general information of the learners, the majority were from the 2023 academic year, totaling 130 learners (48.5% of all respondents). For the years 2019-2022, the number ranged from 30 to 42 learners (11.2% – 15.7%). The majority were from the clinical department, totaling 247 learners (92.2%), while 21 learners (7.8%) were from the preclinical department. Regarding their affiliations, 132 learners (49.3%) were affiliated with the Faculty of Medicine Siriraj Hospital, 87 learners (32.5%) were affiliated with other medical schools, and 48 learners (17.9%) were from the Free train program. The majority were enrolled in the residency program, with 231 learners (86.2%), while 25 learners (9.3%) were in advanced programs. Most learners reported that they would not remember their academic results (201 learners, 75.0%) and believed that the environment facilitated the application of knowledge (149 learners, 55.6%). The next largest group was unsure 94 learners (35.1%). Among the colleagues who completed the questionnaires, the majority were residents 172 respondents (72.9%), followed by advanced program physicians 39 respondents (16.5%), and teaching assistants 15 respondents (6.4%). The results of the research are summarized as follows:

1) Knowledge Application Behavior of Learners from the Course SIID 529 Effective Clinical Teaching at Faculty of Medicine Siriraj Hospital, Based on self-assessment and peer assessment.

Table 3 Knowledge Application Behavior of Learners

Item	Self-assessment (n = 268)			Peer assessment (n = 240)		
	$\bar{X}$	S.D.	Behavior level	$\bar{X}$	S.D.	Behavior level
Clinical supervision	3.86	0.49	High	3.86	0.49	High
Ward round	3.63	0.53	High	3.70	0.52	High
Giving feedback	3.72	0.60	High	3.75	0.58	High
Teaching on the run	3.81	0.62	High	3.83	0.59	High
Overall	**3.73**	**0.49**	**High**	**3.77**	**0.50**	**High**

Table 3 shows that the overall knowledge application behavior from the SIID 529 Effective Clinical Teaching course is at a high level. When categorized by topic, all items were rated at a high level. The topics with the highest mean scores, in order, are Clinical supervision, followed by Teaching on the Run, Giving feedback and Ward round respectively.

2) Comparison of learners' behavior in applying knowledge from the SIID 529: Effective Clinical Teaching course, conducted by the Faculty of Medicine Siriraj Hospital, Mahidol University, based on general information of the learners.

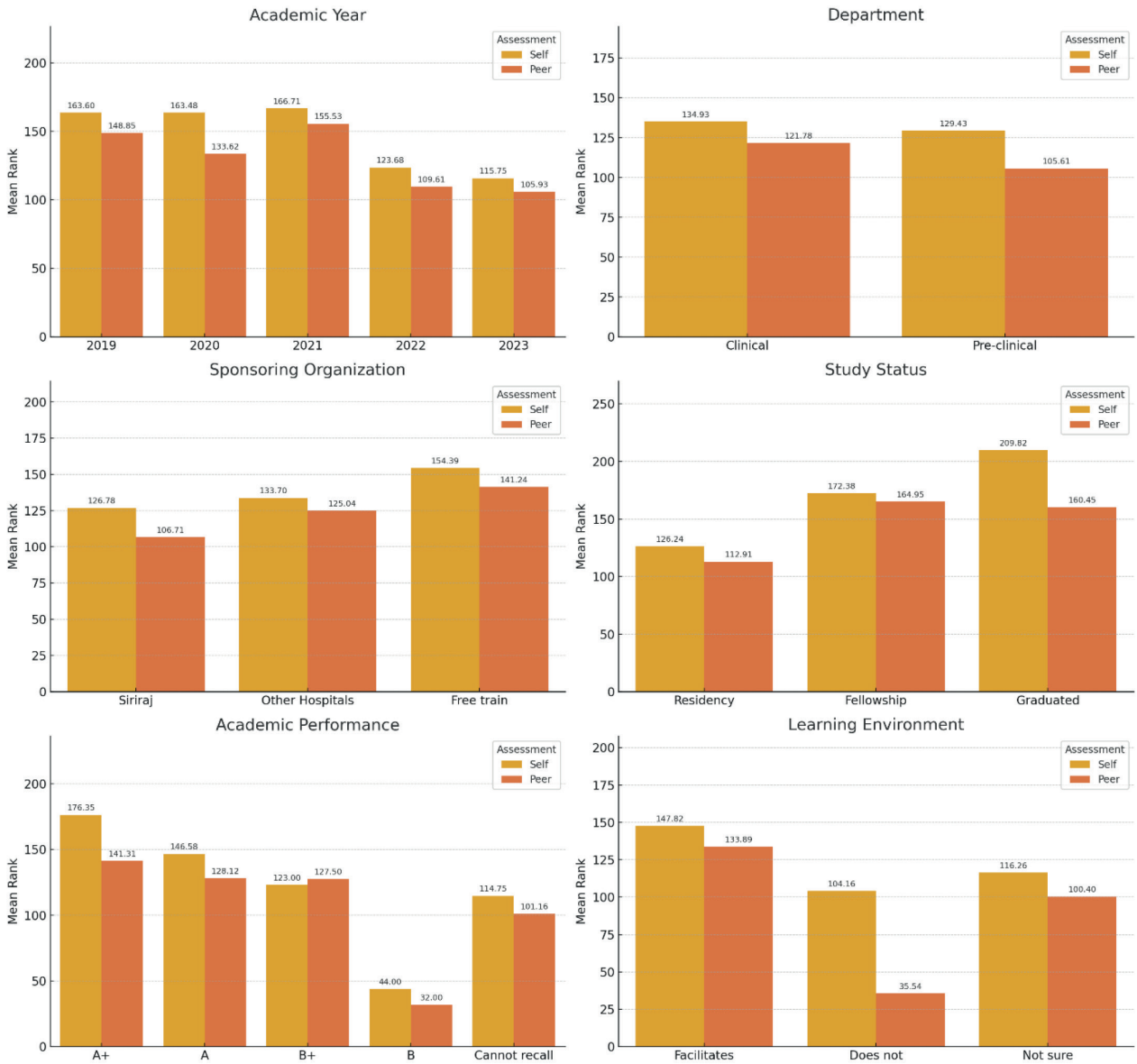

Figure 2 Comparison of learners' behavior in applying knowledge, based on general information of the learners

Figure 2 shows comparison of learners' knowledge application behavior from the SIID 529: Effective Clinical teaching course, based on self-assessment and peer-assessment, across six categories: academic year, department, sponsoring organization, study status, academic performance, and learning environment. Bars represent mean rank scores from non-parametric analyses (Kruskal-Wallis and Mann-Whitney U tests), with numeric values displayed on top.

Statistically significant differences ($p < 0.05$) were observed in comparisons by: Academic year: Learners from 2019–2021 showed significantly higher knowledge application than those from 2023.

Study status: Graduates and fellows reported higher behavioral application than those still in residency.

Academic performance: Learners with an A+ grade applied their knowledge more effectively than lower-performing peers.

Learning environment: Supportive environments correlated with higher application behavior scores in both assessments.

No statistically significant differences were found in:

Department: Clinical and pre-clinical learners showed similar application behaviors, suggesting that departmental affiliation may not be a determining factor.

Sponsoring organization: While peer-assessment indicated significant differences favoring Free-train participants, self-assessment did not reach statistical significance. This discrepancy may reflect differences in external perception or institutional support.

Discussion

Knowledge Application Behavior of Learners from the Course SIID 529 Effective Clinical Teaching at Faculty of Medicine Siriraj Hospital, Based on self-assessment and peer assessment, the overall average scores and all specific aspects met the required criteria. All aspects were rated at the highest level. Additionally, both self-assessments and peer evaluations ranked the highest-scoring aspects in the same order, indicating that the knowledge application behavior in each aspect follows the same direction. When analyzing specific aspects in detail, it was found that learners applied their knowledge most prominently in the Clinical Supervision aspect. They prioritized patient safety over allowing medical students to gain hands-on procedural experience. This is because physicians are instilled with the principle that patient safety is the top priority, this aligns with research findings indicating that the medical profession is one of the occupations with the highest responsibility index score (100%). This demonstrates that, from the past to the present, physicians remain highly conscious of their societal responsibility to provide patient care.[13] As medical students learn while caring for patients, errors may occur, and at times, their clinical decision-making may be less developed compared to faculty members or senior physicians. Therefore, it is essential to anticipate potential errors, minimize them as much as possible, and, when they do occur, ensure a supportive environment that allows medical students to reflect on their actions and learn from their mistakes rather than feeling blamed.[14] Due to time constraints, high patient loads, and heavy workloads, the application of knowledge in the Ward Round aspect was the least prominent. In this setting, focused teaching is employed, selecting specific key topics that are appropriate for the medical students' level and the available time. Meanwhile, the Teaching on the Run aspect ranked second in terms of knowledge application, where, after understanding the underlying reasons, general principles were also taught to medical students. Regarding the Giving Feedback aspect, the most applied behavior was allowing medical students to ask questions while demonstrating active listening. This aligns with the principle that "There is a tradition for doctors to teach their colleagues and medical students," emphasizing the importance of sharing expertise and transferring medical knowledge.[15] However, this has become increasingly challenging due to lack of time, increasing patient loads, insufficient teaching knowledge, and inadequate training. Clinicians need to enhance their knowledge on how to motivate learners and provide constructive feedback.[16]

The results demonstrated meaningful patterns in how learners applied knowledge from the SIID 529 course, which are discussed in detail below across key variables.

Academic Year: Learners from the academic years 2019, 2020, and 2021 exhibited the highest knowledge application scores. This suggests that the effectiveness

of SIID 529 is most evident after learners have progressed beyond the residency phase and have had more time and opportunities to apply their teaching skills in practice. This finding supports the Kirkpatrick Model (Level 3: Behavior), which emphasizes that behavior change requires not only the acquisition of knowledge but also the chance to apply it in real-life contexts over time.[17] Bilal, et al. (2017) similarly noted that faculty development is most impactful when it includes follow-up opportunities for reflection and implementation.[18]

Study Status: Graduates and fellows scored significantly higher than those currently in residency. This may reflect increased professional confidence and greater autonomy in teaching roles. The finding aligns with Adult Learning Theory[19], which posits that adult learners are more motivated to apply knowledge when it is directly relevant to their roles and responsibilities.

Academic Performance: Learners with an A+ academic grade demonstrated significantly greater application of teaching behaviors. This result can be interpreted through Bandura's Self-Efficacy Theory[20], where individuals with stronger self-belief are more likely to apply knowledge assertively and persistently. Additionally, Alam, et al.[21] found that high-performing individuals were more proactive in sharing knowledge and mentoring others-behaviors consistent with those promoted in SIID 529.

Learning Environment: Participants who reported being in a supportive environment had the highest mean scores. These environments likely include reasonable workloads, opportunities to teach students, and collaboration with motivated peers - factors that reinforce the practical use of teaching skills. According to Green and Kreuter's PRECEDE–PROCEED Model[22], behavior is shaped by predisposing, enabling, and reinforcing factors. A learning-friendly environment enables the application of newly acquired skills and reinforces them through organizational support and recognition.

This is further supported by literature on organizational performance, which identifies workplace responsibility, knowledge exchange, and supportive infrastructure as essential for enhancing professional behavior and effectiveness.[23]

Non-Significant Differences: No statistically significant differences were found between learners from clinical and pre-clinical departments, suggesting that departmental affiliation does not influence the application of teaching knowledge. This finding implies that learners, regardless of specialty, can benefit equally from the course. Additionally, although peer-assessment indicated higher scores for Free-train participants, self-assessment did not show a significant difference based on sponsoring organization. This discrepancy may reflect external perceptions shaped by institutional support, teaching culture, or frequency of teaching opportunities.

Study Limitations

1) The use of self- and peer-report instruments may be subject to response bias, such as social desirability or recall limitations.

2) The response rate was modest (approximately 30%), which may limit the generalizability of the findings across all participants in the SIID 529 course.

3) The study could not control for external variables, such as patient load, actual teaching responsibilities, or departmental teaching culture, which may have affected learners' ability to apply knowledge.

Practical Implications

1) For educators and curriculum planners: Structured post-course interventions

such as peer coaching, mentoring, or reflective practice groups may help learners sustain behavioral change.

2) At the organizational level: Institutions should consider strategies to promote teaching-conducive environments by managing clinical workloads, providing feedback systems, and encouraging teaching roles among trainees.

3) The dual-assessment approach (self and peer) enhances the validity of outcome evaluation and should be adopted in similar programs.

Recommendations for Future Research

1) Future studies should incorporate qualitative or mixed methods approaches (e.g., interviews or observations) to deepen the understanding of how and why teaching behaviors are applied.

2) Including perspectives from medical students who receive instruction from SIID 529 graduates may offer indirect evidence of course effectiveness.

3) Expanding the sample size and including a broader range of institutions would improve the external validity of future findings.

Conclusion

The study on learners' knowledge application behavior from the SIID 529: Effective Clinical Teaching course at the Faculty of Medicine Siriraj Hospital demonstrated that the course content is highly beneficial for physicians. As senior physicians are inevitably responsible for teaching and mentoring junior doctors, the course contributes meaningfully to enhancing their teaching competency. Institutions should therefore manage clinical workload and time allocation effectively, while providing formal training in clinical supervision, ward rounds, teaching on the run, and giving feedback to empower their role as educators.

Moreover, fostering a supportive environment - such as providing opportunities to teach, manageable patient loads, and collaborative teaching culture - can enhance the real-world application of teaching skills. These improvements ultimately benefit both medical students and patients.

Although most learners were able to apply their knowledge in real practice, the extent of application varied depending on individual and contextual factors.

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Conflict of Interest

The authors have no conflicts of interest.

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