

Effectiveness of Workshop on Concept Mapping in Improving Knowledge, Perceptions of Faculty

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ABSTRACT

The ASEAN Work Plan on Education 2021-2025 emphasizes the need to introduce innovative teaching and learning methods to improve the quality of education through regional cooperation. ASEAN initiatives aim to facilitate the continuous professional development of teachers by equipping them with the required skills to implement these methods in teaching. However, the application of concept maps (CMs) in teaching in parts of ASEAN is related to several problems and challenges. One such issue is the lack of training among teachers. This quasi-experimental study evaluated the effectiveness of a workshop in enhancing the knowledge and perceptions of faculty members regarding the use of CMs. Self-perceived knowledge and perceptions regarding CMs were assessed via a pre-and post-test questionnaire. The median knowledge score, self-reported knowledge of CMs, self-reported ability to create digital CMs, and self-perceived confidence level in applying CMs in medical education improved ($p < 0.001$) among the participants after the workshop.

Keywords: Concept maps, faculty, knowledge, perception, workshop

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Introduction

Concept mapping is an active learning method that promotes critical thinking among learners beyond rote memorization. It enhances the clinical reasoning and decision-making skills required in clinical practice. Saeidifard et al. (2014) in an Iranian study reported that medical students taught using concept maps (CMs) answered problem-solving questions significantly better than controls. According to Ausubel's learning theory, learners acquire new ideas by making connections to information they already know, which explains how CMs facilitate learning. CMs have currently gained importance in medical schools (Loizou et al., 2022).

Teachers need clear instructions regarding CMs before CMs can be introduced in the classroom, for the benefit of the students. They need to make changes in their conventional approaches to teaching that encourage rote memorization of concepts to learning that involves connections between ideas.

In an Indonesian study, Kusumadewi et al. (2022) reported that students can only prepare good CMs after repeated exercises under the guidance of teachers. Chiou et al. (2017) reported that learning achievements were better among students who learned via computer-assisted CMs than those who learned using paper-and-pencil-created CMs, indicating the importance of using digital technologies for creating CMs. Therefore, teachers need to be first trained in the use of digital technologies in designing CMs.

CMs, although increasingly used in the Philippines as a teaching tool across various educational levels, their implementation is not widespread. It faces challenges, including a lack of teacher training and awareness (Cabiling

& Magday, 2020). Manzon (2021), in another study conducted in the Philippines, suggested that teacher training institutions should include the CMs' training strategy as part of all teachers' training. Nguyen and Pham (2018) stated in a study conducted in Vietnam that teachers were not sufficiently qualified to meet the educational needs of students as outlined in the government's recent initiatives for educational reform. These findings imply that a major educational challenge faced in ASEAN is the lack of adequate training among teachers in the use of CMs.

The ASEAN supports regional commitments in education by building the capacity of education personnel with the digital competency skills required in the 21st century (ASEAN Secretariat, 2025). Although ASEAN has made significant progress in developing education technology over the past two years, there is still a long way to go. Several training programs for teachers currently being implemented in this region are found to be one-size-fits-all professional development initiatives. The content of training given to most teachers is more general and lacks focused training on key aspects required to deliver quality education to the students. Hence, there is a need for relevant training programs that address varied contexts to fulfill the requirements of current classroom realities and offer solutions in settings with resource constraints.

Workshops form an ideal platform for training participants to acquire skills such as developing CMs, as they involve hands-on exercises under the guidance of an expert. Liu (2022) observed that workshops are very practical in training teachers. Funding for workshops in ASEAN institutions can come from various sources, including ASEAN's funds, contributions from external partners, and

domestic public funding within member states (Pascua-Valenzuela, 2025).

Hence, to address the concerns mentioned above, this institutionally funded workshop was designed to train faculty members in this setting. In addition to the general content, which included the fundamental aspects of CMs, information on their essential elements was also provided to participants in this workshop. Hands-on exercises were planned as part of this workshop to help participants create the various aspects of a CM. It was performed via free digital tools that are readily available and accessible to every learner, including the students. Handouts and YouTube videos showing the pathway of various key functions while applying these digital tools were also shared with the participants to encourage independent learning.

Although workshops actively encourage participation and foster a collaborative environment for skill-building and knowledge exchange, it becomes essential to evaluate whether they have truly benefited the participants of a training program, particularly on a topic of importance, namely CMs.

Objectives

This study, therefore, assessed the effectiveness of a workshop in enhancing the knowledge and perception of CM use among faculty members of various health science courses. The study also evaluated their prior practices regarding the use of CMs in medical education.

The creation of CMs using cost-effective technologies was deliberately planned to keep the ASEAN educational policies and practices in mind.

Participants

Table 1

Sociodemographic Characteristics of the Participants.

Characteristics	%	n
Age group (years)		
21-30	15.2	5
31-40	30.3	10
41-50	33.3	11
51-60	21.2	7
Gender		
Males	39.4	13
Females	60.6	20
Specialty		
Clinical subjects*	36.4	12
Para-clinical subjects**	30.3	10
Preclinical subjects ***	24.2	8
Allied Health Sciences****	9.1	3
Designation		
Professor	27.3	9
Additional Professor	3.0	1
Associate Professor	33.3	11
Assistant Professor	9.1	3
Senior Resident	18.2	6
Tutor	6.1	2
Clinical supervisor	3.0	1
Teaching experience after graduation (years)		
<1	12.1	4
1-10	36.4	12
11-20	36.4	12
21-30	15.1	5
Total	100.0	33

*Departments of Obstetrics and Gynaecology 3, Paediatrics 3, General Surgery 2, Anaesthesiology 1, Orthopaedics 1, Otorhinolaryngology 1, Radiation Oncology 1

**Departments of Community Medicine 5, Microbiology 3, Pathology 1, Pharmacology 1

***Departments of Biochemistry 5, Anatomy 2, Physiology 1

****Departments of Physiotherapy 2, Audiology and Speech Language Pathology 1

The study population comprised faculty members from various health sciences courses at a private medical college who participated in this workshop. The inclusion criterion was being a faculty member of this teaching institution, and the exclusion criterion was nonconsenting participants. All the workshop participants provided informed consent to participate in this research study. Both workshop facilitators were members of the Department of Medical Education at this institution. They also monitored the hands-on activities during this workshop.

The mean age of the participants was 41.4 (SD 9.0) years and ranged from 27 to 58 years. The participants' median years of teaching experience was 11 years (IQR 2.7, 19.5), ranging from 6 months to 30 years. (Table 1)

Methodology

Research design

This quasi-experimental study involved a training intervention in the form of a three-hour onsite workshop on "Concept Mapping in Medical Education," held in April 2024.

Instruments

The pre-and post-test questionnaires for this study were designed using Microsoft Forms. The study instruments were prepared by the investigators with the assistance of a literature review. The pre- and post-test questionnaires were semi-structured, comprising both open-ended and closed-ended questions. Two experts in medical education performed content validation of the data collection tools. They were asked to rate each item on the questionnaire on a four-point Likert scale, with the options "not relevant," "somewhat relevant," "quite relevant," and

"highly relevant." The items selected as "quite relevant" and "highly relevant" by both experts during the content validation process were retained in the questionnaire by the investigators. Pilot testing of the tools was performed among five faculty members who were not participants in this workshop. The Cronbach's alpha value of reliability of the pre-test questionnaire was 0.739, and that of the post-test questionnaire was 0.762.

Procedures

Phase 1: Preliminaries and Preparation

It took approximately 10 minutes to complete the pre-test questionnaire. The pre- and post-test questionnaires were anonymous, and the links were emailed to the participants before and after the workshop, respectively.

Phase 2: Survey Process

The information sheet and the consent form were in the initial part of the pre-test questionnaire. The first section of the questionnaire inquired about the general details of the participants, including their age, gender, department, designation, and duration of teaching experience following postgraduate training. The second section inquired about their practices, including their history of attending similar training programs, prior use of CMs for educational purposes, and the various advantages and disadvantages they experienced following their use for academic purposes. The third section consisted of 15 questions to assess the participants' baseline knowledge of CMs. This comprised six true-or-false questions, seven single-answer multiple-choice questions, and two open-ended questions.

In the final 10 minutes before the workshop concluded, participants completed the post-test questionnaire and the feedback form. The

post-test questionnaire inquired about the participants' self-perceived knowledge, skills in creating a CM, and confidence in using CMs for medical education before and after attending this workshop on a scale of 0-10 points. After attending this workshop, they were given the same 15 questions to assess their knowledge of CMs. A question on whether CMs are a valuable tool for medical education was asked on a five-point Likert scale to all the participants.

Phase 3: Workshop Proper

Details of the workshop proper are placed as a document in the figshare data repository <https://doi.org/10.6084/m9.figshare.29459177>

Phase 4: Post-Survey Process

The feedback form was shared as a separate link. Their feedback was rated as “not useful, less useful, somewhat useful, useful, and very useful,” with scores ranging from one to five.

Feedback regarding the workshop was collected on various parameters, including the content and delivery of the talk, explanations provided, use of audio-visual aids, and interactivity, using a five-point Likert scale. The ratings on this scale were “poor, average, good, very good, and excellent,” and the points awarded ranged from one to five. The usefulness of the preworkshop instructions, sessions on demonstrations of how to make CMs and mind maps (MMs) by the facilitators, and hands-on exercises given to the participants during the workshop were rated by the participants as “not useful, less useful, somewhat useful, useful, and very useful,” with scores ranging from one to five, respectively. Feedback on the time allotted for hands-on exercises during the workshop and the time allocated for discussions at the end of each session was assessed on a Likert scale with

responses of “adequate,” “less adequate,” and “not adequate.” The overall pacing of the program was rated on a scale of “too slow,” “too fast,” or “just right.” The participants were also asked to share their feedback regarding expectations “accomplished” and “not accomplished” by the end of this workshop. They were also invited to share any open comments regarding the topics chosen for this workshop.

Data Analysis

IBM SPSS for Windows version 25.0, Armonk, New York, was used for data entry and analysis. The Kolmogorov–Smirnov test was used to test the normality of the participants' various scores. The Chi-square test, Fisher's exact test, unpaired t-test, analysis of variance, Karl Pearson's correlation coefficient, Spearman's rank correlation coefficient, and Wilcoxon signed-rank test were used to test associations. A p-value of less than 0.05 was considered statistically significant.

Results

The participants stated the purpose of attending this workshop was to gain knowledge regarding CMs (by 17), to learn a new tool that can be applied in the classroom teaching process (by 6), to learn to draw CMs (by 6), for undergraduate and postgraduate teaching (by 6), to enhance the effectiveness of classroom teaching (by 6), to use the same tool in small group teaching (by 2), to understand various types of CMs (by 1), to learn to organize thoughts using CMs (by 1), to apply it in clinical teaching (by 1), and to understand MMs (by 1).

The expectations from this workshop, as stated by the participants, were to create a CM by themselves at the end of this workshop (by 6), to have a good understanding of the fundamentals of

a CM (by 5), to learn more about the application of CMs in medical education (by 3), to use CMs in classroom teaching (by 3), and to use various software to create CMs (by 3).

One of the participants had received training on CMs before this workshop. It was a continuing medical education program organized by this institution's Department of Medical Education.

Table 2

Concept Map Usage-related Characteristics of the Participants (n=33).

Characteristics	%	n	Characteristics	%	n
Heard about CMs before					
Yes	69.7	23	Sources of information (n=23)*		
No	30.3	10	Internet	60.9	14
			Colleagues	52.2	12
			Workshop	30.4	7
			Friends	21.7	5
			Printed literature	21.7	5
Had used CMs in medical education					
Yes#	33.3	11	Specify setting (n=11)		
No	66.7	22	Classroom teaching	100.0	11
			Specify student population (n=11)*		
			Undergraduate students	100.0	11
			Postgraduate students	36.4	4
			Advantages experienced while using CMs for teaching (n=11)*		
			Students understood the concepts better	100.0	11
			Students found this form of teaching interesting	81.8	9
			Class interaction was good	63.6	7
			Disadvantages experienced while using CMs for teaching (n=11)*		
			Unfamiliarity with the software used to make CMs	81.8	9
			Unfamiliarity with drawing CMs	72.7	8
			Time consuming process if applied for teaching	63.6	7
			Prior preparation of the topic is required on the part of the students	9.1	1

*Multiple responses

#Topics for which it was used: Anatomy of the periosteum and embryology of the gastrointestinal tract and anatomy of the diaphragm 1, Epidemiological determinants of cerebral palsy 1, Integrative medicine 1, Clinical chemistry 1, Digestion and absorption of nutrients 1, Down syndrome 1, Tonsillitis 1, Laboratory diagnosis of tuberculosis 1, Reanimatology 1, Laboratory diagnosis of sexually transmitted diseases 1, Stroke in pediatric age group 1

Practices of participants regarding the application of CMs in medical education

Of the thirty-three participants, 23 (69.7%) had heard of CMs, and 11 (33.3%) had previously applied them in medical education. (Table 2)

Among the eleven faculty members who had applied CMs in classroom teaching, all reported that students understood the concepts better, and 81.8% of them felt that students found this form of teaching interesting. However, unfamiliarity with the software used to make CMs was the drawback stated by the majority (81.8%). (Table 2)

All the faculty members strongly agreed that much preparation was required for its implementation in classroom teaching. The senior faculty members, in particular, were apprehensive about the increase in teaching hours due to the use of CMs instead of conventional methods. Three-fourths of faculty members disagreed that CMs imposed an extra burden on them, and three-fourths strongly agreed or agreed that it should be included in the curriculum.

Effectiveness of the workshop in improving the knowledge and perceptions of the participants regarding CMs

The self-reported knowledge regarding CMs, self-reported ability to create digital CMs, and self-perceived confidence level in applying CMs in medical education significantly improved among the participants in this study after the workshop. This workshop thus improved the faculty members' knowledge and perceptions in using CMs. (Table 3)

After the workshop, as many as 15(45.5%) participants strongly agreed, and 10 (30.3%) agreed that CMs are useful tools in medical education. The rest were uncertain about the same.

The median score obtained in the pre-test among the 33 participants was 8 (IQR, 7-9), with scores ranging from 1 to 11. The median score obtained in the post-test among the 33 participants was 13 (IQR, 11-14), with scores ranging from 4 to 14 ($Z = 4.901$, $p < 0.001$). (Figure 1) This improvement in their knowledge, as reflected in the significant increase in their post-test scores, supports the effectiveness of this workshop.

Table 3

Self-perceived Knowledge and Self-perceived Confidence Level Regarding CM Preparation among Participants before and after the Workshop.

	Before the workshop Mdn score (IQR)	Min score, Max score	After the workshop Mdn score (IQR)	Min score, Max score	Z value	p value
Self-perceived scores for knowledge regarding CMs	3(1.5-4.5)	1,10	7(7-8)	4,10	4.381	<.001
Self-perceived scores for skills in developing digital CMs	2(1-4)	1,10	7(6-8)	3,9	4.341	<.001
Self-perceived scores for confidence level for using CMs for medical education	3(2-5)	1,10	8(6-8)	4,10	4.269	<.001

($n = 33$)

The mean post-test score among the male participants ($n = 13$) was 13.1 ± 1.3 , and that among the female participants ($n = 20$) was 11.5 ± 2.5 ($t = 2.069$, $p = .047$). There was no significant association between the designation ($p = 0.613$) and no significant correlation between the age (p

$= .765$) or teaching experience ($p = .775$) of the participants and the post-test scores obtained by them.

The performance of the participants in the post-test is shown in Table 4.

Figure 1

Distribution of the Pre-and Post-test scores among the Participants ($n=33$).

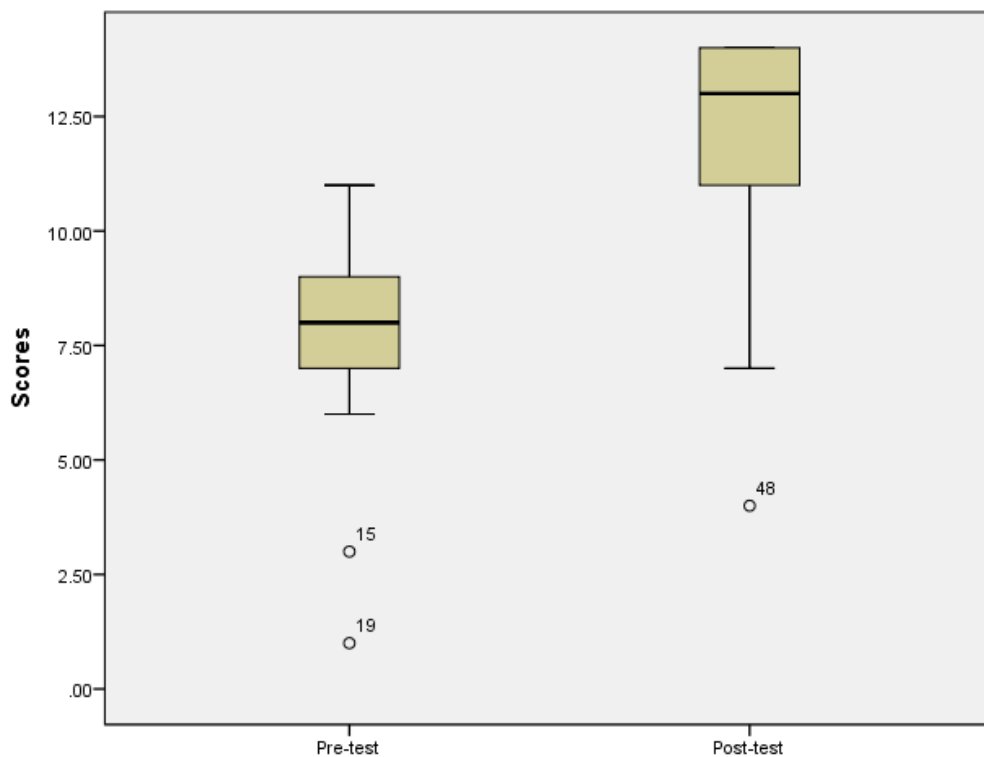


Table 4

The Distribution of the Participants' Responses in the Post-test, Intended to Assess their Knowledge of CMs and Mind Maps (MMs).

Questions with correct answers	%	n
True or false questions		
CM connects new knowledge with existing concepts		
True	84.8	28
CM will only benefit the visual learners under the VARK model of types of learners		
False	75.8	25
A CM helps students to self-reflect		
True	93.9	31
The CM will enhance the interpersonal communication skills of the students		
True	87.9	29
CMs is an easy way to enhance cognitive performance		
True	84.8	28
A CM is a very powerful tool to assess students' understanding of the topic		
True	87.9	29
Multiple-choice questions (MCQs)		
Which of the following is not a disadvantage of a CM? (MCQ)		
High-cost technology (correct response)	60.6	20
Which of the following patterns of CMs are most suitable to present processes? (MCQ)		
Flow charts (correct response)	75.8	25
Identify from the below options the correct sequence of making a CM (MCQ)		
Focusing stage, Brainstorming stage, Organizing stage, Layout stage, Linking stage, Revising stage (correct response)	66.7	22
"Nodes" in a CM refers to (MCQ)		
Boxes (correct response)	69.7	23
The number of cross links in a CM is an indicator of (MCQ)		
The extent to which knowledge has been integrated (correct response)	78.8	26
Identify the correct statement about MMs (MCQ)		
Shows topics with a single parent and several children (correct response)	45.4	15
Which of the following is not an element in the rubric for assessing CMs? (MCQ)		
Type of concept map (correct response)	66.7	22
Open-ended questions		
Identify the type of CM from the "structure" shown below in the picture		
Correctly answered by	78.8	26
Name at least one digital tool used to prepare CM or MM		
Correctly answered by	90.9	30

Overall, the usefulness of the hands-on exercises in the workshop was rated as very useful by 9(27.3) participants. (Table 5)

The participants reported that the following expectations of theirs were fulfilled in this workshop: twelve participants stated that they

Table 5

Feedback regarding the workshop among the participants.

Characteristics	Scores		
	Min score, Max score	Mean feedback score	SD
Content of the talk	2,5	4.3	0.9
Delivery of the talk	2,5	4.2	0.9
Explanations provided	2,5	4.2	0.9
Use of audio-visual aids	2,5	4.2	0.8
Interactivity with the audience	2,5	4.3	0.8
Proportions			
The usefulness of preworkshop instructions	%	n	
Very useful	51.5	17	
Useful	36.4	12	
Somewhat useful/Less useful	12.1	4	
The usefulness of demonstration on application of the Cmap to create CMs			
Very useful	33.3	11	
Useful	54.6	18	
Somewhat useful/Less useful	12.1	4	
The usefulness of demonstration on the application of draw.io to create MMs			
Very useful	33.3	11	
Useful	57.6	19	
Somewhat useful/Less useful/Not useful	9.1	3	
Overall usefulness of the hands-on exercises during the workshop			
Very useful	27.3	9	
Useful	69.7	23	
Less useful	3.0	1	
Time allotted for the hands-on exercises during the workshop			
Adequate	81.8	27	
Less adequate	18.2	6	
Time allotted for discussion at the end of each session			
Adequate	81.8	27	
Less adequate/Not adequate	18.2	6	
The overall pacing of the workshop			
Just right	84.8	28	
Too fast	15.2	5	
Total	100.0	33	

(n=33)

received an idea of the fundamentals of CMs; eleven indicated that they were aware of the sources and names of the various digital tools available to create CMs; two stated that they understood the fundamentals of MMs; two of them each expressed their confidence in making a CM and a MM at the end of the session; one each stated that they gained knowledge about the various types of CMs and how to assess the quality of the CMs via a standardized rubric; one participant reported that the handouts shared during the sessions were handy (mainly the ones concerning key functions that can be performed in Cmap and draw.io); one participant felt that the session was very interactive; and one participant stated to have understood how CMs complemented small group teaching and how it can be used as an assessment tool in classrooms.

However, one participant suggested that the workshop should have been held for a full day and that more digital tools for creating CMs and MMs should have been demonstrated, along with hands-on experience for the participants. Another felt that more time was needed for hands-on exercises.

A total of four participants submitted home assignments to create a CM. Three of them made CMs via Cmap. The topics were “pathogenesis of cell injury,” “biochemical alterations in protein-energy malnutrition,” and “clinical features of scurvy.” One participant made a CM of “microbiological methods for the diagnosis of tuberculosis” via the MindMeister tool.

Discussion

Little more than two-thirds of the participants in the present study had heard of CMs, and just one-third of them had applied them for teaching in the

past. This implies a lack of satisfactory awareness and application of CMs for teaching purposes among the faculty members in this setting.

All eleven participants who had previously applied CMs in teaching felt that students understood concepts better when CMs were used. In a study performed in Faridkot, India, by Jain et al. (2020), all the faculty members strongly agreed or agreed that the reasoning skills of medical students were enhanced using CMs, which will help students in practice, and 80% of them strongly agreed or agreed that the students enjoyed constructing CMs. These findings support Ausubel’s learning theory and Kolb’s experiential learning theory, where learning new ideas is facilitated by the use of CMs, which helps students make connections to their prior information and experiences.

In another study performed in Kolkata, India, by Nath et al. (2021), 83.3% of faculty members strongly agreed or agreed that CMs made the learning process enjoyable among medical students, and all of them strongly agreed or agreed that the pictorial representation in CMs enhanced students’ ability to remember concepts. These observations support constructivist learning strategies involving CM, wherein students actively engage in steps such as exploration, collaboration, experimentation, critical thinking, and reflection to construct their knowledge.

More than 80% of the faculty members who had applied CMs in teaching in the present study stated that unfamiliarity with the software was the primary deterrent to its application in classroom teaching. Similar is the situation of teachers in several ASEAN contexts, as stated earlier. In a study conducted in Ethiopia, teachers’ lack of skills and time shortages were identified as the

major problems hindering the application of CMs in teaching (Abraha, 2024).

After the workshop, more than three-fourths of the participants strongly agreed or agreed that CMs are valuable tools in medical education. In a qualitative research study by Demirci and Memis (2021) in Turkey, preservice science teachers expressed a positive perception towards using CMs in teaching activities and creating them. They were also in favor of including activities containing CMs in textbooks

This workshop was found to significantly improve participants' self-reported knowledge of CMs, their ability to create digital CMs, and their self-perceived confidence level in applying CMs in medical education. The workshop significantly improved the participants' knowledge in this study, as supported by their post-test scores. Hence, empowering teachers to utilize digital technology and apply innovative teaching-learning methods, such as CMs, through workshops such as these is necessary. In a study conducted in Indonesia, the use of advanced supporting tools in preparing CMs enhanced teachers' concept mapping efficiency (Pinandito et al., 2021). Thus, the integration of cost-effective technology in ASEAN institutions and its inclusion in regional educational policies could address ASEAN-specific challenges, such as resource limitations and a lack of training and awareness among teachers.

Close to two-thirds of the participants who had used CMs earlier in teaching felt that applying CMs was a time-consuming process. Now, with the advent of technology and numerous digital tools available to prepare CMs, creating electronic CMs has made it possible to save time. It has also enabled learning to be self-constructed, where students create CMs by linking phrases

independently or through a scaffolded approach, where a teacher-designed template is given to the student to complete (Eachempati et al., 2020). However, as agreed upon by all participants in this study, prior preparation is essential for implementing it in classroom teaching and student assessment purposes.

Conclusion

The workshop on CMs was found to be effective in enhancing the knowledge and perception of CMs use among participants. Overall, the participants provided good feedback regarding the workshop.

It was also observed that just one-third of faculty members had previously used CMs for medical education. This again reflects the unsatisfactory awareness of CMs among the majority of the faculty members, resulting in their poor application in the teaching processes. Therefore, more workshops on CMs are recommended at every teaching institution in parts of Asia. The use of cost-effective, digitally created CMs in classroom teaching will help not only medical students but also students from other educational and socio-economic backgrounds to utilize the benefits of CMs, thereby improving their scholastic performance. Therefore, the need for an educational policy that supports cost-effective technology integration for creating digital CMs as a part of general teacher training is needed in ASEAN countries. The training should involve workshops and utilize free tools, such as CMaps, to ensure wide accessibility to technology and empower faculty members to acquire the requisite skills and knowledge, as well as overcome perceived challenges while developing CMs.

A limitation of this study was the small sample size of participants. As this research study was conducted as part of a workshop, the total sample size that could be achieved was 33, and all participants were enrolled using a non-probability sampling method. The study was also conducted at a single institution in an urban setting; therefore, the findings may not be generalizable.

Future multi-institutional and prospective research studies should be conducted after the implementation of such workshops to evaluate feedback from faculty members on their experiences with using CMs in classroom teaching over extended periods. Experimental studies should also be conducted among students taught via CMs versus those taught via conventional methods to determine how their exam performance scores differ after the implementation of CMs. This will then align with ASEAN's goal of impacting students' outcomes by empowering teachers to achieve the long-term goal of equitable and high-quality education, stated in the ASEAN Work Plan on Education 2021-25.



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5. **Declaration of Generative AI in Scientific Writing:** Not used

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