“How Intense Should Be A Nurturing Program Physician Mindset?”

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Abstract The professional development of medical students starts with clinical reasoning growth. Facilitating the growth of clinical reasoning, from a single method to a program strategy could be used. An integrated program between knowledge and performance was applied within the curriculum in the third year students. The program consist of two tutorial meeting with multilevel type scenario, a single integrated performance training, and apply Objective Structured Clinical Examination (OSCE) at the end of the third year. This study aimed to evaluate a clinical reasoning course by using the OSCE score at the end of the program. A simple pair t-test analysis was conducted to compare OSCE scores before and after this program was implemented. There was a significant difference in OSCE scores between before and after the course was implemented on three stations from a total of seven stations, regardless of whether it was a procedural or non-procedural type of station. This clinical reasoning program could positively influence students’ clinical reasoning growth. The course’s length, and intensity given through tutorials and integrated training sessions influenced how the student can cognitively build critical thinking skills, especially the pattern of recognition and recall. However, more research is needed to better understand how much intensity is required in the sessions to build a firm tacit knowledge and pattern recognition.

Keywords Clinical reasoning · Students’ professional development · Objective structured clinical examination · Program evaluation

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1 Introduction

Clinical reasoning (CR) is "an ability to integrate and apply different types of knowledge, to weigh evidence, critically think about arguments, and to reflect upon the process used to arrive at a diagnosis" [1]. CR depends on the cognitive process within a physician's mind, recognition of patients' problems, searching evidence related to a relevant diagnostic test, and decision-making based on certain examination results. How a physician thinks deliberately could be categorized into two processes: the short and long way, depending on the physician's expertise in the field [2]. The cognitive architecture theory, a combination of mathematical and psychological theories, explains what happens in a physician's cognition through their decision-making process [3, 4]. Some theorists have argued that the clinical reasoning process is not only part of the cognition process but reflects higher order thinking skills and actual experiences. However, the cognitive process still dominates the process.

Programs in facilitating clinical reasoning typically follow the SPIRAL curriculum, starting from simple to complex material. In contrast, training on clinical reasoning should follow closely after students demonstrate a full understanding of basic medical science [5]. In order to insert this pattern of thinking as a critical thinking skill in clinical reasoning, several phases should be managed through the program [6]. Before entering the program, the student should fully understand human physiology, anatomy, and pathophysiology. Basic medical knowledge should be structured in such a way that it will build students' tacit memory so they can easily retrieve accurate information when needed. After delivering the knowledge on basic medical science (anatomy, physiology, and pathophysiology), it is proposed by Cutrer, Sullivan, and Flemming that the clinical reasoning nurturing programs should facilitate the dual process of thought by inserting the pattern of the diagnostic process through a cycle of two systems [6].

In the first system, the student should have experience in the diagnostic process by facing clinical cases, either simulated or actual. Through this system, a cognitive framework will be developed throughout the process. The facilitator/teacher could address the student's performance from unconsciously competent to unconsciously incompetent by informing them of their failures during discussion for the diagnostic process (Fig. 1) [7]. In order to facilitate this, case-based clinical reasoning in the problem-based learning strategy is a specific type of discussion that uses specific clinical cases as a trigger point that could be used to facilitate immediate real-time feedback [8, 9]. In the beginning phase, a script concerning an illness should be started by adding students' knowledge of the disease. Integrating their knowledge of physiology, anatomy, and pathophysiology under the term diagnosis will help them "chunk their memory" when addressing similar patients' complaints. The discussion will follow just like in a diagnosis process, which involves the applied gathering of data from anamnesis until additional examination results confirm a definitive diagnosis, called a multilevel type scenario. This CR process should be followed by the scaffolding phase, where the students will receive immediate real-time feedback on their understanding of clinical presentation through an active process [9].

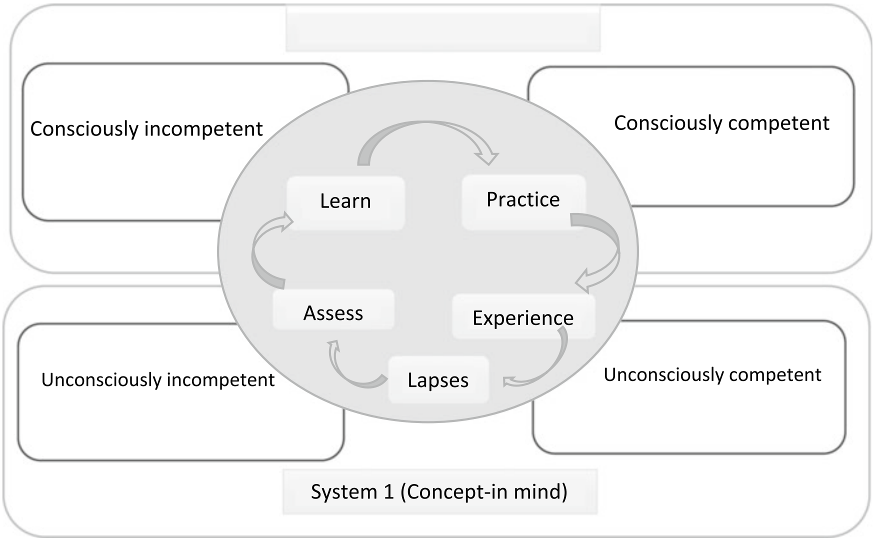

Fig. 1 An integrated program for improving clinical reasoning [5]

In the second system, as an active iterative process, the students should learn more specifically to enhance their cognition by understanding the illness script and ‘chunking it’ or relating it to basic medical science to confirm the content of their memory on a particular disease through actual performance. In this system, a cognitive framework is developed, and a skills or performance framework is further developed. The facilitator/teacher could facilitate the students’ change from unconsciously incompetent to consciously competent by stimulating their critical thinking throughout the diagnosing process within their full performance [10]. Therefore, the facilitating of the CR process implies that the teachers should facilitate a complete package of direct feedback.

In the advanced phase, the students need help in data-gathering, which could be facilitated through encounters with simulated or real patients. Facilitators could use a strategy such as **S**ummarize the history and findings-**N**arrow differentials-**A**nalyze differentials-**P**robe preceptor about uncertainties-**P**lan management-**S**elect case-related issues for self-study (SNAPPS), and **R**eporter-**I**nterpreter-**M**anager-**E**ducator (RIME) in facilitating the process [8].

Additionally, there are also other strategies such as self-explanation, structured reflection prompts for differential diagnosis, illness script, and health and disease schema which could be encouraged throughout the educational program [10].

The most common applied strategy to facilitate the students’ clinical reasoning is only focusing on the cognitive domain, by a discussion through a clinical case. As also proposed by Cutrer, Sullivan, and Flemming, we conducted an integrated CR training system between cognition and performance for medical students. The cognitive domain was developed by using case-based methods and the performance domain was integrated into the patient management session for the third year curriculum [6]. In this study, we aimed to re-visit whether what we have done by using this specific course to train students' CR would increase students' performance measured through the Objective Structured Clinical Examination (OSCE).

2 Methods

2.1 Intervention

An integrated program between first and second systems was established by problem-based learning sessions using a case-based CR type of discussion, and also training the students' performance through an integrated patient management (IPM) session. A multilevel scenario, with two case-based CR forms were consistently applied for the third year students in each block. In between, the students had one IPM session in the skills laboratory in each block that aimed to train their performance step by step through a specific clinical scenario related to the blocks' theme as the trigger. In total, the student had 12 multilevel type scenarios for their problem-based learning strategy, and 6 sessions of IPM in one year.

Methods in assessing students' CR are varied from knowledge-based levels, including key performance or script concordance, to the OSCE, and one minute preceptor [11]. By the OSCE, we can observe students' ability in CR through gathering data, interpreting data, and selecting the diagnosis. Good CR ability will help the students in performing better clinical skills since they get used to thinking systematically through the dual process. This will lead to shorter decisive time during their actual performance: how they choose certain physical exams, decide the diagnosis, and propose the treatment. As a consequence, better CR ability either can result in both better scores and/or shorter performance. However, some factors affecting students' performance during OSCE were identified such as anxiety or depression, nervousness, previous knowledge, previous performance during training regarding feedback, and technical problems during doing the instruction [12–15]. Nevertheless, a study revealed that there is no significant relationship between students' CR ability with OSCE by assessing students' CR through patients' notes after the encounter [16].

At the end of the third year, we conducted a performance-based assessment; the OSCE with seven stations was used to assess the students' complex skill set by using clinical cases as a trigger. Stations 1–4 assess the students' complex ability in communication skills, conducting physical examination, asking for additional examination, diagnosing, and proposing the treatment. A presented clinical problem such as typhoid or acute otitis media was followed by students' instructions to deal with the problem, analyze the case through the diagnosis process, recommend conducting certain related physical examination, ask for any additional examination then conclude the problem and propose the solution. A simulated patient was assigned to present the clinical data by mimicking the real condition presentation.

Meanwhile, stations 5–7 assess the student's ability in certain procedural skills such as injection, IV line, and surgery while still assessing students' ability in simple communication such as patients' education, and delivering informed consent.

We conducted a comparison study on two consecutive years of third year OSCE scores before the implementation of the integrated program to two consecutive years of third year OSCE scores after the implementation of the integrated program. We used the students' scores regarding the absolute percentage from each of the stations and conducted a simple paired t-test analysis for further analysis.

3 Results

We compared two consecutive years before and after the course was implemented, i.e., student batch 2013, 2014, 2015, and 2016. The student batch 2013 and 2014 were the batches before the course was implemented, while the batches 2015 and 2016 were the batches after the course was implemented. By using borderline method of standard setting, each batch had different pass rates in the OSCE year 3. Table 1 shows the students' characteristics.

3.1 Descriptive

3.2 Analysis

From the analysis of seven stations, only three stations had different statistical significance: IPM2, IPM4, and IPM7 (Table 2). This pattern shows that there was a change in OSCE scores after the strategy was implemented. In further analysis, we could see whether this strategy made those scores better or not by comparing the t-value as twice of α value. Based on that assumption, we could see that the IPM 4 had exceeded the lower border confidence interval of the difference, which means that only the IPM 4 stations had better scores after the programs' implementation.

Table 1 Students' characteristics

Year	Pre	Post
Total N	593	554
Gender	303 (51.1%) 290 (48.9%)	201 (36.22%) 354 (63.78%)
Mean age	21.05	21.1
Mean GPA	3.49	3.455

Note GPA, grade point average

Table 2 Example cases in objective structure clinical examination (OSCE)

		Pre	Post	Sig	t-value
Integrated stations					
IPM 1	Mean	76.3142	76.4450	0.831	−0.214
	Std Dev	15.56957	16.01970	–	–
	Skewness	−0.424	−0.575	–	–
IPM 2	Mean	69.2770	75.8538	0.000	−7.203
	Std. Dev	16.53847	14.73252	–	–
	Skewness	−0.131	−0.625	–	–
IPM 3	Mean	68.5849	69.2758	0.146	−1.455
	Std. Dev	15.40540	14.89739	–	–
	Skewness	−0.263	−0.221	–	–
IPM 4	Mean	77.3801	73.4444	0.000	3.991
	Std. Dev	13.44112	13.49135	–	–
	Skewness	−0.781	−0.333	–	–
Procedural stations					
IPM 5	Mean	76.2380	75.0557	0.212	1.249
	Std. Dev	14.62530	14.34799		
	Skewness	−0.520	−0.498		
IPM 6	Mean	72.2705	70.650	0.776	0.284
	Std. Dev	18.94659	25.54401		
	Skewness	−0.808	−0.828		
IPM 7	Mean	64.5382	68.9576	0.000	−4.133
	Std. Dev	20.25391	19.70862		
	Skewness	−0.481	−0.384		

4 Discussions

Less than half stations from the total sevens stations of OSCE showed changes after the program, and only one station showed better score achievement after the program. Furthermore, only one integrated station skill was changed. This station assessed students' performance, including their ability in history taking, physical examination, diagnosing, and recommending certain treatments to the patient. Many factors were revealed in determining students' performance in OSCE, such as their nervousness, mental problems (anxiety or depression), previous knowledge, previous performance during training, and technical problems [12–15]. Research in test-taking has shown that nervousness or mental problems will disrupt students' thought processes by distracting their focus of attention, and perceiving instructions, until possibly freezing their minds.

As a consequence, this will cause the students to miss critical parts of the decision-making process. Nevertheless, how the levels of previous students' knowledge and performance affect their performance needs to be better understood. Further investigation by using the diagnosing time and correctness of the student' diagnosing ability will help to determine whether this integrated program will help the student have better CR skills.

In inserting the pattern of thought, the dual process system needs an abundance of effort, but much is still being determined concerning how much effort should be made. In this case, we already gave 12 times practice in cognitive domains and 6 times in real performance domains. The results showed that this could change the OSCE score, but it did not adequately increase all of the scores. There may be many other factors that influence the students' thinking patterns that shaped their behavior either during the case-based discussion or during their performance. For example, how feedback is delivered to the students will influence how they accept correction, triggering them to consider how they think and stimulating them to 'chunk it' with their previous understanding of basic medical science and learning during the process. From this research, it is still unknown how often the pattern of thought should be inserted to make the students have good systematical thought during their diagnosing performance. More research is still needed concerning how many training times with adequate feedback are necessary in establishing the pattern of thought.

Most factors involved in inserting the dual pattern of thought are solely cognitive-based. Using cognitive architecture theory, understanding how students' thought processes work can be developed much easier. Cognitive architecture, a combination of formal mathematical theories such as Bayesian and knowledge-level strategies theories such as the Heuristic-made decision-making process, permits a more precise picture [3]. In novice thought, a student will build their own "chunk" consisting of declarative knowledge with its base level of activation based upon its redundancy and frequency of occurrence. Retrieval of such knowledge will need an active process, such as adding focus or attention and building a causal association relationship. In the educational process, good case descriptions will make the student focused and trigger pattern recognition in a case-based discussion. The students will retrieve their memory, and regarding the heuristic model, they will value the memory after thinking and seeking the causal relation with the current condition. Accordingly, the case is essential in triggering the student's recall. In the process, facilitators are also essential in triggering the causal relation between students' declarative memory and the current case. At the end of the process, valuing the information process should happen through the facilitator's debriefing of key information regarding the case. Cutrer provides a good systematical way of training students' CR by giving a chance for interactions between cognitive and performance domains [6]. Nevertheless, there still needs to be more known on how often this encapsulation process should happen in building strong declarative memory for students to become an expert in the medical field. Our research also emphasizes that this process was not done correctly, underscoring the importance of a faculty development program specifically for feedback on inserting a systematical thought of the students in thinking and deciding the diagnosis for their patients.

Regarding the process, the students' minds and psychological states have significant implications. Consequently, any negative aspects related to students' minds and psychological states could hamper the process. For example, in the OSCE, students' minds and, thereby, their performance will be influenced by their nervousness or anxiety. Once the students can overcome their nervousness or anxiety, they could retrieve their declarative memory or think over the case. While in the process, if the student is not comfortable with the situation or the educational process cannot reveal a causal relationship between students' thoughts with current cases, the encapsulating process of the proposed 'chunking' will not happen. This gap in recall implies that either the educational or assessment process will need to maintain the students' focus of attention, stimulate active memory, and create a stable, safe psychological environment.

5 Conclusions

Helping students in medical schools build their minds' encapsulating process to become an expert needs an abundance of effort. In this study, by using Cutrer's model, an integration between cognitive and performance systems in CR training could improve students' ability in clinical reasoning. Nevertheless, based on this study, the number of sessions with 12 times the cognitive domain process and 6 times the performance domain process was not adequate enough to support the development of a stable and good students' 'chunking' process. This essential cognitive development might need more intense and more frequent sessions of training with adequate feedback from the teachers.

Ethical Clearance This research was already reviewed and gained the ethical approval from the institutional ethical review board with letter number KE/FK/0915/EC/2020.

Conflict of Interest All of the authors have no conflict of interest with the publication of the research. We do hope that this research will enrich the science of evaluation in term of assessment for learning paradigm.

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Authors' Contribution HNR is the junior (main) researcher and the first author of this manuscript, PU is HNR colleague who worked together with HNR in analyzing the scores. TSH is HNR's supervisor in terms of curriculum and consultant in publishing this manuscript.

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