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Original Article

Analyzing the effectiveness of teaching and factors in clinical decision-making

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Abstract

Objective: The aim of this study is to prepare junior physicians, clinical education should focus on the teaching of clinical decision-making. This research is designed to explore teaching of clinical decision-making and to analyze the benefits of an "Analogy guide clinical decision-making" as a learning intervention for junior doctors. **Materials and Methods:** This study had a "quasi-experimental design" and was conducted in a medical center in eastern Taiwan. Participants and Program Description: Thirty junior doctors and three clinical teachers were involved in the study. The experimental group (15) received 1 h of instruction from the "Analogy guide for teaching clinical decision-making" every day for 3 months. Program Evaluation: A "Clinical decision-making self-evaluation form" was used as the assessment tool to evaluate participant learning efficiency before and after the teaching program. Semi-structured qualitative research interviews were also conducted. **Results:** We found using the analogy guide for teaching clinical decision-making could help enhance junior doctors' self-confidence. Important factors influencing clinical decision-making included workload, decision-making, and past experience. **Conclusion:** Clinical teaching using the analogy guide for clinical decision-making may be a helpful tool for training and can contribute to a more comprehensive understanding of decision-making.

Keywords: *Analogy guide teaching, Clinical decision-making, Medical education*

Introduction

One of the challenges in medical education is teaching junior doctors how to reason appropriately and how to understand and apply the scientific methods of clinical problem solving and decision-making to ensure that patients receive optimal treatment [1]. The steps in decision-making begin with collecting information on the patients' problems, followed by evaluation, analysis, planning, action, and review [2]. Clinical decision-making applies to the procedures of collecting relevant data, assessing subjective and objective information, listing all possible problem-solving methods, surmising possible results, and finally selecting, and executing feasible solutions. Subsequent evaluations of the advantages and disadvantages of potential solutions, as well as the formulation of remedy regimes, enable fabrication of comprehensive clinical decisions [3-5].

Studies of teaching methods in clinical decision-making have revealed that "analogy-guided learning," this is a learning method similar to reflective learning, may facilitate clinical reasoning and diagnosis. This type of learning method includes chart reviews and journal reading sessions [6,7]. Therefore, the extended benefits of analogy-guided learning for other clinical teaching activities merit further investigation. Since the inception of the classical model of judgment, curricula in various fields of science education have been designed to examine the decision-making process. In particular, the Tanner clinical judgment model and the dual-processing model are among the most frequently used classical models in medical education [8,9]. In the Tanner model, the judgment process comprises four aspects: noticing, interpreting, reflecting, and responding; reflections "on-action" during the noticing process comprise a particularly crucial component of the model [10]. The dual-processing model involves a diagnosis process that is not limited to either the heuristic–intuitive or systematic–analytical decision-making system [11].

Most studies on clinical decision-making have employed case discussion to investigate the procedures and results of simulated scenarios or real cases. However, few studies have emphasized how to teach clinical decision-making [12,13]. In recent years, scholars have proposed innovative teaching methods such as narrative medicine, reflection and written

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articulation, concept mapping, and the preceptor model. However, these methods have not been applied to clinical teaching due to difficulties in integrating decision-making elements such as reflection, the build-up concept, and experiential learning [14,15].

Materials and methods

This study mainly employed a pretest–posttest equivalent–group design based on the experimental research method, which was supplemented with semi-structured interviews. The study was conducted in a teaching hospital in eastern Taiwan. The effective sample size was 30 postgraduate year 1 (PGY-1) junior doctors, who were divided into an experimental group (n = 15) and control group (n = 15). Ten interviewees were recruited from the experimental group through purposive sampling. The experimental group received training that adopted teaching of analogy-guided clinical decision-making (1 h of instruction every day), and the control group received regular instruction. The teaching experiment lasted 3 months. The doctors from both groups completed a pre- and post-test. Three months after the teaching intervention, they completed a delayed test called the clinical decision-making self-evaluation form, which is a widely used tool. This scale describes the perceptions of nursing students in clinical decision-making based on self-expression [16]. Five experts in the field provided ideas for strategies and modifications of the tool. Data were also collected through semi-structured, audiotaped interviews with the participants. This study was approved by the Institutional Review Board and Hualien Tzu Chi Medical Foundation Research Ethics Committee (IRB103-79-B).

Program description

The analogy-guided clinical decision-making teaching method used in the experimental group began with establishing sets of standardized processes. To maintain consistent teaching quality, instructor meetings were held weekly to discuss the teaching materials and related problems. Advisers, experts, and scholars were invited to joint the development of teaching materials to improve the accuracy of teaching execution, and the instructors were asked to participate in training courses. The Teacher's Guide was edited according to Oermann [17,18].

Program evaluation

SPSS version 16.0 for Windows (SPSS Inc., released 2007. SPSS for Windows, version 16.0. SPSS Inc., Chicago, IL, USA) was used to analyze the quantified data in this study. Analysis of variance (ANOVA) was conducted with pretest scores as the control variable. The clinical decision-making self-evaluation form was used to evaluate the participants' progress. The questionnaire items were classified into three categories: decision-making steps, the Tanner model, and the dual-processing model. The data were analyzed through a two-way repeated measures ANOVA to examine (1) the between-subjects effects of the teaching and (2) the within-subjects effects of time and time with teaching. The assumption of sphericity was evaluated with the level of statistical significance set at $P < 0.05$. When interaction effects were observed, the main effects were analyzed.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards (IRB103-79-B).

Results

Comparing the teaching effects of the aspects of the decision-making steps revealed a significant difference in the aspect of "identify a problem" (F [29, 60] = 6.7, $P < 0.005$). Both time and teaching affected the test score, and an interaction effect was observed between the aspects of "develop options" and "act on the decision" (F [29, 60] = 8.1, $P < 0.005$; F [29,

Table 1: Repeated measures analysis of variance results for the decision-making steps

	Source of variation	df	SS	MS	*F*
Identify a problem	Between subjects	29	23.1		
	Teaching	1	4.5	4.5	6.7*
	Error subjects within teaching	28	18.6	0.7	
	Within subjects	60	11.3		
	Time	2	0.2	0.1	0.5
	Teaching × time	2	0.4	0.2	1.1
	Error	56	10.7	0.2	
	Total	89	34.4		
Gather information	Between subjects	29	11.9		
	Teaching	1	0.9	0.9	2.1
	Error subjects within teaching	28	11.0	0.4	
	Within subjects	60	6.7		
	Time	2	0.6	0.3	2.8
	Teaching × time	2	0.1	0.0	0.3
	Error	56	6.0	0.1	
	Total	89	18.6		
Develop options	Between subjects	29	13.0		
	Teaching	1	0.1	0.1	0.1
	Error subjects within teaching	28	12.8	0.5	
	Within subjects	60	5.9		
	Time	2	0.1	0.1	0.9
	Teaching × time	2	1.3	0.6	8.1*
	Error	56	4.5	0.1	
	Total	89	18.8		
Analyze the situation	Between subjects	29	16.1		
	Teaching	1	0.2	0.3	0.4
	Error subjects within teaching	28	15.9	0.6	
	Within subjects	60	7.9		
	Time	2	1.9	1.0	9.4*
	Teaching × time	2	0.3	0.1	1.2
	Error	56	5.7	0.1	
	Total	89	24.0		
Act on the decision	Between subjects	29	15.8		
	Teaching	1	0.6	0.6	1.2
	Error subjects within teaching	28	15.1	0.5	
	Within subjects	60	12.0		
	Time	2	6.7	3.3	42.2*
	Teaching × time	2	0.9	0.4	5.6*
	Error	56	4.4	0.1	
	Total	89	27.8		

*P<0.05. SS: Sum of square, df: Degrees of freedom, MS: Mean square

60] =5.6, P = 0.006). Table 1 presents the repeated measures ANOVA results for the decision-making steps. In the simple main effect of teaching, significant differences were observed between the experimental and control groups for the aspect of "develop options" in the pretest (experimental group < control group, F = 5.2, P < 0.05) and the aspect of "act on the decision" in the delayed test (experimental group > control group, F = 5.5, P < 0.05).

In the Tanner model, which was adopted to explore the benefits of teaching, the aspects of noticing and action had statistically significant results for the main effect of teaching (F [29, 60] = 5.5, P < 0.005 and F [29, 60] = 6.8, P < 0.005). Both time and teaching affected the test scores, and an interaction effect was observed between the aspects of noticing and action (F [29, 60] = 6.0, P = 0.005 and F [29, 60] = 6.2, P < 0.005, respectively). Table 2 shows the repeated measures ANOVA results for the Tanner model. According to the analysis of the simple main effect of teaching, the aspects of noticing and action did not differ statistically between groups in the pretests, but the aspect of noticing differed significantly between groups in the delayed tests (experimental group > control group, F = 14.2, P < 0.05). In addition, the aspect of action differed statistically between groups in both the posttests and delayed tests (experimental group > control group, F = 6.6, P < 0.05 and F = 11.2, P < 0.05, respectively).

Comparisons of the teaching effects in the dual-processing model revealed that the main effects of teaching did not differ significantly between the groups (F [29, 60] =3.1, P = 0.09; F [29, 60] =0.3, P = 0.57). Both time and teaching affected the scores of the participants, and the aspect of heuristics demonstrated an interaction effect (F [29, 60] =38.7, P < 0.001), as shown in Table 3. In the heuristics aspect, the analysis of the simple main effect of teaching indicated that the experimental group exhibited significantly higher delayed test scores than did the control group (F = 9.3, P = 0.004). In addition, the simple main effect of time indicated that both the posttest and delayed test scores of the experimental group were significantly higher than those of the control group (F = 19.8, P < 0.001).

During the interviews, we observed that the following factors affected the students' ability to learn to make clinical decisions: personal factors (professional capacity, workload, and personal values) and external environmental factors (teaching environment, external support, and social factors). In addition, the instructors who employed inquiry-based teaching techniques of clinical decision-making and demonstrated role modeling characteristics had a substantial influence on the junior doctors' learning efficiency in clinical decision-making. The junior doctors, in general, believed that self-improvement is essential for making appropriate clinical decisions.

Table 2: Repeated measures analysis of variance results for the Tanner model

Item	Source of variation	df	SS	MS	*F*
Noticing	Between subjects	29	10.9		
	Teaching	1	1.8	1.8	5.5*
	Error subjects within teaching	28	9.1	0.3	
	Within subjects	60	4.4		
	Time	2	0.1	0.1	0.9
	Teaching × time	2	0.8	0.4	6.0*
	Error	56	3.6	0.1	
	Total	89	15.4		
Interpreting	Between subjects	29	20.5		
	Teaching	1	0.9	0.9	1.2
	Error subjects within teaching	28	19.7	0.7	
	Within subjects	60	4.6		
	Time	2	0.2	0.1	1.5
	Teaching × time	2	0.1	0	0.6
	Error	56	4.3	0.1	
	Total	89	25.2		
Action	Between subjects	29	8.8		
	Teaching	1	1.7	1.7	6.8*
	Error subjects within teaching	28	7.1	0.3	
	Within subjects	60	7.2		
	Time	2	2.8	1.4	21.3*
	Teaching × time	2	0.8	0.4	6.2*
	Error	56	3.7	0.1	
	Total	89	16.0		
Reflection	Between subjects	29	15.5		
	Teaching	1	0.1	0.1	0.2
	Error subjects within teaching	28	15.4	0.5	
	Within subjects	60	6.9		
	Time	2	2.1	1.1	13.4*
	Teaching × time	2	0.4	0.2	2.2
	Error	56	4.5	0.1	
	Total	89	22.4		

*P<0.05. SS: Sum of square, df: Degrees of freedom, MS: Mean square

Table 3: Repeated measures analysis of variance results for the dual model

Item	Source of variation	df	SS	MS	*F*
Heuristic	Between subjects	29	21.8		
	Teaching	1	2.2	2.2	3.1
	Error subjects within teaching	28	19.6	0.7	
	Within subjects	60	22.7		
	Time	2	11.5	5.8	38.7*
	Teaching × time	2	2.8	1.4	9.3*
	Error	56	8.4	0.2	
	Total	89	44.5		
Analytical	Between subjects	29	7.3		
	Teaching	1	0.17	0.1	0.3
	Error subjects within teaching	28	7.2	0.3	
	Within subjects	60	3.1		
	Time	2	0.5	0.2	5.5*
	Teaching × time	2	0.3	0.1	3.1
	Error	56	2.4	0.0	
	Total	89	10.4		

*P<0.05. SS: Sum of square, df: Degrees of freedom, MS: Mean square

Discussion

Through qualitative and quantitative analyses, this study revealed that the analogy-guided clinical decision-making teaching method enhanced junior doctors' confidence. The most crucial factors in clinical decision-making are workload, time limits, and learning experience. Instructors who received

skills training in clinical teaching are more likely to strengthen the learning interests of junior doctors. The analysis findings are discussed as follows:

Perspectives from decision-making steps

In decision-making processes, significant differences between the aspects of "identify a problem" and "act on the decision" were observed between the experimental and control groups. Consequently, analogy-guided clinical decision-making teaching may enhance junior doctors' capability to act on a decision. These results are similar to those of previous research which emphasized identifying patients' problems as the first step in decision-making [19]. The interviews conducted in the present study revealed that PGY-1 junior doctors not only gradually understood their patients' discomforts but also actively listened to their patients describing their feelings and displayed empathy toward their patients throughout the learning process. In a literature review by Bradley, doctors' experiences and environments were found to affect their decision-making processes [20]. This study also revealed that, according to the delayed tests, the experimental group continued to improve because the clinical instructors constantly encouraged them to explore and track their patients' problems.

Perspectives from the Tanner model

The Tanner judgmental model, which has been widely used since its inception in 2000, posits that the background, objective reality, and social background of decision makers affect the decision-making process [21]. This study reveals that the experimental group improved in the aspects of noticing and action. Lasater evaluated the Lasater Clinical Judgment Rubric in medical simulation education through the four steps of assessing students' decision-making processes in the Tanner model, and, similar to the present study, demonstrated that students can be guided through self-evaluation and reflection [22]. A concept-based clinical decision-making teaching method derived from the Tanner model in 2009 also revealed findings similar to the present study regarding the strengthening of deep thinking and clinical decision-making skills [23]. The analogy-guided clinical decision-making teaching model used in the present study further enhanced the students' ability to collect evidence, thereby improving the aspects of noticing and action.

Perspectives from the dual-processing model

The dual-processing model, which emphasizes the ongoing interrelationship between heuristic and analytical processes, has become a prevalent medical decision-making theory in recent years [24,25]. Norman proposed that medical malpractice may affect the dual-processing model [26]. In the present study, the experimental group demonstrated significantly greater improvement in the aspect of heuristics than the control group did after the intervention. Despite the absence of an evident interrelationship between the two systems, we observed that the junior doctors analyzed the situation first and then made decisions heuristically, whereas the senior doctors first evaluated the situation heuristically and then made decisions analytically. Based on the reasoning demonstrated by the students during the interviews, we believe that in addition to the teaching intervention potentially affecting clinical decision-making processes, doctors' growth in experience is also a crucial factor in the dual-processing model.

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Conflicts of interest

There are no conflicts of interest.

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