

Original Article

The Longitudinal Case Study: From Schön's Model to Self-Directed Learning

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Abstract

Background: Rapid changes observed in information technologies, medical practice, and learning methods encourage physicians to develop new updating strategies. To test its feasibility and to help physicians devise new learning and updating strategies, the knowing-in-action model developed by Schön was applied in planning and evaluating an interactive workshop. Acquisition of knowledge was tested.

Methods: The office and hospital charts of a family physician were reviewed. They were used to prepare a longitudinal case study, based on the real-life story of a hypertensive patient followed by her doctor over a period of 15 years. The clinician's approach to solving clinical problems was triangulated for credibility with general practitioners, specialists, and the information available in the literature. This longitudinal case study was used to develop an interactive educational workshop. The workshop was presented to physicians who had registered in an accredited continuing medical education event. Changes in pre- and postevent knowledge among the participants were assessed using touch pad technology to evaluate the effectiveness of this approach on the acquisition of knowledge related to management of arterial hypertension and associated clinical problems.

Results: A comparison of pre- and post-test data showed a significant improvement in knowledge for participants who answered all questions on both questionnaires ($n = 8/37$). The average score of these participants increased from 5.5 of 10 before the workshop to 8.3 of 10 after the workshop ($p < .05$). Participants reported a high satisfaction rate for the event.

Findings: A workshop using the longitudinal case study enables physicians to perceive their daily practice through a continuing education activity in which they experience the processes of reflection in action and reflection on action described by Schön. It also increases awareness of the gap between current practice and experts' recommendations and provides an opportunity to evaluate the means for bridging or closing this gap. It sensitizes the physician to patients' changing needs and prompts the clinician to reflect on the who, what, when, where, and how of learning.

Key Words: Case study, interactive workshop, learning method, Schön's model, self-directed learning

Continuing medical education (CME) models have evolved considerably over the last few

decades, reflecting the new knowledge acquired in recent studies on learning and practice change. CME is shifting from the traditional model, by which the expert determines what knowledge the learner should acquire, to the learner-focused interactive model, by which the expert adapts his or her teaching to the learner's needs. As Davis and Fox point out, it is more important to develop new medical teaching approaches centered on the learner than to stick to a specific teaching program.¹ The evolution of medical practice and learning

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methods is spurring the development of these new approaches, especially those that promote self-directed learning.

Fox et al. studied 340 American and Canadian physicians.² Their results showed several factors that are key to learning and change in practice. The investigators observed that assessment of a gap between a physician's current knowledge and skills and the knowledge and skills needed to make changes helps to determine not only whether the physician engages in learning but also the ways of learning used to make the change. Examining only cases of successful change, they noticed that the greater the gap between the current and the desired situation, the greater the effort made to learn. Furthermore, when the main motivation for change was greater competence, learning was more likely to be directed toward clinical problem solving and the use of first-hand experience.

Patients' needs, practice conditions, scientific knowledge, and treatment modalities are in constant evolution. Rapid changes observed in information technologies, medical practice, and learning methods urge physicians to develop new updating strategies. Physicians need to build and constantly refine their practice in light of their patients' needs and the multiple constraints imposed by the health care system. In this process, physicians may consider a reflection from McWhinney: "Medical scientists sometimes make reference to 'the frontiers of knowledge.' I think they have in mind a frontier that is 'out there.' The newest and most challenging frontier may be within us."³

Schön's Model

Donald Schön's model of knowing in action explains how the expert or practitioner uses experience and reflection on action to learn and acquire knowledge.⁴ According to Schön, experts have a zone of mastery that enables them to solve problems they encounter in their practice. This expertise is unique to each expert and results from a combination of knowledge, skills, attitudes, and clinical experience (Figure 1).

When a case does not fit the usual criteria or requires knowledge, skills, or attitudes that are not

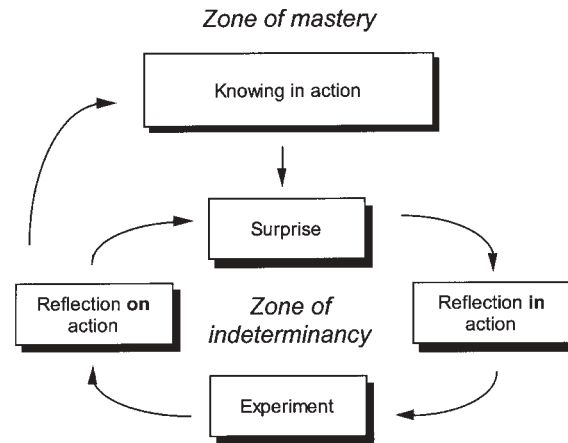


Figure 1 Schön's model. Adapted from Schön D. Educating the reflective practitioner: toward a new design for teaching and learning in the professions. San Francisco: Jossey-Bass, 1987.

immediately available in the zone of mastery, the practitioner is confronted with what Schön calls a "surprise." A course of action has to be decided on before the patient leaves the office. In the heat of the action, the expert has to formulate different hypotheses. This stage is known as "reflection in action." Often, reflection leads to a search for additional information. For example, the expert may order a laboratory test, seek assistance from colleagues, or prescribe a treatment and ask the patient to return.

Subsequently, the expert may be led to reflect on the course of action after the fact and to critically re-examine the "surprise" and the clinical approach that was taken. In Schön's model, this stage is known as "reflection on action." At this stage, the expert reviews and assesses the relevance of new information in solving the problem.

Eventually, the process leads to the acquisition and use of new knowledge that is added to the zone of mastery. The expert has moved into the stage called "knowing in action." The newly acquired knowledge reduces the chances of being "surprised" again when a similar case presents itself. Often, this process of reflection in and on action leads to other questions that motivate the physician to take part in new continuing education activities that can eventually reinforce actual or newly acquired knowledge.

Methods

To test its feasibility and to help physicians devise new learning strategies that involve experience in clinical problem solving, the knowing-in-action model developed by Schön was applied in planning and evaluating an interactive workshop.^{4,5} The present study describes the development of an interactive workshop using a case based entirely on the actual care of a patient with arterial hypertension followed by her doctor for more than 15 years. Throughout this patient's development, various surprises awaited the clinician.

Participants in a CME activity were asked to decide their course of action and to compare their decisions with those taken by the clinician, the original doctor, while considering changes in medical knowledge and standard treatments that occurred throughout a selected 15-year period. In this clinical, reality-like context, the data are not always conclusive, and certain test/examination results or therapeutic options may be surprising. Therefore, participants are asked to reflect on the action, the clinical approach, and to discuss with their colleagues the factors related to the different approaches, choices of treatment or investigation, underlying reasons for each alternative, available sources of information for solving clinical problems, and theoretical concepts that guide physicians' course of action. Feedback from a specialist provides an opportunity to review the current state of knowledge and makes it possible to compare the proposed approach with the experts' recommendations and, if need be, to review current practice guidelines and basic biologic mechanisms.

Development of the Case and Use in the Workshop

Clinical settings are full of teaching opportunities. A physician who practiced for more than 20 years, the late Dr. Yves Dagneault, was interested in the didactic potential of the case of a patient he had documented for 15 years. He believed that a clinical case developed from actual data gathered over a long period of time would offer a credible

and stimulating learning experience for participants in a CME activity, in addition to making it easier for the participants to recognize their practice through that of the attending physician.

With the help of other CME organizers of his region, Dr. Dagneault initiated this project by conducting a needs assessment with more than 200 general practitioners participating in several CME activities. Analyses of answers to questionnaires administered during meetings indicated that perceived needs were mainly related to the management of arterial hypertension, diabetes, and heart failure. Dr. Dagneault consulted specialists working in private and hospital settings to determine more specifically the learning needs of family practitioners who referred patients for cardiac and diabetes problems.

Dr. Dagneault's office and hospital charts were reviewed and used to prepare the first draft of a case study. All pieces of relevant information according to the needs assessment were put together. Dr. Dagneault's approach to solving clinical problems was triangulated for credibility with general practitioners, specialists, and the literature. First, Dr. Dagneault, in collaboration with a cardiologist, Dr. Daniel D'Amours, completed a literature review and prepared the case discussion. Subsequently, general practitioners and other specialists added their input to elucidate the material. In this way, reflection and feedback on the course of action taken in a real-life situation could be compared with objective data.

Using the original records, Dr. Dagneault and his collaborators developed three modules of 2 to 6 hours duration: (1) a longitudinal case study (complete version), (2) arterial hypertension in women, and (3) arterial hypertension and diabetes. The case study began when a diagnosis of arterial hypertension was made in a 40-year-old patient. The case was divided into four periods to reflect her clinical evolution over the last 15 years.

The activity, which was developed as an interactive workshop with a facilitator and an expert, was intended for general practitioners and designed for groups of 10 to 25 participants. The CME activity based on the longitudinal case study was offered to general practitioners during accredited

Longitudinal Case Study

Table 1 Extract from Syllabus: Longitudinal Case Study of High Blood Pressure

Case	The patient consults for dyspnea, which, for the last few months, occurs more rapidly at the time of effort, and occasionally feels a tightening in the throat. This occurs especially when she dances for a long period of time without a break. If she rests for a few minutes, these feelings disappear.			
Systems review	The systems review is negative except for nocturnal sudation. She acknowledges taking her hypotensive medication regularly, more particularly when she drinks alcohol.			
Medical examination	You notice an appreciable gain in weight, especially truncal, since 4 years ago. The rest of the medical examination is within normal limits except for a blood pressure at 170/100 mm Hg.			
	Actual weight	171 lb	Previous weight	157 lb
	Height	5', 4"	Pulse	72/min
	Medical records mention blood count results from 4 years ago:			
	Hemoglobin	146 g/L		
	Blood glucose on an empty stomach	5.4 mmol/L		
	Total cholesterol	5.66 mmol/L		
	Triglycerides	2.61 mmol/L		
	Creatinine	96 mmol/L		
	Thyroid-stimulating hormone	1.8 mU/L		
	High-density lipoprotein cholesterol	0.98 mmol/L		
	Low-density lipoprotein cholesterol	3.71 mmol/L		
	<i>What do you do?</i>			
	<i>What has been done by the family doctor?</i>			
	<ul style="list-style-type: none">• Blood count• Cardiology consultation• Substitution of pindolol for chlorothiazide pindolol• Addition of sublingual nitroglycerin			
	<i>Can these steps be compared with yours?</i>			

weekend seminars and regional and local CME events. The activities met CME accreditation rules for Canadian physicians. The instructional objectives for the case study were to improve knowledge concerning the approach to and treatment of arterial hypertension in light of the clinical problems associated with it and develop a critical attitude toward the clinical action taken.

During the workshop, participants were asked, through a series of questions, to make critical decisions to resolve the clinical problems presented in the longitudinal case. To foster discussion and enhance knowledge acquisition, open-ended and multiple-choice questions on clinical problems, investigation, or treatment were incorporated into the case history. To encourage participants to reflect on the action, the following questions or comments were included at different stages: (1) What would your course of action be?, (2) What did the original doctor do?, and (3) Is this approach similar to yours? (Table 1).

During the workshop, participants were invited to work in three different ways. They first worked alone to clarify the problem and empower themselves over the situation. Then, in groups of four to five persons, they discussed with their peers the choices, considerations of clinical issues, or decisions they made to solve the clinical problem. Finally, participants received consultations with a specialist (their usual regional consultant) in a plenary session. The role of the specialist was to provide participants with feedback, validate and correct perceptions and performance, clarify medical concepts, and present national experts' recommendations and key messages. The facilitator ensured that all participants received opportunities to interact with the specialist.

A formal assessment of the longitudinal case approach was made during the workshop session, evaluating the knowledge acquired during the workshop on the treatment of arterial hypertension and its associated clinical problems. The study pop-

Table 2 Frequency of Responses* to the Knowledge Questionnaire

	Pre	Post		Pre	Post
Question 1 (N = 21)					
<i>Among the following factors, which one must be considered as the main marker of insulin resistance?</i>			(b) autonomic nervous system activity	0	0
(a) arterial hypertension	3	1	(c) changes in ionic transportation	1	0
(b) lipid anomalies	0	1	(d) vascular changes	5	0
(c) glucose intolerance	10	9	(e) all of the above	19	26
(d) central obesity	8	10	Question 7 (N = 17)		
Question 2 (N = 25)			<i>Which drug(s) would be the prime target to lower blood glucose level in a patient with insulin resistance?</i>		
<i>All of the syndrome X factors tend to increase the frequency of some pathologies. Which ones?</i>			(a) biguanides	3	0
(a) thyroid problems	2	0	(b) sulfonylureas	2	1
(b) macrovascular diseases	14	20	(c) acarbose	0	0
(c) arthrosis	4	2	(d) all of the above	8	4
(d) all of the above	5	3	(e) 1 and 3	2	12
Question 3 (N = 20)			(f) 1, 2, and 3	2	0
<i>Abdominal obesity is linked to</i>			Question 8 (N = 28)		
(a) an increase in systolic and diastolic arterial blood pressure	0	0	<i>What is the incidence of nephropathy in patients with Type 2 diabetes?</i>		
(b) an increase in triglyceridemia and blood glucose	1	2	(a) 50%	6	1
(c) a decrease in level of high-density lipoprotein	1	0	(b) 25%	9	0
(d) the presence of glucose intolerance	1	0	(c) 10–15%	8	25
(e) all of the above	17	18	(d) 30–40%	5	2
Question 4 (N = 24)			Question 9 (N = 24)		
<i>The most important treatment for syndrome X is</i>			<i>Concerning stage 1 of diabetic nephropathy, which one/ones of the following statements is/are right?</i>		
(a) arterial hypertension control	2	1	(a) normal renal biopsy	3	18
(b) weight control	15	22	(b) basal membrane proliferation	7	4
(c) dyslipidemia control	5	0	(c) glomerular filtration reduction	5	2
(d) strict control of blood glucose	2	1	(d) albumin excretion rate from 30 to 60 mg per 24 hours	9	0
Question 5 (N = 26)			Question 10 (N = 31)		
<i>Which hypotensive drug should be avoided in a case of insulin resistance?</i>			<i>What is your therapeutic goal for a diabetic patient with 80 mg/24 h microalbuminuria?</i>		
(a) hydrochlorothiazide 50 mg	25	26	(a) aim at a diastolic blood pressure < 90 mm Hg	8	0
(b) fosinopril sodium 10 mg	0	0	(b) aim at a diastolic blood pressure < 70 mm Hg	1	0
(c) diltiazem 240 mg	0	0	(c) aim at a diastolic blood pressure around 80 mm Hg	22	31
(d) indapamide hemihydrate 2.5 mg	1	0	(d) aim at a diastolic blood pressure < 95 mm Hg	0	0
Question 6 (N = 26)					
<i>Hyperinsulinism leads to arterial hypertension by different mechanisms. Which one/ones is/are implied?</i>					
(a) sodium retention	1	0			

*For paired responses only; Boldface indicates the correct answer.

ulation was a convenience sample of 33 general practitioners, mainly from the Quebec City region,

who were invited by their regional CME organizers to participate in the CME activity.

Table 3 Wilcoxon's Signed Rank Test: Pre- and Post-Test Scores

	N	Mean Difference	Sum of Ranks	Level of Significance (One-Tailed Test)
Post/Pre	7	2.75	28	$p < .05$

Post-test score: $n = 8$, mean = 8.3, SD = 1.0, range = 6–9; pretest score: $n = 8$, mean = 5.5, SD = 1.4, range = 3–7; mean difference post/pre: mean = 2.75, SD = 1.5, range = 0–5.

A multiple-choice questionnaire was developed and pilot-tested with general practitioners and cardiologists. Later, it was administered before and after the workshop. Touch pads, which were identified by a unique numeric code, were used to compile the answers of the participants. Data from the pretest and post-test were compared using the nonparametric Wilcoxon matched-pairs signed rank test.

Results

Thirty-seven physicians from the province of Quebec, mainly the Quebec City area, attended the CME workshop. Most of the 37 participants were male, practicing in urban areas, with a range of 3 to 20 years of practice. Depending on the item, 17 to 31 participants answered both pre- and post-test questions regarding a patient with high blood pressure. Table 2 reports increases in the frequency of correct responses at the end of the workshop.

The average score of the eight participants who answered all questions in both the pre- and post-test questionnaires increased from 5.5 (SD = 1.4, range = 3–7) to 8.3 (SD = 1.0, range = 3–7) of a maximum of 10. Wilcoxon's signed rank test (Table 3) comparing the post-test and pretest scores suggests that knowledge about the treatment of arterial hypertension and its associated clinical problems significantly improved in these participants from the beginning to the end of the workshop (mean difference post/pretest = 2.75, SD = 1.5, range = 0–5; sum of ranks = 28, $p < .05$).

Comments written on the workshop evaluation forms indicated that participants were highly satisfied with the whole process. They included the following: “excellent presentation format”; “clarity, simplicity, clear management indications, real

cases”; “new acquisition and important clarifications”; “interaction—practical case study, so it stays better in my mind.”

Discussion

The longitudinal case study presented in this study was based on a real patient case. Adapting a real case for study during a CME workshop is a rather demanding task for the clinician. Patient charts must be reviewed to find a case that fits the educational needs of the participants, changes in practice standards through the years have to be analyzed, and the relevant information from the charts and the literature have to be put together. A longitudinal case study takes on its full significance when the physician can refer to the development of a patient who was followed over a period of several years. Information needed to build the case may, however, be difficult to obtain when patients see several physicians working in different practice settings over the years.

The longitudinal case study enables physicians to perceive their daily practice through a continuing education activity in which they experiment with the processes of reflection in action and reflection on action as described by Schön. When presented in a CME activity, surprises and critical incidents prompted the participants to reflect on their own approach and to compare it with that of the clinician who acted in the heat of the moment. Examining one's own medical decisions and comparing them with those of a group of peers is an important factor that facilitates physicians' learning.⁶

This approach incorporates principles of adult learning by introducing real problems extracted from real situations.⁷ In learning situations in which participants have to seek solutions to prob-

lems that they recognize from their daily practice, “physician learners not only recognize how the proposed learning will benefit them, they also are more ready to learn those things that will contribute to their own performance” in real settings.¹

Peer group discussion coupled with feedback from the specialist enables participants to compare clinical decisions and identify the gap between their current knowledge and their desired knowledge. Moreover, this approach may help to increase physicians’ awareness of the gap between their current practice and a “more optimal” practice. As pointed out by Fox et al., awareness is a key factor determining what knowledge the physician needs to acquire and the means used to acquire the knowledge in a self-directed way.² Self-directed learning is defined as “a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes.”⁸ Physicians are more likely to follow this process if they are aware of their knowledge gap and the means they can use to fill this gap.

Since pre- and post-test questions were identical, participants may have become more attentive to the clinical problems raised during the workshop, thus improving their score at the end of the session.⁹ The significant difference in knowledge on a post-test versus a pretest may, at least partially, reflect the participants’ ability to learn and to retain information in the short term.

As pointed out by Davis et al., “Workshops that provide more opportunity for case discussion and rehearsal of practice are considerably more effective than are more didactic programs.”¹⁰ An interactive CME workshop using the longitudinal case study approach reproduces the conditions that contribute to effective CME.

So far, the only available indicator of the effectiveness of the longitudinal case study approach is an increase in knowledge pre- and postactivity. However, it is reasonable to believe that this type of activity enhances the reflection in

action of participating physicians as in Schön’s model and leads to the development of expertise and a critical attitude with regard to clinical decisions that may have an impact on patients’ health status. Further studies are needed to assess the full impact of this approach on physicians’ learning and clinical habits.

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