

## A conceptual framework for developing teaching cases: a review and synthesis of the literature across disciplines

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**CONTEXT** Case-based teaching is regarded as a superior instructional method compared with lectures in promoting a learner's critical thinking skills. While much is known about the role a discussion facilitator plays in case-based teaching, the debate on the influence of the format and structure of cases on learning is controversial.

**OBJECTIVES** We sought to identify strategies for constructing cases based on studies from multiple disciplines, which report the development and use of cases in teaching and learning. The purpose was to offer the medical and other educational communities a conceptual framework that can be examined in future research.

**RESULTS** Based on a review of 100 studies, we synthesised 17 strategies around 5 core attributes of cases: relevant (level of learner, goals and objectives, setting of case narrative); realistic (authenticity, distractors, gradual disclosure of content); engaging (rich content, multiple perspectives, branching of content); challenging (difficulty, unusual cases, case structure, multiple cases), and instructional (build upon prior knowledge, assessment, feedback, and teaching aids).

**DISCUSSION** Despite the wide use of cases in disparate disciplines, there has been no overarching study that synthesises strategies of case development or tests these strategies in research settings. The

framework we developed can serve as a menu of case development options that educators and researchers can pilot and evaluate in their local settings.

**KEYWORDS** teaching/\*methods; education, medical, undergraduate/\*methods; clinical competence/\*standards; \*decision making; \*thinking; students, medical/\*psychology; humans; goals; review [publication type].

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### INTRODUCTION

Case-based teaching has been found to be a more effective instructional method than conventional lecture-based teaching for promoting students' critical thinking and decision-making skills.<sup>1,2</sup> Learners are challenged to analyse problems presented in cases, make inferences based on limited information, and make decisions on uncertain, ambiguous and conflicting issues that simulate a real-world, professional context. Many disciplines, including medicine, law, business, education and engineering, have a long history of teaching from cases that challenge learners with problems in complex, real-world situations. In medical education, case-based teaching requires learners to build upon knowledge, collect clinical information, elicit patient perspectives and synthesise this complex information to formulate and test diagnostic hypotheses.

Our study extends the ongoing debate over the impact of the format of cases on learning. Two camps exist. The first argues that the power of cases lies in a skilled discussion facilitator who unpacks the content.<sup>3</sup> The second camp argues that a well constructed case affects

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## Overview

### What is already known on this subject

By simulating real-world situations, case-based teaching challenges learners to engage in problems they are likely to encounter in their professions. Whether successful case-based teaching depends on a skilful discussion facilitator or well crafted case materials is debatable.

### What this study adds

We sought to identify strategies for constructing cases for a variety of learning settings based on studies from multiple disciplines reporting the development and use of cases.

### Suggestions for further research

Many research opportunities exist with cases delivered in a Web-based learning environment. The use of databases in conjunction with an interactive Web interface is an area where the effectiveness of selected case development strategies can be tested.

the type and quality of inquiry learners generate regardless of the facilitator's skills or expertise.<sup>4-7</sup> We believe the format and structure of cases play an important educational role, particularly in a Web-based environment, where most case-based learning occurs without a facilitator's involvement. With few criteria available to guide the case development processes, research for examining the features and structures that underlie cases is called for.<sup>8,9</sup> We sought to identify strategies for constructing cases for a variety of learning settings based on studies from multiple disciplines, which report the development and use of cases. We suggest a conceptual framework of case development principles and cite examples and guidelines we compiled from the literature review.

## METHODS

We identified reports included in this review by searching literature across multiple disciplines using the following keywords: CASE-BASED TEACHING, CASE-BASED LEARNING, CASE DISCUSSION, CASE WRITING and CASE DEVELOPMENT. We

also interchanged SCENARIO or SCRIPT with CASE to identify additional studies. We searched the following 13 databases:

- 1 ABI/INFORM (global business);
- 2 Compendex (engineering);
- 3 Cumulative Index to Nursing and Allied Health Literature;
- 4 Current Contents Search (sciences and social sciences);
- 5 ERIC (Educational Resources Information Centre);
- 6 Expanded Academic Index (sciences and social sciences);
- 7 MEDLINE (medicine, nursing, dentistry);
- 8 PsycINFO (psychology);
- 9 INSPEC (electrical engineering, computer sciences);
- 10 PAIS International (social, public policy);
- 11 Sociological Abstracts (sociology);
- 12 Web of Science (Institute of Scientific Information Citation Databases) (sciences and social sciences), and
- 13 LegalTrac (law).

Additional citations were identified from references in reviewed articles. We included journal articles, books and book chapters written in English that reported original data, descriptions or theoretical frameworks covering the structure, process and outcomes related to developing teaching cases. Studies solely focusing on the benefit and techniques of case discussions and studies that addressed case-based teaching without reporting the implications for developing cases were excluded. Out of 974 reports identified from the literature search, we selected 100 reports based on the inclusion criteria.

The process of synthesising the literature was iterative and collaborative. The lead author (SK) and research co-ordinators (JK, KP) reviewed all reports, and culled and catalogued emergent themes related to case development strategies. With the

participation of a senior author (WRP), we summarised these themes into parsimonious and manageable strategies. We then held a meeting with all authors, who reviewed the strategies, refined their meanings and combined the strategies into more coherent themes. Subsequently, we organised the strategies into a conceptual framework using the following categories:

- 1 Content (strategies that affect the scope of case content);
- 2 Structure (strategies that affect case layout);
- 3 Attribute (strategies that determine case purposes), and
- 4 Process (strategies that affect learning processes).

The lead author reviewed all 100 reports again to ensure that the conceptual framework represented the key points covered in the reports.

## RESULTS

All 100 reports included in the study originated from multiple disciplines, as shown in Table 1.

*Table 1 Case teaching reports by discipline*

Discipline	Reports <i>n</i>
Medicine (including pharmacology)	40
Education	28
Business/economics/public policy	13
Nursing	5
Engineering	4
Veterinary medicine	4
Dentistry	2
Law	2
Other (maths, psychology)	2
Total	100

Education and medicine contributed the largest number of reports, followed by business, economics and public policy. Less than 5% of the reports came from dentistry, engineering, law, nursing, veterinary medicine and other disciplines. The majority of the reports (82) covered text-based cases, 12 dealt with cases delivered via computer<sup>9-18</sup> and 6 reported video cases.<sup>9,19-23</sup> We found 10 studies in medical education and 5 in general education that reported outcomes using randomised experimental methods,<sup>14,15,24,25</sup> cross-over design<sup>16</sup> and other study designs.<sup>9,13,26-33</sup> The main outcomes included learners' knowledge based on multiple-choice questions in 4 studies<sup>9,13,27,28</sup> and critical thinking skills predominantly measured by case analyses in 11 studies.<sup>14,15,24-26,28-33</sup>

Figure 1 summarises the conceptual framework developed from the literature review. It illustrates the relationship of 17 strategies to core attributes of cases:

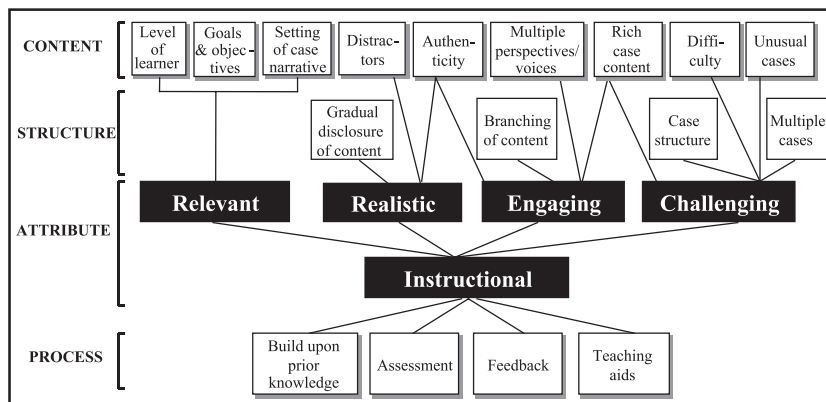
- 1 Relevant;
- 2 Realistic;
- 3 Engaging;
- 4 Challenging, and
- 5 Instructional.

There are 2 strategies that relate to more than 1 attribute: authentic content (related to both Realistic and Engaging) and rich content (related to Engaging and Challenging).

Below, we discuss in detail each case development strategy included in the conceptual framework.

### Relevant

To engage learners with sustained interest and motivation, teaching cases should target an appropriate level of learners, match the content with instructional goals and objectives, and make explicit the setting of the narrative.<sup>3,34</sup>



**Figure 1** Conceptual framework of teaching case development.

*Level of learner*

Cases should reflect the backgrounds, needs and diversity of learners.<sup>35–38</sup> Case developers can provide guidelines for customising the content to match the learner levels.<sup>37</sup> One study analysed data collected from medical students and residents for determining the appropriateness of case content.<sup>19</sup> Based on the number of correct hypotheses and tests ordered, the authors determined that the case was of sufficient difficulty for differentiating the training levels of learners.

*Goals and objectives*

Cases should address the goals and objectives of both learners and teachers.<sup>13,38–43</sup> Faculty goals should be explicit in the tasks students will analyse and study.<sup>5</sup> Goals and objectives of case materials can cover a wide spectrum of cognitive levels, such as: eliciting information; interpreting information; integrating multiple sources of information; making decisions, and providing the rationale for the decision-making process.<sup>27,44</sup>

*Setting of case narrative*

Cases should be set in realistic and relevant practice settings, such as the office visit, hospital admission, or SNF (skills nursing facilities) rounds.<sup>13</sup> The setting of the case should be provided at the beginning of the scenario, in order to help learners know how to relate to the narrative.<sup>22,45,46</sup>

**Realistic**

Cases that approximate real-world settings increase the likelihood that learners will transfer their learning from one setting to another.<sup>11,29,46–48</sup> Realism in cases can be added by providing:

- authentic materials;
- distractors or non-pertinent features, and
- gradual disclosure of content.

*Authenticity*

Authenticity is increased by incorporating into cases the tasks, knowledge and problem-solving skills learners are likely to encounter and apply in future practice.<sup>4,9,10,12,20–23,27–30,38,41,46,49–65</sup> Professional dilemmas reflecting ambiguity and multiple influences can help learners experience complex and

unpredictable decision-making processes.<sup>49</sup> Treating a patient as a real person enhances the authenticity of the case.<sup>10,32,33,39,50,51</sup> Actual clinical cases based on hospital and medical office records can be used as models for making teaching contexts more authentic.

*Distractors and non-pertinent features*

Cases should include both pertinent information (positive and negative) and unnecessary information to simulate the real challenge of data collection and synthesis.<sup>10,51,52</sup> In real-world scenarios, not only is irrelevant information present but relevant information can be missing.<sup>52</sup> However, adding too many distractors can create unnecessary complexity. In 1 study, students' self-reported competence levels for problem solving were low when cases covered diseases with many symptoms, signs and complex treatments.<sup>51</sup>

*Gradual disclosure of content*

Instead of presenting the case in its entirety at once, a progressive disclosing of content simulates the process of care in practice, sustains a learner's interest in the case, creates points for clinical decision making, and provides stages for assessment, feedback and teaching.<sup>9,13,39,53,54</sup>

**Engaging**

In order for cases to be engaging, they should include:

- rich and sufficient content that allows multiple levels of analysis and interpretation;
- multiple voices and perspectives, and
- opportunities for learners to determine the course and outcome of the case.

These strategies allow learners to avoid oversimplification or overgeneralisation by exploring problems from different vantage points.<sup>4,9</sup>

*Rich content*

Sufficient information in a case allows learners to identify the people, problems, situations, and tasks involved.<sup>9,29,49,55–57</sup> Complexity can be increased by including multiple correct responses, decision-making opportunities and explanation. Layering of cases with rich content creates a multidimensional situation, which can be interpreted from different angles.<sup>41,51,54,58</sup> Complex cases can

be used more than once for analysis, reflection and discussion.<sup>30</sup>

### *Multiple voices and perspectives*

Cases can allow learners to elicit information from multiple sources and examine problems from a variety of perspectives.<sup>9,50,57,59,60</sup> For example, an end-of-life care problem considered from the perspectives of the patient, family member, provider and hospice nurse allows the learner to integrate multiple voices and points of view.

### *Course and outcome of cases dependent on learner's action*

Depending on the goals and objectives, the content of the case can vary depending on the choices learners make during patient care.<sup>50</sup> This branching feature in a case allows learners to explore appropriate decision-making actions and to see consequences of both the positive and negative choices they make. Multiple decision-making opportunities help learners experience how problems may be embedded in larger systemic issues or how they may cause subsequent problems.<sup>12,41</sup>

## **Challenging**

Cases can be made challenging for learners by:

- increasing the degree of content difficulty;
- including cases that are rare or unusual;
- altering the structure of cases by presenting data in a non-sequential way, or
- including multiple cases in a series.

### *Difficulty*

Difficulty in a case can be increased by adding information or withholding information, adding tasks, problems, ambiguity, uncertainty or possibilities for multiple solutions.<sup>11,61,62</sup> A computer authoring tool for developing cases can allow authors to vary the difficulty level by increasing or decreasing the amount of pertinent and unnecessary information in cases.<sup>10</sup> One study examined whether learners' knowledge and clinical reasoning skills in a surgery rotation differed when they studied with structured and unstructured cases.<sup>25</sup> Structured cases presented prototypical examples of a diagnosis with all pertinent data summarised in the written scenario. Unstructured cases led to several diseases that would otherwise have been presented in multiple cases. Based on a multiple-

choice test and identification of differential diagnoses and diagnostic studies, students in the first rotation performed better on structured cases, whereas students in the fifth rotation did better on unstructured cases. The authors concluded that unstructured cases, which closely simulate a real-world patient care environment, involved more prior experiences, and were therefore more difficult for the students in the earlier rotation.

### *Unusual cases*

Cases can progress to present atypical cases as the learner masters the management of classical cases. Atypical cases can cover rare conditions, unusual presentations or causes of a common condition, an unexpected association between 2 relatively uncommon problems, or an unexpected event in the course of patient care.<sup>63,64</sup>

### *Structure of case presentation*

The structure in which information is presented in cases can be varied.<sup>9,24,25</sup> A typical medical case is structured into the presentation of signs and symptoms, history taking and physical examination, laboratory and study findings, and differential diagnosis. Interacting with cases related over the phone can be an example of varying the case structure, as learners experience data collection in a non-chronological way.<sup>49,52,65</sup>

### *Multiple cases*

Cases can be also presented in a series.<sup>4,9,11,12,24,28,66</sup> Multiple cases can be sequenced to:

- represent the developmental trajectories of a learner's thinking;<sup>28</sup>
- illustrate important insight into the ageing process and its interaction with a chronic illness trajectory,<sup>57</sup> and
- build each case episode based on a typical story by reinforcing selected features or showing some features to be less specifically an essential part of the prototype.<sup>49</sup>

When presenting atypical cases in comparison with typical cases, Gentner *et al.*<sup>24</sup> found that learners needed to see both cases side by side with an explicit explanation that highlighted similar and unique case features. Koehler<sup>9</sup> also showed that when specific descriptions illustrated how multiple cases were connected, learners demonstrated a higher level of

knowledge compared with learners who interacted with individual cases where explicit connections were absent.

### Instructional

Methods for improving the process of case-based learning include:

- building up students' prior knowledge;
- assessing students' knowledge and skills;
- providing specific feedback to students, and
- embedding various teaching aids to support student learning.

### *Build upon prior knowledge*

Cases should help reinforce the student's prior knowledge by allowing students to progressively use the most recently acquired materials.<sup>5,35,39,51,62,67</sup>

Asking students to state what they remember from prior cases before learning with new case materials is 1 strategy for activating their knowledge.<sup>46,68</sup>

### *Assessment*

Many aspects of case-based learning can be assessed via:

- self-report by learners regarding quality of cases;
- evaluation of learners' performance, including errors in facts, decisions and rationales;
- tracking of learners' interactions with cases, and
- feedback by instructors on the usefulness of cases.

### *Self-report*

Many studies reported learners' feedback on:

- usefulness of cases;<sup>10,13,35,69</sup>
- amount of learning by thinking through cases individually or collectively in a group;<sup>15,35,70,71</sup>
- adequacy of number of cases;<sup>70</sup>
- case realism;<sup>18,19</sup>
- content level;<sup>72</sup>
- preparation for the first 'real' patient encounter;<sup>12,16,25,73</sup>
- level of challenge and fun;<sup>12,14,16,27</sup>
- time to complete cases;<sup>15</sup>
- components of cases that contributed to learning,<sup>16</sup> and
- preference for instructional sequences between didactic materials and clinical cases.<sup>16</sup>

### *Measures of learning*

Examples of assessing learners' knowledge and skills include:

- the number of correct case features and differential diagnoses as well as inappropriate or unnecessary diagnostic procedures or treatments learners selected;<sup>15,23,25,26,35</sup>
- quizzes or multiple-choice questions to test content knowledge levels,<sup>9,13,14,25,27,74</sup> and
- case analysis to examine a learner's ability to identify dilemmas, provide evidence of multiple viewpoints, formulate a plan, and justify actions.<sup>24,29,30,31,38,58,70,71,74-77</sup>

### *Tracking the student learning process*

Studies involving computer-based cases reported tracking the case components learners accessed, as well as comments, questions and resources they posted during case learning,<sup>9,26,78</sup> and duration of time spent learning with cases.<sup>9,13</sup>

### *Instructors' feedback on cases*

Feedback from faculty included appropriateness of case content, degree of detail and difficulty, and the perceived value of cases.<sup>13,51,79</sup>

### *Feedback on consequences of decisions*

Cases should reveal to learners the outcomes of their choices, both positive and negative, to help a learner's self-assessment,<sup>15,18</sup> to keep learners engaged,<sup>62</sup> and to help them identify further learning needs.<sup>12,80,81</sup> Displaying negative outcomes resulting from learners' incorrect expectations or preconceptions prompts them to explain rationales behind their choices.<sup>9-94</sup> Two studies describe a feature built into computer cases that allowed learners to progress through the case only after they had selected the correct answers.<sup>17,78</sup>

### *Teaching aids*

We identified the following teaching aids in the reviewed studies:

- clinical decision rules, algorithms, guidelines and pathways for case management;<sup>49</sup>
- branching diagrams to support decision making;<sup>95</sup>
- concept map illustrating a visual summary of interrelationships of knowledge components in a case;<sup>48,96</sup>

- case-related questions for stimulating a learner's critical thinking;<sup>1,12,22,38,46,51,61,64,93,95,97-99</sup>
- expert modelling of problem-solving approaches or applications of rules;<sup>11,47,80,100,101</sup>
- explicit support for comparing and contrasting features, factors, and issues embedded in cases;<sup>66,100,102</sup>
- instructors' materials that specify teaching points,<sup>103</sup> and
- reminders of previous problem-solving strategies.<sup>4,46,61,93,94</sup>

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## DISCUSSION

We organised case development strategies using a conceptual framework that comprised 5 attributes: Relevant; Realistic; Engaging; Challenging, and Instructional. Despite the wide use of cases in disparate disciplines, there has been no overarching study that synthesises strategies of case development or tests these strategies in research settings. The majority of studies we reviewed are descriptive in nature and lack data. Only 15 studies included outcome measures associated with learning. Few studies addressed the implications of their study results for improving and refining case development methods. From our review, it is difficult to validate the widely accepted belief that cases contribute to critical thinking skills in learners, compared with conventional teaching methods. Although 11 studies examined various aspects of critical thinking skills, few linked the results to specific case components that may be associated with a learner's critical thinking ability. None of the studies we reviewed used a validated measure, such as the California Critical Thinking Skills Test (CCTST), that assesses key dimensions of critical thinking, including analysis, evaluation, inference, and deductive and inductive reasoning.<sup>104</sup> Without documented evidence of effectiveness of the strategies, it is challenging to point to any minimum combination of strategies for an optimal educational outcome in selected domains. This is a limitation of our study. Another limitation is that the authors of this paper have backgrounds mainly in education and medicine, which might have created biases in the way the literature review was synthesised.

The majority of the studies we reviewed covered text-based cases. With interactive media such as video and audio, computer-based cases can simulate real-world patient encounters. While several studies of Web-based cases reported the frequency of case components accessed by learners based on computer log files, few reported learners' decision-making patterns using

real-time data collected from learners. The Web-based case-learning environment makes it possible to generate patterns of case work-up by learners and compare them with pathways generated by subsets of students or experts. We believe the use of databases in conjunction with an interactive Web interface is an area where the effectiveness of selected case development strategies can be tested with a large pool of learners.

Despite the long history of using cases for training in many academic disciplines, the scientific base of theory and evidence is lacking for the design, use and evaluation of teaching cases. With the growing importance of the Web for teaching with cases, there is an acute need to develop the knowledge base on how to translate guidelines for constructing cases into an online learning environment. The findings from our review call for improved educational practices with cases and research opportunities in case-based teaching and learning. The framework we developed can serve as a menu of case development options that educators can pilot and evaluate in their local settings.

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