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Emerg. Med. J. 2005;22:577-581
doi:10.1136/emj.2004.022707

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PREHOSPITAL CARE

Case based learning—a review of the literature: is there scope for this educational paradigm in prehospital education?

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Emerg Med J 2005;22:577–581. doi: 10.1136/emj.2004.022707

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Accepted for publication
10 May 2005

This paper discusses the findings of a literature review of case based learning (CBL) from a multidisciplinary health science education perspective and attempts to draw comparisons with the available literature relating to prehospital education and CBL.

CBL is an exciting educational prospect in which to develop research capacity, strategies, and opportunities. This paper provides an examination of the literature exploring the major consistencies and inconsistencies, and reveals areas of potential future research for prehospital education institutions.

This paper discusses the research topic development and the literature review of case based learning (CBL) from a multidisciplinary health science education experience. This was undertaken from the author's present role of lecturer for Monash University Centre for Ambulance and Paramedic Studies (MUCAPS) Melbourne, Australia.

Whereas professions such as veterinary science, medicine, dentistry, nursing, and others have experience in evaluating their use of CBL,¹ prehospital education does not seem to produce any evaluation of CBL use within this field. Problem based learning (PBL) is considered the founding paradigm that models such as CBL have been based upon. There is a plethora of literature on PBL within many different disciplines; however, there is a paucity of literature within the contexts of prehospital education.

Undertaking further research in this area is important and significant in prehospital education. First, there has not been any literature found or secondary evidence outlining where any prehospital educators or ambulance services have used CBL (or even PBL for that matter). This means one of two things: CBL has not been utilised in prehospital education or that it has but no research has been published to show its use and efficacy. Second, this would potentially pave the way for other researchers or educators to be cognisant with CBL and its potential benefits. Third, it would give prehospital educators the ability to establish closer collaborative partnerships with other institutions and also develop collegial partnerships within higher education providers.

LITERATURE REVIEW

The purpose of this paper is to critically evaluate the available literature about CBL in order to understand its significance in relation to prehospital or other allied health science education. A literature review was undertaken using several databases: ERIC, Australian Education Index, MEDLINE, EMBASE, Cochrane Library, and MetaLib. The following MeSH terms were used in the search: case based learning, case-based learning, case series learning, medical education, nurse education, ambulance education, prehospital education, paramedic education, out-of-hospital education, EMS education, problem based learning, problem-based learning, patient centred learning, and educational methods.

CBL: A BACKGROUND

CBL is an educational paradigm closely related to the more common PBL. This PBL approach is andragogical (adult teaching/learning), posing contextualised questions that are based upon "real life" problems that may be clinical or non-clinical.²

CBL's main traits derived from PBL are that a case, problem, or inquiry is used to stimulate and underpin the acquisition of knowledge, skills, and attitudes. Cases place events in a context or situation that promote authentic learning.³ Cases are generally written as problems that provide the student with a background of a patient or other clinical situation. Supporting information is provided, such as latest research articles, vital signs, clinical signs and symptoms, and laboratory results. CBL allows students to develop a collaborative, team based approach to their education. Other characteristics include hypothesis generation and the consolidation and integration of learning activities.³ Other benefits:

- intrinsic and extrinsic motivation is developed, allowing individualised learning;
- encourages self evaluation and critical reflection;
- allows scientific inquiry and the development of support provision for their conclusions;
- integration of knowledge and practice, and
- development of learning skills.^{2 4 5}

Some regard the term PBL as negative and misleading, and highlight that there is no definitive description of PBL.³ The growing numbers of synonyms include integrated learning, patient centred learning, pathway models, project based learning, and CBL (fig 1). All have similar educational characteristics to PBL and can be considered as commensurate variations;² however, a clear distinction can be made despite the similarities between PBL and CBL.

The fundamental difference is that PBL requires no prior experience or understanding in the subject matter, whereas CBL requires the students to have a degree of prior

Abbreviations: CBL, case based learning; MSLQ, motivated strategies for learning questionnaire; PBL, problem based learning; SRLI, self regulated learning inventory

knowledge that can then assist in solving the problem (fig 2). Garvey *et al* (2000) describe it in another way:

Although problem-based learning and case-based learning share common goals, each instructional design possesses unique characteristics. In problem-based learning, the problem drives the learning. The case-based format requires students to recall previously covered material to solve clinical cases, which are based on clinical practice.⁷

LIMITATIONS OF STUDIES

Many of the studies included in this paper have varying limitations given their small sample sizes. In many cases the study was one dimensional whereby the researchers were only examining one particular subject from the same semester using the same educational paradigm. The papers by Kassebaum *et al*⁸ and Engel and Hendricson⁹ employed a quasi crossover methodology whereby the two control groups were used: one group being taught under CBL conditions and the other through didactic lecture format. This allowed the authors to compare between the two groups.

The major gap or shortcoming of the research reviewed in this area, and similar to most educational quantitative research, is the ability to state or predict that students have not only enjoyed their new learning experience but importantly whether this in fact actually alters the way in which they learn and practice.

CBL VERSUS TRADITIONAL LECTURE FORMAT

Pearson *et al*,¹⁰ Kassebaum *et al*,⁸ and Hansen *et al*¹¹ discussed the comparison of CBL with traditional lecture/didactic formats. Pearson *et al*¹⁰ were able to conclude that the innovative CBL paradigm appeared to be an effective adjunct to the traditional lecture format. Granted, they were unable to determine if this method of teaching could increase other problem solving attributes or improve clinical performance.

The study by Kassebaum *et al*⁸ was able to demonstrate several important aspects to students' attitudes to CBL after alternating their teaching methods during several work sessions. They were able to show that students undertaking

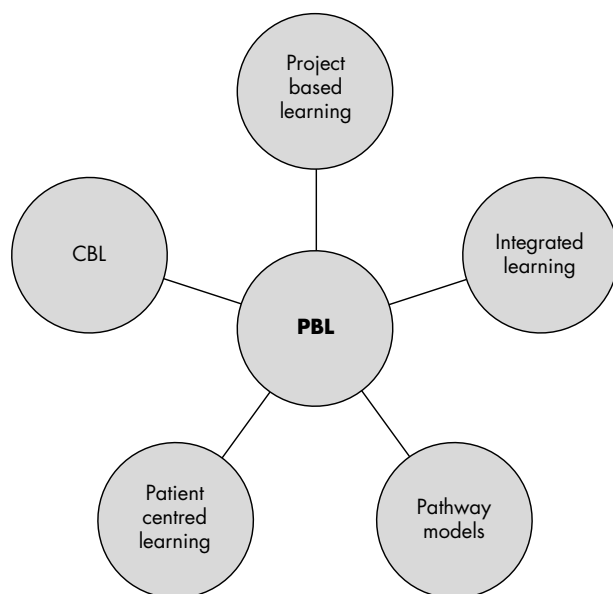


Figure 1 Educational fusions of problem based learning (PBL)⁶

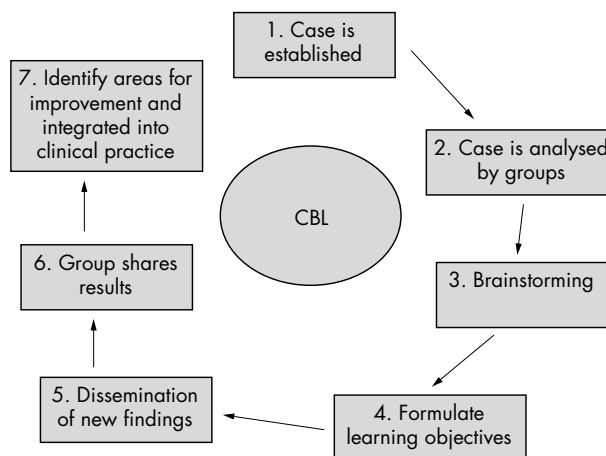


Figure 2 The case based learning (CBL) process (adapted from the Maastricht "Seven Jump" process)⁶

the CBL format were better able to ask questions and make comments during class and CBL made the learning more enjoyable. The lecture format produced an interesting result; students felt the lecture method was more helpful in preparing for a written exam.⁸

Student evaluations were undertaken by Kassebaum *et al*,⁸ Engel and Hendricson,⁹ Garvey *et al*,⁷ Hay and Katsikitis,¹² Pearson *et al*,¹⁰ and Hansen *et al*¹¹ through a combination of Likert Scales and questionnaires. The articles remonstrate that CBL was enjoyed and embraced by the majority of students. Student perception indicated that clinical reasoning, diagnostic interpretations, and the ability to think logically was also improved with CBL.

Some concerns were however raised in the Garvey *et al*⁷ paper (Table 1) where the students' responses indicated that "the cases facilitated active discussion at the seminars" and "the discussion sessions facilitated interaction between staff and students" were less than 4-point scale "agree" when these two questions are fundamental to the success and main driving forces of CBL environment. The ideology that students are driven by learning was challenged by results obtained by Kassebaum *et al*⁸ where students felt that a lecture format was far superior in preparing for a written exam compared to a CBL format.

MOTIVATION

Ertmer *et al*¹ questioned 58 students using two self report learning inventories: motivated strategies for learning questionnaire (MSLQ) and self regulated learning inventory (SRLI). Both questionnaires measure student self regulation, self efficacy, and motivation levels in relation to their learning.¹ In summary, the authors were able to show that students' confidence and motivation levels increased as they became more acquainted with problem orientated learning. This is reinforced by the following: "...some high students actually became motivated by their lack of knowledge. It's like a kid with a new video game...".¹

Engel and Hendricson⁹ found that the tutors believed CBL should have been incorporated into the curriculum of the Bachelor of Dentistry. Despite the preparation time being longer, tutors believed that students developed better problem solving skills under a CBL model compared with a lecture mode.⁹

Similar results were noted by Garvey *et al*⁷ (Table 2). The tutor response was highest against the question "This teaching method is a useful preparation in clinical problem

Table 1 Student response to CBL versus lecture format (n = 37)⁷

| Questions | % Strongly disagree | | ↔ | | | % Strongly agree | Class mean |
|--|---------------------|-----|------|------|------|------------------|------------|
| | 1 | 2 | 3 | 4 | 5 | | |
| 1. The cases presented were interesting and involved several disciplines | 0 | 0 | 8.1 | 37.9 | 54 | 4.46 | |
| 2. The cases presented were relevant to final year dental students | 0 | 2.7 | 5.4 | 27 | 64.8 | 4.46 | |
| 3. The course was well organised | 2.7 | 2.7 | 32.4 | 35.1 | 27 | 3.87 | |
| 4. The cases facilitated active discussion at the seminars | 0 | 2.7 | 27 | 46 | 24.3 | 3.92 | |
| 5. Case based learning is a worthwhile progression from problem based learning | 2.7 | 2.7 | 5.4 | 19 | 70.2 | 4.51 | |
| 6. Case based learning helped to improve my diagnostic skills and lateral thinking | 0 | 0 | 16.3 | 43.2 | 40.5 | 4.24 | |
| 7. Case based learning improved my ability at treatment plan | 0 | 5.4 | 19 | 43.2 | 32.4 | 4.02 | |
| 8. This teaching method is a useful preparation in clinical problem solving | 0 | 0 | 10.8 | 46 | 43.2 | 4.32 | |
| 9. The discussion sessions facilitated interaction between staff and students | 2.7 | 0 | 32.4 | 40.5 | 24.3 | 3.83 | |
| 10. I enjoyed case based learning | 0 | 0 | 21.6 | 46 | 32.4 | 4.10 | |
| Composite mean | | | | | | 4.16 | |

solving...”, whereas this same question produced the lowest score in the student’s evaluation.⁷

Several authors (Kassebaum *et al.*,⁸ Engel and Hendricson,⁹ Garvey *et al.*,⁷ Hay and Katsikitis,¹² Pearson *et al.*¹⁰) highlight student attitudinal results of CBL versus other paradigms, such as PBL and didactic lectures. No literature was found of any measurement and subsequent results of whether CBL had any impact on clinical performance or skill improvement. The only paper to evaluate beyond student attitudes of CBL models was by Hay and Katsikitis,¹² where they not only measured students’ attitudes but also reviewed students’ knowledge levels. However, this could not be

further attributed to any improvement in clinical performance.

DYNAMIC CURRICULUM

CBL allows students to develop a collaborative, team based approach to their education and their profession. It is intended to foster learning for competence, deep level understanding² and provide opportunities for vertical and horizontal integration of the syllabus. In other words, this unique feature of the curriculum allows thematic elements to be incorporated both vertically and horizontally over the duration of the degree. This is also a feature within the paper

Table 2 Tutor response to case based learning versus lecture format (n = 8)⁷

| Questions | % Strongly disagree | | ↔ | | | % Strongly agree | Class mean |
|--|---------------------|------|------|------|------|------------------|------------|
| | 1 | 2 | 3 | 4 | 5 | | |
| 1. The cases presented were interesting and involved several disciplines | 0 | 0 | 0 | 50 | 50 | 4.5 | |
| 2. The cases presented were relevant to final year dental students | 0 | 0 | 0 | 50 | 50 | 4.5 | |
| 3. The course was well organised | 0 | 0 | 12.5 | 37.5 | 50 | 4.37 | |
| 4. The cases facilitated active discussion at the seminars | 0 | 12.5 | 12.5 | 50 | 25 | 3.87 | |
| 5. Case based learning is a worthwhile progression from problem based learning | 0 | 0 | 12.5 | 25 | 62.5 | 4.5 | |
| 6. Case based learning helped to improve my diagnostic skills and lateral thinking | 0 | 0 | 0 | 62.5 | 37.5 | 4.37 | |
| 7. Case based learning improved my ability at treatment plan | 0 | 0 | 25 | 37.5 | 37.5 | 4.12 | |
| 8. This teaching method is a useful preparation in clinical problem solving | 0 | 0 | 0 | 37.5 | 62.5 | 4.62 | |
| 9. The discussion sessions facilitated interaction between staff and students | 0 | 0 | 0 | 50 | 50 | 4.7 | |
| 10. I enjoyed case based learning | 0 | 0 | 12.5 | 37.5 | 50 | 4.37 | |
| Composite mean | | | | | | 4.37 | |

by Pearson *et al*¹⁰ who describe a similar structure within their Preventive Medicine Faculty at the University of Rochester. A "Double Helix Curriculum" was developed to allow basic sciences and clinical practice to overlap and evolve through the four year degree. This allows the themes to be integrated into the student's daily instruction across all facets of the curriculum.

EXPERT VERSUS NON-EXPERT TUTORS

An important issue in CBL is the use of "expert" and "non-expert" tutors. The most common area of enquiry relating to desirable CBL tutor characteristics concerns the issue of whether the tutor should be an expert in the subject matter related to the problem under study. Hay and Katsikitis¹² argue that students led by experts had higher test scores and levels of learner satisfaction, although they acknowledge this was at the expense of student learning where teacher preparation time detracted from total classroom time. Hay and Katsikitis¹² also highlight that non-expert tutors were able to provide greater student/tutor flexibility and spend less time in teaching preparation and if they have been trained in facilitation skills are likely to be the best facilitators. The results of knowledge acquisition in the paper by Hay and Katsikitis demonstrated that the mean score was higher in student exam results when facilitated by expert tutors compared with the non-experts.

In a questionnaire developed by Garvey *et al*⁷ the non-expert tutors had a higher composite mean score in evaluating CBL compared with the students and from a pragmatic point of view this would be expected given that most tutors in the CBL area would be comfortable with its methodology. The main goal of the facilitator is to assist the students through the facts and to engage in analysis and the development of possible solutions or strategies. Garvey *et al* reinforce this and add "Students assume responsibility for their own learning and the tutors, instead of providing information to students, act as facilitators of their learning."⁷ Because the CBL in this study was offered from a multi-disciplinary clinical teaching group this required non-expert tutors to facilitate small group instructions and often required the groups to receive new tutors at frequent intervals. Student evaluation highlighted that they were less than satisfied with the course being well organised. Garvey *et al* add: "Students commented that they were unhappy to change tutors during the course and wished to be assigned the same tutor for the entire course."⁷

STRUCTURED VERSUS UNSTRUCTURED CASES

Sutyak *et al*¹³ conducted a prospective study of 79 medical students to assess whether student learning activity in CBL would vary between a structured and an unstructured case presentation. The structured student group were asked to establish and address a given diagnosis and were given clear and specific identification of the disease being studied. The unstructured student group were given the same task; however, they did not receive the same confirmatory results. Sutyak *et al*¹³ stress that despite many medical curricula utilising a CBL/PBL paradigm, their true benefits, risks, and outcomes have yet to be fully based upon evidence. Despite this, their study produced preliminary evidence that medical students preferred an unstructured approach to their cases.¹³

GENDER IN CBL

Peplow¹⁴ questioned a sample group of 162 students undertaking an undergraduate anatomy degree to measure gender differences in the level of understanding and examination performance in an active CBL programme. Peplow demonstrated in Table 3 that female students developed and viewed the constructs of CBL better than male students. The study

was able to establish that female students "... responded more positively to tasks undertaken in the initial discussion sessions ...".¹⁴

Interestingly, the study was also able to establish that female students in the early parts of the programme performed better in their examination marks compared with the male students.

FLEXIBLE DELIVERY AND CBL

The Internet and computer mediated learning offers educational providers the ability to deliver CBL from multiple approaches. The discussion paper by Ward¹⁵ emphasises that computer mediated learning can encourage high levels of engagement and motivation beyond using just one methodology. Ward discussed several important pedagogical issues such as increased teacher workload and resource management, like as curriculum development and time to build up lecture material. A further issue was identified by a pilot study undertaken to determine whether students were "deep" or "surface" learners as classified by the Entwistle Learning Style Inventory. Performance in general coursework and examination was higher in the "deep" learners compared with the "surface" learners. These findings are interesting given that computer mediated learning and hypertext browsing can be considered as passive or surface skimming.¹⁵ One possible solution could be found in the following statement: "Computer assisted learning does not necessarily mean students working individually at and with the computer. It can involve broader activities, including group work around the computer..."¹⁵

Naidu *et al*¹⁶ and Thomas *et al*¹⁷ in their discussion papers describe their nursing education experiences from a web and

Table 3 Female versus male medical students' responses to CBL¹⁴

| Question | Females (n=75) | | Males (n=79) | |
|--|----------------|---------|--------------|-------------|
| | Mean* | (SE) | Mean* | (SE) |
| 1. Sessions had clear direction and purpose | 2.25 | (0.098) | 2.96 | (0.104)**** |
| 2. "Seven jump" method found helpful | 2.99 | (0.116) | 3.49 | (0.109)*** |
| 3. I participated in the discussions by my group | 2.04 | (0.101) | 2.39 | (0.094)** |
| 4. I improved my skills in recognising points in the history | 2.61 | (0.098) | 3.06 | (0.092)**** |
| 5. I improved my ability to suggest ideas or hypotheses | 2.87 | (0.099) | 3.08 | (0.109) |
| 6. I improved my ability to talk clearly about the case | 2.99 | (0.096) | 3.22 | (0.109) |
| 7. These sessions were valuable in terms of developing new skills | 2.88 | (0.120) | 3.39 | (0.106)*** |
| 8. The concept map for each case history was useful | 2.07 | (0.113) | 2.71 | (0.119)**** |
| 9. The group formulated learning goals during the sessions | 2.67 | (0.126) | 3.00 | (0.119) |
| 10. The group collected new information after the session | 3.71 | (0.139) | 3.78 | (0.131) |
| 11. These sessions encouraged teamwork by the group | 2.91 | (0.130) | 3.16 | (0.119) |
| 12. The discussions would have been improved by having a tutor present | 2.35 | (0.152) | 2.24 | (0.147) |

Students answered on a 5 point scale: very large extent (1); large extent (2); moderate extent (3); small extent (4); not at all (5).

Eight of the questions measured the student's own response to the initial discussion sessions, and four measured how each student rated the group's achievements: females versus males (Student's *t* test).

p*<0.05; *p*<0.001; *****p*<0.001.

interactive multimedia CBL perspective. Naidu *et al* stated that the premise came about by the need to alter the educational focus from content centred to case based. The main theme in both papers was the question of whether clinical practice or clinical decision making could be achieved through these modes. Naidu *et al* add: 'Our proposition combines powerful educational technologies and proven learning strategies to build self paced technology enhanced learning environment...'.¹⁶ They attempted to achieve this by using authentic and real life situations within a typical medical ward through the architecture of clinical reasoning and clinical problem solving. The student would be led through the scenario through streaming audio and video attachments until finally submitting their treatment plan to the lecturer. Thomas *et al* developed two cases through standard web browsing in the area of psychiatry nursing. Each module was organised in normal phases of care to ensure the student would observe accurate patient care skills. Although both articles refer to "authentic" cases this has direct implications in web learning because the situations are prestructured and often constrained thereby reducing independent learning responses.¹⁷

CONCLUSION

The majority of the evidence outlined in the literature review revealed that as a whole CBL was enjoyed by both students and tutors. Other key elements discussed in the remaining articles centred on the use of CBL in a horizontal and vertical curriculum, how CBL or case series are viable in an electronic format, and that female students may perform better at a CBL style of education early in their medical education.

It is important to note that no parallel research was found in the area of prehospital education, although anecdotally some prehospital education institutions may be using CBL. The potential is high to measure prehospital student perceptions of CBL in their curriculum. This aspect may need to be undertaken with a collaborative partner, such as another university, to generate adequate sample numbers. Either way, there seems to be significant scope to develop further research questions and potentially shape the way in which prehospital students learn.

Competing interests: none declared

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