Original Article

Development and evaluation of learning module on clinical decision-making in Prosthodontics

Saee Deshpande, Dipti Lambade, Jayashree Chahande

Department of Prosthodontics, VSPM's Dental College and Research Centre, Nagpur, Maharashtra, India

Abstract

Purpose: Best practice strategies for helping students learn the reasoning skills of problem solving and critical thinking (CT) remain a source of conjecture, particularly with regard to CT. The dental education literature is fundamentally devoid of research on the cognitive components of clinical decision-making.

Aim: This study was aimed to develop and evaluate the impact of blended learning module on clinical decision-making skills of dental graduates for planning prosthodontics rehabilitation.

Methodology: An interactive teaching module consisting of didactic lectures on clinical decision-making and a computer-assisted case-based treatment planning software was developed Its impact on cognitive knowledge gain in clinical decision-making was evaluated using an assessment involving problem-based multiple choice questions and paper-based case scenarios.

Results: Mean test scores were: Pretest (17 ± 1), posttest 1 (21 ± 2) and posttest 2 (43 ± 3). Comparison of mean scores was done with one-way ANOVA test. There was overall significant difference in between mean scores at all the three points ($P < 0.001$). A pair-wise comparison of mean scores was done with Bonferroni test. The mean difference is significant at the 0.05 level. The pair-wise comparison shows that posttest 2 score is significantly higher than posttest 1 and posttest 1 is significantly higher than pretest that is, pretest 2 > posttest 1 > pretest.

Conclusion: Blended teaching methods employing didactic lectures on the clinical decision-making as well as computer assisted case-based learning can be used to improve quality of clinical decision-making in prosthodontic rehabilitation for dental graduates.

Key Words: Blended learning, case based computer assisted learning, clinical decision making

Address for correspondence:
Dr. Saee Deshpande, Department of Prosthodontics, VSPM's Dental College and Research Centre, Nagpur, Maharashtra, India. E-mail: drsaeedeshmukh@gmail.com
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INTRODUCTION

The cornerstone of professional practice is the application of thought processes that allow dentists to recognize pertinent information in a patient's presentation, make accurate decisions-based on deliberate and open-minded review of available options, evaluate outcomes of therapeutic decisions, and assess their own performance. This is a gradual process which comes with gaining factual knowledge and also with exposure to various clinical cases during undergraduate training. Cognitive psychologists categorize "knowledge" into three areas viz., declarative knowledge, procedural knowledge, and an ill-defined gray zone between declarative and procedural knowledge that includes the reasoning skills often described as critical thinking (CT) and problem solving. In the health professions, CT and problem-solving are often loosely defined as clinical reasoning, decision-making or clinical judgment.[1]

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Decision-making in Prosthodontics is very critical as every patient poses a unique problem with multiple possible solutions. In view of its ever-broadening scope, brought about by many new and improved materials and techniques, prosthodontic decision-making is becoming increasingly challenging. The role of more informed and more litigious patients at the individual level, as well as greater demands for cost-effectiveness of dental health care by funding authorities at the societal level, add to the complexities.[2]

In the present educational system training and assessment of knowledge and psychomotor skills is being done effectively. However, training and assessment for clinical decision-making has been empirical in nature. Thus, a learning module for improving clinical decision-making in Prosthodontics was conceived and developed to train the dental graduates. It consisted of an interactive teaching module on the said subject for students and a computer-assisted case-based treatment planning software was developed and both these methods were evaluated for their impact on students' decision-making skills while planning prosthodontic rehabilitation.

METHODOLOGY

This was a cross-sectional study using pre- and post-test study design [Figure 1].

The study population involved 30 students who have entered into 1-year of compulsory rotatory internship after passing their final BDS exam during the period of June–August 2014. Evaluation was done using prevalidated written assessment method consisting of the case-based multiple-choice questions (MCQs) and paper-based case scenarios.

The scores were compared using one-way ANOVA test and Bonferroni test.

Figure 1: Impact of learning module: Test scores

Intervention

- Design of interactive module
  - Lectures on the concept of clinical decision-making, a general protocol to be followed in decision-making process and its importance in prosthodontic practice
  - Group activities related to different ways of decision-making.
- Design of software.

The cases included completely and partially edentulous patients requiring prosthodontic rehabilitation using tooth and/or implant supported removable and/or fixed prostheses. Cases with acquired maxillary and mandibular defects were also included. A special emphasis was given to select cases, which required preprosthetic treatments by endodontics, periodontal therapy, surgery and other specialties also. The intent was to train the students to make an interdisciplinary clinical decision and correct sequencing of the treatment.

The first phase is the provision of information about the patient in the form of chief complaint, clinical examination report, clinical photographs, X-rays, reports of investigations, etc. In the second stage the request for some action from the respondent was sought that is, to device a treatment plan for that particular case in given structured template (for treatment sequencing and prosthesis design). At the third stage, a standard treatment plan for that particular case which was fed in the software beforehand was displayed along with the treatment plan submitted by the student for that case so that student can compare, analyze and learn by means of reflective critique of their own decisions.

Students can choose any case and after submission their response for that particular case is stored in the software for reference.

In the present investigation, we wanted to evaluate cognitive skills of clinical decision-making amongst the students before and after our intervention. Assessment of clinical decision-making is challenging and rarely reported in the literature. Oral examination, essays, problem-based MCQs and case scenarios (role plays or paper cases) have been recommended.[3] There is a lack of objectivity for orals and essays as a method of assessment. Therefore, an assessment using both Problem-based MCQs and case scenarios was designed and validated. Cases were designed in such a way that factors such as past dental history, patient's general health, time, economy were important for final treatment decision and planning.

RESULTS

Mean test scores [Figure 2] were as follows:

- Pretest (17 ± 1)
- Posttest 1 (21 ± 2), and
- Posttest 2 (43 ± 3).

Comparison of mean scores was done with one-way ANOVA test. There was overall significant difference in between mean scores at all the three points [Table 1].

A pair-wise comparison of mean scores was done with Bonferroni test. The mean difference is significant at the 0.05 level. Pair-wise comparison shows that posttest 2 score is significantly higher than posttest 1 and posttest 1 is significantly higher than pretest that is, pretest 2 > posttest 1 > pretest.

DISCUSSION

Prosthodontics represents a highly developed body of knowledge and skills. There are various biologic, mechanical, or materials science factors that influence decisions about patient care. On a daily basis as clinicians, teachers, or students we experience the interplay of social, economic, and psychologic conditions that similarly influence treatment decisions.[4] Inconsistencies among clinicians' treatment decisions have a financial impact and ultimately can affect the clinical viability of the treatment outcome. Therefore, an improvement in professional ability to plan the treatment efficiently is required for a better clinical practice.[5]

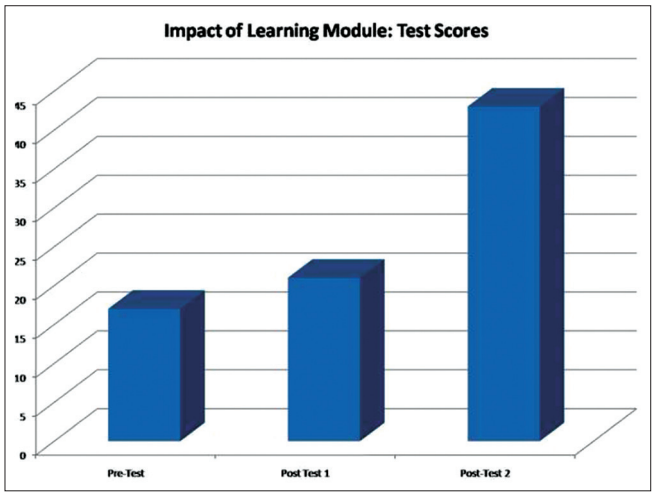

Figure 2: Impact of learning module on cognitive knowledge

Table 1: Comparison of mean scores with one-way ANOVA test

Dependent variable	Mean	SE	*P*
Pretest	17.133	0.115	<0.001
Pretest (1)	21.167	0.234	
Posttest (2)	43.167	0.316	

SE: Standard error

Computer-assisted learning (CAL) is a learning that supplements regular classroom activities with computer activities during or surrounding time.[4] The educational goals related to CAL in health care education are enhancing CT and problem-solving skills.[6] CAL has been proved as a method of providing alternate means of education.[7-9] The basic objective of CAL is that the student should independently search for necessary information, apply it to the problem, and summarize what has been learned.[10] Thus, it fosters the development of self-directed learning skills. It also promotes the structuring of new, accessible knowledge in clinical context and the development of effective clinical reasoning skills.[8-10] Contemporary CAL programs used in medical education simulate patient scenarios either with text or by creating a virtual patient, using live video streaming and provide opportunities for patient assessment.[8-10] Compared to lecture and discussion, it fosters activation of prior learning, high motivation to learn, and the development of self-directed learning skills. In the health sciences, it also promotes the structuring of new, accessible knowledge in clinical context and the development of effective clinical reasoning skills.

There has been a trend toward blended learning in higher education, involving initial acquisition of factual foundation knowledge in a traditional format and case-based or issue-based learning that allow students to clarify misconceptions and gain insight into the practical utility of foundation concepts by trying to apply them to problems. Trainees educated in the blended format described above do not make more accurate decisions than individuals trained in a purely classroom-based program, but they sample a wider variety of data sources, seek information from higher-quality and more desirable sources, have better understanding of the underlying diseases, and provide more sophisticated rationales and explanations for their treatment decisions.[1,11,12]

Considering this background a blended learning module for improving clinical decision-making skills of dental graduates was evaluated. Firstly an interactive teaching module on the decision-making in prosthodontics was developed and validated. The content included theoretical information about various factors viz., clinical, socialeconomic etc., influencing decision-making regarding type and design of prosthesis followed by a logical sequence of treatment planning. Such information is lacking in the standard textbooks recommended to undergraduate students which provide compartmentalized knowledge about removable or fixed prosthodontics.

Secondly they were asked to plan the treatment for all cases in the computer assisted case-based learning software. The results showed that the test scores improved significantly. This can be explained by the fact that theoretical concepts regarding clinical

decision-making taught in the learning module were reinforced after using CAL software and observing and planning treatment for actual cases (in the form of pictures, their radiographs, study casts, etc.) brings clarity in thought process and promoted the reasoning skills of the students.

Analysis of the answers of patient case scenarios revealed that after using the software students applied the generic framework of treatment sequencing that is, emergency treatment first followed by preprosthetic treatment and lastly prosthetic rehabilitation. Even while planning prosthetic treatment, they elaborated on prosthesis design (different components and materials), steps in execution more effectively.

Furthermore, they addressed patients' chief complaint, their socio-economic status, the urgency of treatment and patients' overall health as a factor in deciding treatment plan, which was missing in the pretest. Students' gave a very positive feedback regarding both methods and strongly agreed that it should be included in regular teaching.

We have been attempting innovations in educational methodology at our institute for past 5 years. Our experience with the case-based educational software has been encouraging. According to Kirkpatrick's hierarchy of program evaluation,[13] level I evaluates learners' reactions/perception. This was positive. Level 2 involves modification of attitude and behaviors of learners which was also found to be significantly improved after use of this software.[14] The present investigation dealt with level 3 that is, investigating whether learning has occurred by the acquisition of knowledge *per se*. This blended approach should, therefore, be implemented in undergraduate training to improve clinical decision-making while planning prosthodontic rehabilitation.

Limitations

Limitations include small sample size, convenience sampling, researchers' bias and outcome measures as all of the measures were created for this study because of the specificity of the content. The study should be replicated at multiple institutes over a longer period to overcome these shortcomings.

CONCLUSION

Medical and dental education is undergoing reform all over the world, focused on both content and pedagogy that is, what we teach and how we teach. Blended teaching methods employing didactic lectures on clinical decision-making as well as computer assisted case-based learning can be used to overcome the drawbacks of conventional teaching such as compartmentalization of knowledge and promote clinical problem solving skills thereby we can substantially improve quality of clinical decision-making.

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