Evaluating Effectiveness of Traditional Learning versus Computer Assisted Learning in Orthodontics

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Abstract:
The objective of the current prospective randomized study was to evaluate effectiveness of traditional lecture as compared to CAL process on study model analysis for undergraduate dental students. The study comprised of forty students randomly allocated to two groups stratified on pre-test GPA scores. One group received traditional lecture and the other received the CAL module. The effectiveness was assessed immediately and ninety days after the teaching process by paired ‘t’ test. There was significant improvement in the knowledge gained in both groups however difference between the two groups were statistically insignificant immediately after the teaching process. After retention period it was observed that the CAL group retained the knowledge significantly better than the traditional lecture group. It was concluded that CAL can be an effective teaching aid and should be seen as complimentary to other contact teaching methods more suited for clinical skills and attitudes.

Key words:
Computer assisted learning, orthodontics, dental education, study model analysis, teaching method, prospective randomized study.

Introduction:
Primary objective of teaching activities is the flow of information between teacher and students. Direct and indirect methods of instruction are the two main categories that many educators find useful for classifying teaching methods. No single method of instruction is ideal for a given topic of discussion. Traditional methods have the
advantages of delivering very specific learning targets, where students are explained the importance of a subject with examples, logical reasons can be stressed upon to provide experiences that can inspire learning processes. However traditional teaching is highly dependent on knowledge base and skill of the teacher requiring well organized content preparation and good communication skill of the teacher. Communication is mostly one way and often requires some level of imaginative perception from the students (Khoo EM 2008).

Heightened appreciation of independent learning and early patient contact in the undergraduate dental curriculum has stimulated the academic authorities to emphasize self directed and problem based learning approaches. One such means of providing self instruction is through computer base instructional programs (Rosenberg H 2003, 2005). Computer Aided Learning (CAL), also known as computer assisted learning, computer assisted instruction, and computer based instruction, is a form of self instruction in which material can be presented via text, visual, sound, and motion digital files, providing a multimedia approach to learning (Martin Schittek et al 2001). Computer can facilitate interaction during the learning process on multiple levels like interaction of student/user with the content and learning material, contents can be updated regularly, encourages greater learning inputs in the areas of subjects interest (Phongthara Vichitrejpaisal et al 2008). However this method has certain disadvantages as it needs computing skill, it is time consuming, and at times distractive (ADPRIMA 2009). More over this method is expensive in terms of staff time (M Aly, Elen, Willems 2004).

Very few studies have been conducted and published in literature comparing direct and indirect method of instructions for orthodontic teaching curriculum on Indian subjects. The objective of the current prospective randomized study was to evaluate effectiveness of traditional lecture as compared to CAL process on study model analysis for undergraduate dental students.

Materials and methods:
Study model analysis as per undergraduate orthodontic teaching curriculum was the basis of the current study. The CAL module was prepared as per the guidelines for the design of educational software by ANSI standards committee on dental informatics 2002 (University of Pittsburgh). A demo version of the CAL module was presented for evaluation to three orthodontists with at least five years of experience in teaching. They were asked to comment on: a) adequacy of the background information given, b) presentation, c) ease of use and d) need for further development. The evaluators found the entire exercise was user-friendly, adequately informative. Suggested modifications for the CAL module were considered and improvised.

Study included a total of forty third-year and final year dental students. They could be expected to be fairly uniformly unfamiliar with the material. The students were allocated randomly by their grade points average (GPA) (Wikipedia, 2006) of pre test scores into two subgroups: A & B with equal number of representatives, based on their scores. Both groups received the same materials about the study model analysis. The courseware package was a relevant, self-directed learning resource for better
understanding of the subjects and the students were assured that the test results were confidential and did not constitute part of their formal assessment.

Group A (n=20) received traditional one hour lecture followed by interactive session, and group B (n=20) received computer aided learning (CAL) module which was of multimedia design with didactic, interactive and video components. Students of CAL group were timetabled to spend one hour using the CAL module. Both the groups were evaluated fifteen minutes post session (short break) and after a wash out period of ninety days with twenty four multiple choice questionnaire on the same topic. The post-tests were aimed at measuring student's knowledge, understanding and application of the learned materials and to elicit views of student concerning the strength and weakness of the aids used. The tests were assessed by calculating the total score of the correct answers. Paired t tests were used to compare the scores between two groups.

Results:
There was no significant difference in prior knowledge level between students in the two groups at baseline (Table 1).

At the completion of the study, analysis of the data revealed that in both the groups’ students scored significantly higher in the immediate post-test as compared to pre-test and there were no statistical differences in acquiring knowledge, understanding the instructional content and application of the learned matter between the lecture versus the CAL module groups (Table 2). Post retention test scores of the CAL group were significantly better than those of the lecture group (Table 3).

Discussion:

The randomized controlled study was conducted on third and fourth year dental students who had entered their clinical postings as they would have had some experience of interpretation and clinical management. They could be expected to be fairly uniformly unfamiliar with the material.

All forty students were administered pre-test on the same day to avoid contamination of prior knowledge between subjects. Based on the grade points of pre-test scores the students were randomly allocated into two groups. The groups displayed no statistical significance between them, implying that the comparative groups were homogeneously distributed with same base line knowledge. Similar study design was followed by various researchers.

We found no significant differences between the groups immediately after the teaching process. Similar findings were also found by (Turner PJ 1993, Clark RD 1997, Lowe CI 2001). However some studies have demonstrated significant difference immediately after the study, CAL showing better response as compared to traditional lecture (Luffingham JK 1984, Irvine NR 1986, Komolpis R 2002). In contrast one study (Hobson et al 1998) reported a superior effect using conventional teaching. Proper stratification based on base line knowledge of participating groups; stringent protocols to prepare lecture and CAL; and objective driven assessment criteria followed in the study maybe the reasons for insignificant difference between two groups immediately after the teaching process. Findings of the present study extend the widening body of evidence which indicate CAL is as
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Effective as standard lecture in orthodontics.

Nevertheless we continued our study to evaluate the retention of information for a wash out period. After a wash out period of ninety days the study demonstrated better performance of CAL group as compared to traditional lecture which was statistically significant. This opinion was in accordance with other researchers (Irvine NR 1986.). This finding may be due to CAL group students were forced to respond to and interact with taught materials. It was observed that students in CAL group preferred to sit in groups (2-3) while studying the subject matter, on the contrary students in lecture group were rather passive receivers even though they had been encouraged to interact with the lecturer. The interaction in the CAL group might have provided constant highly effective reinforcement of concept and content resulting in better performance after wash out period. Self instructional nature of CAL could have also encouraged in taking the most efficient path of content mastering investing more time in areas of weakness while skipping areas of strength. CAL when applied for model analysis is at least as effective as conventional modes of orthodontic learning and adds an additional small but significant gain in student knowledge acquisition. Similar opinion was observed in a meta-analysis on CAL in orthodontic education. (Al-Jewair et al 2009)

Conclusion:

Computer aided learning may be a new cost effective way of conveying knowledge specially when shortage of academic staff is becoming an issue. This approach provides a flexible means of learning and can free staff student contact time while providing the student with an effective teaching medium provided they are based on a didactic and guided approach. Although CAL proved to be superior in retaining the knowledge as compared to the standard lecture the difference was little, leaving space for further improvement in the CAL design and modes of implementation. Care should be taken not to use CAL exclusively and should be seen as complimentary to other contact teaching methods more suited for clinical skills and attitudes.

REFERENCES:

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“[Online]” (Updated 4 September
Evaluating Effectiveness of Traditional Learning versus Computer Assisted Learning in Orthodontics


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Table 1: pre-test mean scores to assess the baseline knowledge between the two groups

<table>
<thead>
<tr>
<th></th>
<th>Group A (n = 16)</th>
<th>Group B (n = 16)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test mean score (GPA)</td>
<td>4.38 ± 1.79</td>
<td>4.31 ± 1.86</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

GPA--- Grade point average

Table 2: comparison of pre-test and immediate post-test mean scores

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test mean score</td>
<td>4.38 ± 1.79</td>
<td>4.31 ± 1.86</td>
<td></td>
</tr>
<tr>
<td>Immediate post-test</td>
<td>4.79 ± 0.46</td>
<td>4.89 ± 0.50</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>mean score</td>
<td></td>
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Table 3: comparison of post-retention test scores between two groups

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-retention test</td>
<td>4.5 ± 0.88</td>
<td>4.85 ± 0.55</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>score</td>
<td></td>
<td></td>
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