An Online Multimedia Treatment Planning Tool: Effect on Dental Students’ Knowledge in Using Standardized Clinical Data


Abstract: A multidisciplinary, multimedia, online Treatment Planning Data Acquisition Tool (TPDat) containing standardized information was created at the University of Maryland Dental School to improve students’ actual and perceived knowledge in and self-assessed confidence about the gathering and recording of standardized data at a patient’s initial visit. Students from the classes of 2009 (seniors) and 2010 (juniors) completed a pre-test (2009 N=93, 79 percent of the class; 2010 N=105, 85 percent) and an unannounced post-test six months later (2009 N=46, 40 percent; 2010 N=102, 83 percent). Multiple-choice items were used to test student knowledge, and a Likert scale was used to assess perceived knowledge and confidence (1=low to 5=high). The students also assessed the degree of helpfulness of the different TPDat sections. Juniors’ knowledge about information in the TPDat was significantly higher at the post-test (11.9±1.6) than the pre-test (11.0±1.9, F=13.545, p±0.0001). Their confidence was also significantly higher at the post-test (3.58±0.5) compared to the pre-test (3.34±0.6, F=11.417, p=0.001). Seniors’ perceived knowledge on the pre-test (3.87±0.4) was significantly lower than six months later (4.03±0.4, F=3.984, p=0.048). Seniors’ knowledge and confidence post-test scores were not significantly different from their post-test scores. No significant difference was found between the 2009 (11.3) and 2010 (11.9) levels of knowledge at the post-test. Since there was no significant difference in post-test knowledge scores between juniors and seniors (who had twelve months longer experience), this may indicate that the TPDat was the deciding factor in knowledge acquisition. The results showed that the TPDat facilitated learning and standardization of gathering and recording of clinical data.

Keywords: treatment planning, multimedia online clinical standardization program, standardized clinical data, knowledge and perceived knowledge about treatment planning, recording of history taking and diagnosis

Submitted for publication 5/22/09; accepted 8/27/09

Students often find discrepancies between what was taught about the gathering and recording of clinical data at a patient’s initial visit and developing a treatment plan in the preclinical years and what is expected by faculty in the clinic. Furthermore, full-time, part-time, and volunteer faculty members and faculty from different disciplines may have differing opinions based on their own clinical experience.

The lack of standardization in data gathering and recording can be confusing and frustrating for both students and faculty. Therefore, a need for standardization was identified by the faculty members in charge of treatment planning at the University of Maryland Dental School. For instance, students often failed to record details about furcations, vertical defects, and caries. Other examples of lack of standardization were chart codes used on the odontogram, terms for gingival description, methods for gathering and recording data from the occlusal and TMJ examinations, and techniques for vitality testing of teeth.

Maiers et al. have described the use of a standardized data collection process for a group of patients who chose to have acupuncture treatment. They suggested that this data could then be utilized in a clinical teaching setting. Another approach to standardizing clinical data was to use structured text...
and templates to help improve health status outcomes and quality of health care. Standardized guided documentation templates for Department of Veterans Affairs disability exams resulted in significant quality improvement compared to routinely completed exam templates. Hence, it would be anticipated that utilization of a standardized data collection system in a teaching clinic would prove beneficial for training students to collect patient findings and improve their documentation skills.

Most dental students are Millennials, used to multitasking, wanting immediate feedback, and preferring to learn on their own terms and on their own time. They are also more technologically savvy and keep up with constantly improving electronic tools to a higher degree than most faculty members. McGlynn stressed the importance that faculty members “understand their students through the lens of the culture and history in which they were actually raised.” Foreman discussed the deficiencies of the large lecture as a method to convey knowledge to today’s college students. The ideal learning situation, Foreman says, has to be customized for the specific need at hand, provide immediate feedback, be constructive, and motivate the students to persist in their learning. The main goal of using technology in teaching should be to improve students’ knowledge about and experience in self-learning. The teacher has to move away from the traditional classroom lecture and move toward encouraging his or her students to become self-learners, or technology will make students’ learning less efficient rather than be a tool to increase learning success.

A new approach to teaching gathering and recording of treatment planning information was considered necessary by faculty to make this learning and standardization process successful. A multidisciplinary, multimedia, online Treatment Planning Data Acquisition Tool (TPDat) was created to give students and faculty the knowledge needed to standardize data gathering and recording of findings at a patient’s initial visit. The purpose of this study was to evaluate increase in level of student knowledge, perceived knowledge, and self-assessed confidence after using the TPDat.

**Methods and Materials**

The TPDat was built around the school’s predoctoral clinic’s patient treatment plan workup data sheets, odontogram codes, and the final treatment planning form. Course directors from seven disciplines selected the important information corresponding to their treatment planning data sheets. This information was presented in eight diagrams and tables, fifteen short flash videos, and several images and interactive information buttons. Adobe Flash version CS3 with ActionScript 2.0 (San Jose, CA) was used to create the learning instrument. By holding the mouse over the items marked by an asterisk, students and faculty members are able to view the information needed to correctly complete the clinical data sheets (Figures 1 and 2). Adobe Flash facilitates the designer’s ability to create interactive buttons. This software does not require an operating system or third-party video player to view the web-accessible videos. The school’s IT department made sure that all browsers had Adobe Flash plug-in to make access to the application possible. The TPDat was made accessible by an icon on all computer desktops in the clinic, on the computers in student and part-time faculty work areas, and on Blackboard (Phoenix, AZ), a web-delivered course management system available to all students and faculty.

One of the challenges for the Adobe Flash software is that the size of the datasheet is larger than a normal 800 by 600 learning object application. Therefore, the outside browser scrollbar must be utilized to view the bottom of the pages throughout the application. For future releases at the school, an internal application slider will be implemented for easier usability and access to the information.

Students in the classes of 2009 (seniors) and 2010 (juniors) were introduced to the TPDat in a treatment planning course lecture in the spring of 2008 and encouraged to study it further on their own time. All sections on the TPDat (Oral Medicine, Endodontic Vitality Testing, Periodontics, Restorative Dentistry, Occlusion, TMJ, and Treatment Planning) were presented and discussed, including all videos, diagrams, and text boxes. The students were encouraged to ask questions and were informed about where and how to access the TPDat.

The effect of the TPDat on students’ perceived knowledge and self-assessed confidence about clinical information in the TPDat was assessed in a pre-test and again in an unannounced post-test six months later (Table 1). In addition, two or three multiple-choice items from each section of the TPDat were used to test students’ actual knowledge. For example, one knowledge question inquired about
Figure 1. Examples of information in the TPDat, including a section of the odontogram, a video, and diagram

Note: These are displayed when “GM-BP (PD)” on the odontogram is highlighted by moving the mouse over it.

Figure 2. Examples from the TPDat showing a text box and seven video choices visualized when the mouse moves over the words “fremitus” and “TMJ/TMD” respectively
normal findings when examining the tongue, another questioned how to record radiographic furcations, and a third asked how to determine if the prognosis for a tooth is “fair.”

A Likert scale was utilized to assess perceived knowledge and self-assessed confidence (1=low to 5=high). The students were never given the correct pre-test answers. They used the TPDat in the clinic for six months before being tested again on the post-test. At that time students were also asked to evaluate how helpful (on a scale from 1=not helpful to 5=very helpful) they found each of the twelve sections of the TPDat in acquiring and recording standardized data at a patient’s initial treatment planning visit. The juniors reported their own use of the tool and whether clinical faculty referred to the TPDat while teaching in the clinic (Table 2).

Analysis of variance was used to test for differences in knowledge, perceived knowledge, and confidence, initially and after six months’ use, and to compare juniors and seniors on these variables. A p≤0.05 was considered significant. This survey research study was considered exempt by the Institutional Review Board at the University of Maryland, Baltimore.

Results

There were 116 students in the class of 2009 and 123 students in the class of 2010. The two dental school classes were comparable regarding gender, age, race/ethnicity, and Year II GPA (Table 3). The number of seniors who responded to the pre-test was ninety-three (79 percent of the class), and the number of juniors responding was 105 (85 percent). At the unannounced post-test six months later, forty-six (40 percent) of the seniors and 102 (83 percent) of the juniors participated.

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Table 1. Pre- and post-test survey items about procedures performed at a patient’s initial visit

Students were asked to rate their a) knowledge and b) self-assessed confidence about the following 12 procedures on a scale from 1 (low) to 5 (high):

1. Performing a Head & Neck Examination
2. Diagnostic Testing of teeth
3. Recording Radiographic Findings
4. Evaluating and recording of Occlusal Examination
5. Evaluating and recording TMJ Function data
6. Creating a Problem List for a patient’s oral health needs
7. Using the school’s official Chart Codes
8. Evaluating and recording Periodontal Measurements
9. Formulating a Periodontal Disease Diagnosis
10. Assessing the Prognosis of individual teeth and surrounding tissues
11. Phasing and Sequencing of a treatment plan
12. Including Alternative Treatment Options in the plan

Table 2. Post-test survey items only

For item 13: Indicate on a scale from 1 (strongly disagree) to 5 (strongly agree) how you would rate this item:

13. Faculty members have referred to the TPDat.

For item 14: Indicate the extent of utilization of the TPDat (no, parts of it, or yes) in this item:

14. I have studied/looked at the TPDat in my own time.

For item 15: Indicate on a scale from 1 (not helpful) to 5 (very helpful) the helpfulness of each of the sections of the TPDat:

15. Head & Neck Examination videos
   Vitality Testing videos
   Codes for Charting
   Occlusion
   Periodontics
   Treatment Planning form
   Charting of Radiographic Findings
Students were tested for knowledge about information in the TPDat in fifteen questions. Results showed that the mean score of correct answers for the 2010 students was significantly higher at the post-test (11.9±1.6) than the pre-test (11.0±1.9, F=13.545, p≤0.001). For the seniors there was no significant difference between post- (11.3±1.814) and pre-test scores (10.9±2.621, F=0.966, p=0.327). No significant difference was found between the 2009 (11.3) and 2010 (11.9) level of knowledge at the post-test.

Senior students’ mean score (1=low to 5=high) on each of the twelve sections of the TPDat for perceived knowledge on the pre-test (3.9±0.4) was significantly lower than six months later (4.0±0.4, F=3.984, p=0.048). For the juniors, there was no significant difference in perceived knowledge pre- (3.7±0.573) and post-test scores (3.8±0.411, F=2.151, p=0.144). When evaluating the change in confidence about the TPDat, the juniors’ results were significant whereas the seniors’ were not. The juniors’ post-test confidence level (3.6±0.5) was significantly higher compared to the pre-test (3.3±0.6, F=11.417, p=0.001). There was no significant difference in senior students’ post- (4.90±6.74) and pre-test (3.7±0.5, F=2.961, p=0.088) scores. No other analyses revealed significant differences (Table 4).

The means for the student-reported helpfulness (1=not helpful to 5=very helpful) of each of the twelve sections of the TPDat were reported for juniors and seniors. Sections with mean ratings of “helpfulness” of 3.9 and above by junior students were: Head and Neck Examination, Diagnostic Testing, and Chart Codes. Seniors gave Chart Codes the most favorable mean rating of 3.9. The TPDat section with a mean score of 3.8–3.89 by the juniors was the Treatment Planning Form. The seniors gave a mean score of 3.8–3.89 to five of the sections: Diagnostic Testing, Occlusal Examination, Periodontal Examination, Treatment Planning Form, and Charting of Radiographic Findings. Mean scores of 3.7–3.79 were given to Occlusal Examination, Periodontal Examination, and Charting of Radiographic Findings by the juniors and to Head and Neck Examination by the seniors (Tables 5 and 6).

The percentage of juniors with scores of 1 and 2 (not helpful), indicating that they did not find that section of the tool helpful, were as follows: Head and Neck Examination (8 percent), Diagnostic Testing (2...
percent), Chart Codes (5 percent), Occlusal Examination (5 percent), Periodontal Examination (5 percent), Treatment Planning Form (7 percent), and Charting of Radiographic Findings (8 percent). None of the senior students chose scores 1 or 2 (not helpful) for any of the sections (Table 5 and 6).

Faculty members were given an introduction to the TPDat and a link to access it and were asked to look through it in detail on their own. Juniors, on the post-test, were asked whether faculty referred to the TPDat (item 13). Their mean response was 2.3 on a scale from 1 (strongly disagree) to 5 (strongly agree). At the post-test, the juniors were asked to report their use of the TPDat since its introduction (item 14). Sixty-three percent had studied the complete tool, 31 percent had studied parts of it, and 6 percent had not looked at the TPDat after the explanatory lecture.

Table 5. Class of 2010 evaluation of helpfulness of the TPDat, by number and percentage of total respondents

<table>
<thead>
<tr>
<th>Sections</th>
<th>Mean</th>
<th>Very helpful and helpful (5 and 4)</th>
<th>Somewhat helpful (3)</th>
<th>Barely helpful and not helpful (2 and 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head and Neck Exam</td>
<td>3.92</td>
<td>69 (72%)</td>
<td>17 (18%)</td>
<td>7 (8%)</td>
</tr>
<tr>
<td>Diagnostic Testing</td>
<td>3.97</td>
<td>70 (75%)</td>
<td>19 (20%)</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>Chart Codes</td>
<td>3.90</td>
<td>65 (70%)</td>
<td>23 (25%)</td>
<td>5 (5%)</td>
</tr>
<tr>
<td>Occlusal Exam</td>
<td>3.79</td>
<td>59 (64%)</td>
<td>28 (30%)</td>
<td>5 (5%)</td>
</tr>
<tr>
<td>Periodontal Exam</td>
<td>3.76</td>
<td>63 (68%)</td>
<td>23 (25%)</td>
<td>5 (5%)</td>
</tr>
<tr>
<td>Treatment Planning Form</td>
<td>3.89</td>
<td>66 (73%)</td>
<td>20 (22%)</td>
<td>6 (7%)</td>
</tr>
<tr>
<td>Radiographic Charting</td>
<td>3.74</td>
<td>59 (65%)</td>
<td>25 (27%)</td>
<td>7 (8%)</td>
</tr>
</tbody>
</table>

Note: Percentages may not total 100% because of rounding and skipped questions.

Table 6. Class of 2009 evaluation of helpfulness of the TPDat, by number and percentage of total respondents

<table>
<thead>
<tr>
<th>Sections</th>
<th>Mean</th>
<th>Very helpful and helpful (5 and 4)</th>
<th>Somewhat helpful (3)</th>
<th>Barely helpful and not helpful (2 and 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head and Neck Exam</td>
<td>3.79</td>
<td>18 (55%)</td>
<td>15 (45%)</td>
<td>0</td>
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<tr>
<td>Diagnostic Testing</td>
<td>3.86</td>
<td>20 (57%)</td>
<td>15 (43%)</td>
<td>0</td>
</tr>
<tr>
<td>Chart Codes</td>
<td>3.91</td>
<td>22 (63%)</td>
<td>12 (34%)</td>
<td>0</td>
</tr>
<tr>
<td>Occlusal Exam</td>
<td>3.86</td>
<td>18 (59%)</td>
<td>14 (41%)</td>
<td>0</td>
</tr>
<tr>
<td>Periodontal Exam</td>
<td>3.88</td>
<td>20 (59%)</td>
<td>14 (41%)</td>
<td>0</td>
</tr>
<tr>
<td>Treatment Planning Form</td>
<td>3.89</td>
<td>18 (57%)</td>
<td>15 (43%)</td>
<td>0</td>
</tr>
<tr>
<td>Radiographic Charting</td>
<td>3.85</td>
<td>19 (56%)</td>
<td>15 (44%)</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: Percentages may not total 100% because of rounding and skipped questions.

Discussion

The results showed that the junior and senior dental students were very positive about the TPDat and felt it facilitated their learning and the standardization of their responses on the treatment planning forms. There was no significant difference in post-test mean actual knowledge scores between 2010 and 2009 students. The mean individual item knowledge scores for the seniors were sometimes higher, sometimes lower, and sometimes the same as the junior students’ scores. The seniors, who had twelve months longer clinical data-recording experience than the class of 2010, were expected to have learned the information available in the TPDat during the twelve months of performing treatment plan work-ups in the clinic before the TPDat was introduced to them. It was, therefore, assumed that they would find the TPDat less helpful than the junior students. However, none of the senior students scored any section of the TPDat as not helpful. An explanation may be that the seniors had experienced ten months in the clinic without the TPDat and were frustrated with the lack of standardization, while the juniors had never examined patients in the clinic without access to the learning tool and took it for granted since they had never been without it. This
may indicate that the TPDat was the deciding factor in knowledge acquisition.

The least favorably reviewed sections by the juniors (scores of 3.79 and lower on the TPDat) were Occlusal Examination, Periodontal Examination, and Radiographic Findings, while the seniors gave Head and Neck Examination the lowest score. Possible reasons behind the lower helpfulness scores on some sections may be that the students already knew the material from lectures and clinical experience or that the information in the TPDat was too difficult or was insufficient for a thorough understanding of the topic. It is believed that the sections Charting of Radiographic Findings and Occlusal Examination would benefit from improvement, possibly by adding videos to the Occlusal Examination and more images to Charting of Radiographic Findings. The initial presentation only had diagrams and text boxes. Videos would make it easier for the students to visualize the relationship between the jaws during movement for the occlusal examination. The Periodontal Examination section of the TPDat has been amended after the post-test to include short videos about how to correctly perform periodontal probing. One reason for the seniors’ lower score on helpfulness for Head and Neck Examination could be that this was the one procedure, introduced in the sophomore year, that they had performed several times a week for eighteen months prior to the post-test. Since this procedure had been practiced so frequently, the TPDat might have been perceived as less needed by the seniors. The lower score may, on the other hand, indicate that this section needs improvement to increase its value to the students. Further investigation as to the reason for the lower score for this section is needed.

The lower participation rate by senior students at the post-test (40 percent compared to 79 percent at the pre-test) probably had a minimal effect on the result since the post-test was unannounced, which makes it less likely that only students positive about the TPDat participated. Some students were on externships or assigned to clinical blocks during the time of the post-test. Furthermore, all lectures at the dental school are video-recorded, and many students prefer to watch the lectures on their own time instead of coming to the lecture hall. This also may be a partial explanation for the poor post-test participation. One other plausible explanation could be an observation made by Russek et al., who found that participants’ attitude or perception of the amount of time or perceived inconvenience in data collection or the standardization process can affect utilization or participation.10

Several possible changes in the TPDat are contemplated. Treatment planning faculty will discuss whether students should be required to pass a competency examination on their knowledge of the information in the TPDat after their first months in the clinic. In addition, an in-service training program for clinical faculty, at which all sections are presented and discussed, will be considered in order to improve faculty utilization and correct usage of the information from the TPDat when working with students in the clinic. Further studies about the tool could compare treatment plans completed by students who used the TPDat versus students who did not have the support from the tool. It would also be valuable to evaluate the use of the TPDat by students in other institutions.

Conclusion

In conclusion, this study has shown that by using the TPDat, the students’ knowledge about how to correctly record standardized data at a patient work-up visit has increased. The results show that the TPDat facilitated learning and standardization.

Acknowledgments

We would especially like to thank Dr. Sang-Hoon Park, who prepared the material for the periodontal section of the TPDat and gave valuable advice regarding the writing of this article. We also would like to extend our gratitude to our videographer, Douglas J. Brotherton; the students who participated in this study; and the faculty members who contributed material and knowledge for sections of the TPDat: Dr. Priya Chand (Endodontics), Dr. Edward Grace (TMJ), Dr. Pauline Hayes Garrett (Occlusal Examination), Dr. Timothy Meiller (Head and Neck Examination), and Dr. Grishondra Branch-Mays (Periodontal Probing Videos). The Treatment Planning section was prepared by Dr. Ulla Arvidson Bufano.

REFERENCES


