Problem-Based Learning and the Dental School Library


Abstract: A major curriculum revision involving the utilization of problem-based learning was implemented at Indiana University School of Dentistry in the summer of 1997. Two of the main goals of this new student-centered curriculum were to promote critical thinking skills and to encourage a desire for lifelong learning, both of which were anticipated to increase student use of the library. This study examined circulation at the library for three years immediately prior to, and for three years immediately following, the curricular change. Results show that library circulation has increased significantly since the pedagogical change. This suggests that students in the new curriculum place more emphasis on the library as a learning resource than did their traditional curriculum counterparts.

Keywords: problem-based learning, dentistry, curriculum, libraries

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The 1995 Institute of Medicine report on the future of dental education identified several areas in the dental curriculum that were in need of reform and/or modernization.¹ In response to this, many dental schools have introduced changes to their curricula. Indiana University School of Dentistry (IUSD) reformed its entire D.D.S. program by revising its content and modernizing teaching and learning methods. A new curriculum employing problem-based learning (PBL) as a major teaching component was implemented in 1997.² Major goals of this new student-centered curriculum were to promote the development of critical thinking skills and a desire for lifelong learning. These additional educational aims directly affect utilization of library services.

Libraries serving medical schools with PBL curricula develop their services on the premise that PBL students have different needs and utilize library services differently than do students within a conventional curriculum.³,⁴ These special needs are thought to include an increased demand for learning resources, additional seating needs,⁵ greater referencing and searching facilities, longer hours, and enhanced information-seeking instruction.⁶,⁷

The results of surveys comparing the library habits of medical students in PBL and traditional programs confirm these assumptions. Saunders et al.⁸ found that PBL students spend more time in the library, use a wider variety of information resources, rely more on self-selected rather than recommended resources, and use a larger percentage of journals than do conventional curriculum students. Another survey⁹ found that PBL medical students use the library more frequently and for longer periods of time and that they use MEDLINE®, journals, reserve materials, and audiovisual resources more extensively than their conventional curriculum counterparts. While Rankin¹⁰ agrees that PBL students use the library more frequently and also utilize and value journals and online searching more, she also found that they acquire information-seeking skills earlier and feel more competent using these skills compared to conventional curriculum students. In contrast, Rankin¹⁰ found no difference in the range or variety of resources used by the two groups of students. This may be because the survey presented both groups of students with a clinical problem and then asked them to select resources they thought would be useful in solving it, so in effect both groups were asked to carry out a classic PBL exercise.

A survey of veterinary medicine students in 1988¹¹ and again in 1998¹² showed that, although there is a general shift towards use of computerized indexes and other electronic resources by students today compared with ten years ago, overall use of electronic materials was highest in a group of students taught by PBL methodologies.
Most studies of library usage by students have involved short-term data collection periods (e.g., a few months) and student self-reports. Very few studies have looked at actual library use over a longer time period. Anderson et al.\textsuperscript{13} carried out a two-year prospective study of library usage by PBL and traditional track students. Library use, measured by the number of items checked out of the library, was found to be five to ten times higher for problem-based taught students compared to traditionally taught students. The authors noted that total library use may have been underestimated, as browsing was not followed or tabulated. However, to date, the influence on a dental school library of a curriculum change to PBL instruction has not been examined.

The aim of the present study was to explore the effect of a curricular change involving PBL on dental school library usage.

**Methods**

Statistics for book and journal circulation at IUSD library are collected daily. These are composed of figures for “browse, charge, renew and total” circulation. Data for browsing is collected by counting the number of items reshelved by library staff. The number of items borrowed, recorded as “charge,” is recorded by computer when items are checked out. The same happens for renewal. “Total” is the sum of the above three categories. Monthly and annual circulation statistics for each Indiana University (IU) library are compiled by the IU central library. These statistics reflect circulation to all library patrons and do not specify whether the item was used by a student, staff, or faculty member.

Using centralized circulation statistics, monthly and annual statistics for browse, charge, renewal, and total circulation for the IUSD library were reconstructed for each academic year from 1994-95 to 1999-2000 (three years prior to and three years following the curricular change). Data for total circulation at Indiana University libraries during the same time period was also collected. To control for changes in circulation independent of the curricular change, circulation statistics from University of Michigan (UM) Dentistry Library, where PBL has not been implemented, were used as a negative control. Circulation data for UM was available in the categories charge/renew, browse, and total for the five academic years 1995-96 to 1999-2000. Charge and renew were not recorded separately at UM but rather as a single category “charge/renew.”

IUSD dental student enrollment statistics (IUSD office of student affairs) for all six years were collected to control for changes in student numbers and to allow a correlation between changes in circulation and the number of students using the new curriculum. Indiana University fall semester enrollment statistics (Indiana University Budget office) for 1995-2000 were collected for the same reason. The new curriculum was introduced for first year D.D.S. students in the academic year 1997-98. The following year, both first- and second-year D.D.S. students used the new curriculum, and in 1999-2000 first-, second-, and third-year students were using the new curriculum (see Table 1).

Library usage measurements (charge, renew, charge + renew, browse, total) were modeled as a function of month and year using analysis of variance (ANOVA). The month was included because of the cyclical nature of library usage caused by vacation periods. Year comparisons were used to determine if the change in curriculum was related to an increase in library usage overall and if the increase continued as more classes used the new curriculum. In addition, comparisons were made between the IU dentistry library and UM dentistry library to determine if any increases in library usage at IU were similar to increases at UM, which would suggest increases were due to general trends in dental library usage and not the new curriculum. These comparisons were also made using ANOVA, with additional effects included for school, school-by-month interaction, and school-by-year interaction.

The number of students using the new curriculum was correlated with the change in circulation for each year of the new curriculum compared to the last year of the old curriculum.

**Results**

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**Table 1. Enrollment at IUSD**

The number of D.D.S. students enrolled in each year at IUSD for one year before and the three years following the introduction of the new curriculum.

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Students using new curriculum

Students using old curriculum
As shown in Figure 1, circulation at IUSD was significantly higher during the three years following the introduction of the new curriculum (1997-98, 1998-99, 1999-2000) compared to the three years before (1994-95, 1995-96, 1996-97). This was true for all categories of circulation: charge ($p = 0.0008$), renew, browse, and total ($p \leq 0.0001$). Annual circulation at IU for all six years in each of the categories is presented in Figure 2. Within each category, significant differences ($p \leq 0.05$) are identified by different letters.

Total circulation values for the years prior to the curricular change are not significantly different. However, in the first year following the introduction of the new curriculum, total circulation was significantly higher than in 1994-95 and 1995-96. In the second and third years, it was significantly higher than in all of the preceding years.

Prior to the curricular change (Fall 1997), the number of charges fell. Following the introduction of the new curriculum, charges rose each year. In the years after introduction of the new curriculum (1997-98, 1998-99, and 1999-2000), the number of charges were not significantly different from one another.

Although browsing increased from 1994-95 to 1996-97, it was significantly higher during the second and third years (1998-99 and 1999-2000) of the new curriculum than in all of the preceding years.

Renewals fell slightly each year prior to the curricular change. Following the introduction of the new curriculum, renewals increased. They were significantly higher during the first and third years of the new curriculum (1997-98 and 1999-2000) than during all of the years prior to the change.

When monthly circulation totals are plotted (Figure 3), both the annual range and the cyclical nature of library usage caused by vacation periods are visible.

The number of D.D.S. students enrolled at IUSD during the academic years 1996/97 to 1999/2000 is presented in Table 1. The shaded boxes represent those stu-
dents using the new curriculum. When the number of students using the new PBL curriculum was correlated with increases in total circulation during each year of the new curriculum as compared to the year before its introduction, the $R^2$ was $> 98$ percent (Figure 4).

Library usage was similar or greater at UM than at IU before the curricular change and was lower at UM than at IU after introduction of the new PBL curriculum (Figure 5). This indicates the increased usage seen at IU during the new curriculum was not likely due to a general trend in usage independent of the curriculum.

Figure 6 shows a downward trend in total circulation for all Indiana University libraries for the academic years 1994/95 to 1999-2000 despite an increase in the number of students enrolled.

**Discussion**

This study examined the effect of the introduction of a new undergraduate dental curriculum on library circulation at IUSD. Although this library is used by staff, faculty, graduate students, and students in affiliated programs, undergraduate dental students make up the majority of the library’s patrons. It was possible to separate circulation to dental students from other users for 2001. This data showed that 84 percent of circulation is to dental students. A study of library use in problem-based and traditional curricula by Marshall et al. found that while library use was greater for PBL students, there was no difference in library use by faculty from schools using PBL compared to those from schools with traditional curricula.

In this study, all circulation data for six years was collected and analyzed. In contrast, the data for most of the literature on library use by PBL medical students was collected by survey or questionnaire over a short time period. As pointed out by Rankin, studies relying on self-reported data have limitations particularly regarding library use, because this activity is considered academically desirable.

Data from a non-PBL school was used as a negative control to determine if increases in circulation at IU were part of a general trend in library use by dental students. As in the study by Rankin, a control was chosen based on number of students and geographic location. Michigan School of Dentistry has the same number of students in its D.D.S. program as does Indiana University (100 per class). Both are midwestern dental school libraries. Both keep
circulation statistics in the categories “charge, renew and browse.” The patrons of both libraries are made up mainly of undergraduate and graduate dental students, students in allied programs, staff, and faculty.

An interesting finding of the present study was that circulation in all categories except browse declined in the three years prior to the curricular change at IU. This trend was also evident at UM dentistry library. Total circulation at IU libraries also decreased during the six years examined despite increases in the number of students enrolled. This may be due to the same scale as the five- to tenfold increase reported by Anderson.13 This may be explained by a number of factors. The increases in circulation reported in the present study may account for a lesser proportion of the total materials used by students than in 1987-88 when Anderson’s work was carried out, because of the shift away from printed matter toward computerized or online materials.11 At IUSD, the new curriculum was implemented for the entire class, and therefore the increases reflect usage by all students. Anderson’s data,13 on the other hand, involves a PBL curriculum. While this increase agrees with literature from medical libraries,8-10 which found greater use of library facilities by PBL students, it was not on a shift away from using printed matter accompanied by a shift toward the use of computerized indexes and online materials.11

Despite this trend, a significant increase in circulation was seen in the three years following the introduction of the new curriculum at IU. There was a linear correlation between the increase in total circulation and the number of students in the new curriculum. While this increase agrees with literature from medical libraries,8-10 which found greater use of library facilities by PBL students, it was not on the track for which students volunteered. This group may be more dedicated or predisposed to self-directed learning10 and therefore use a greater amount of library resources than might the typical student.

Conclusions

After a major pedagogical change, library circulation at IUSD increased significantly. The increase in total circulation was linearly related to the number of students using the new curriculum. Students in the new
curriculum appear to use more library resources than did their counterparts using the old curriculum. Since the effect of increased library use by students using the new D.D.S. program extends beyond the first two years of the curriculum where PBL tutorials are concentrated, it appears that the new curriculum has succeeded in at least one of its goals—initiating a desire for life-long learning.

Knowing how the curriculum and the library interact is important for dental schools planning or considering moving to a program using PBL. The impact of PBL on library resources may be more significant in dental schools than in medical schools, because the dental library is typically smaller than the medical school library and has fewer staff. Increased browsing and circulation may require more staff to reshelve used materials. Future studies could examine the impact of PBL in relation to collection size, staffing, or demand for materials, so that budgeting can be improved.

Because electronic curriculum materials may produce a downward trend in the use of printed matter, future studies aimed at determining the total use of library services by students should also examine students’ use of electronic media.

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REFERENCES

3. Lewis M. Library requirements and problem-based learning: the Medical Sciences Library, the University of the West Indies.