Exam questions developed by students lead to higher cognitive level of learning
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ABSTRACT

New dental education accreditation standards emphasize that pedagogy must be competent in the use of critical thinking (high cognitive level skill). Despite the new standards, most written assessments in dental school courses are still based on low cognitive-level questions.

The goal of this project was to determine if an exercise that allows students to collaboratively write exam questions lead to higher levels of learning. To evaluate this exercise, cognitive level of exam questions and students’ scores across two groups were compared: a “control” group in which tests were instructor-generated and an “intervention” group in which students contributed to test development.

Results indicate that the intervention group took exams with higher-level cognitive questions and performed better compared to the control group. Students generating their own assessments developed higher cognitive-level exam questions and performed better on the exams, suggesting expansion of this exercise into other dental classroom experiences.

BACKGROUND

• Student assessment is directly associated with student learning
• Dental school assessments are based on low cognitive-level questions due to the difficulty in developing higher-cognitive questions
• Poor performance of students on higher-cognitive questions
• New dental accreditation standards emphasize competence in critical thinking

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Commission on dental accreditation suggests “the use of questions that require students to analyze problem etiology, compare and evaluate alternative approaches, provide rational for plans of action, and predict outcomes”.

WE HYPOTHEZIZED:

1) Student-generated exam questions lead to higher cognitive level of assessments, compared to instructor-generated assessments
2) Student-generated exam questions at a higher-cognitive level lead to increased learning demonstrated by scoring as good or better on high cognitive level exam questions, compared to students tested on lower cognitive-level questions
3) Students perceive exam question development helpful to their learning

METHODS

1) GROUP WORK:
• Student groups (intervention group) constructed and edited a list of exam questions to study from and used for midterm and final exams

Students created simulated clinical scenarios from assigned lectures, clinical/lab, and related knowledge.

Students generated 5 multiple-choice questions based on simulated scenarios or other course content
• Extra credit given to groups generating questions at high cognitive levels

2) RATING EXAM QUESTIONS:
• Cognitive level of 160 exam questions from intervention and control (instructor-generated exams) groups scored blindly by three expert scorers (weighted kappas=0.88)

Questions given cognitive score based on modified Bloom’s taxonomy (Figure 1)

3) QUALITATIVE DATA:
• Intervention students completed a survey to capture perceptions related to learning, ease, and utility of exercise

Students’ perceptions of exercise were analyzed for additional descriptive statistics

STUDY DESIGN:

Students generating their own assessments developed higher cognitive-level exam questions and performed better on the exams, suggesting expansion of this exercise into other dental classroom experiences.

Table 1. Demographics of intervention and control groups

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Control Group</th>
<th>Intervention</th>
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</thead>
<tbody>
<tr>
<td>Average 1st Year Dental GPA</td>
<td>3.47</td>
<td>3.56</td>
</tr>
<tr>
<td>Average DAT-Perceptual Ability</td>
<td>19.9</td>
<td>20.5*</td>
</tr>
<tr>
<td>Average Enter GPA</td>
<td>3.47</td>
<td>3.56</td>
</tr>
<tr>
<td>Average 1st Year Semester GPA</td>
<td>3.47</td>
<td>3.56</td>
</tr>
</tbody>
</table>

*Intervention group is significantly different from the control group (p<0.05)

RESULTS

Figure 1: Criteria of cognitive levels based on Bloom’s taxonomy

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Figure 2: Group of students generating exam questions

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Figure 3: A) Cognitive level of instructor-generated and student-generated exam questions

Figure 3: A) Cognitive level of instructor-generated and student-generated exam questions

Figure 3: B) Average performance of students on instructor-generated (control group) and student-generated (intervention group) exam questions

Figure 3: B) Average performance of students on instructor-generated (control group) and student-generated (intervention group) exam questions

SURVEY RESULTS

• A majority (79%) of students agreed that the exercise was helpful for their overall learning experience

When asked about helpfulness of the exercise’s components, teamwork was the only one rated significantly differently. Other components included working in teams, using Google Docs, getting feedback from instructors, getting extra credit for higher-level cognitive questions, and seeing exam questions (Table 2)

Table 2. Mean ratings for students’ perceived helpfulness of exercise components (Likert Scale: 1=Strongly Disagree… 5=Strongly Agree)

<table>
<thead>
<tr>
<th>Components</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working in teams</td>
<td>2.90</td>
<td>2.96</td>
<td>2.91</td>
<td>2.96</td>
<td>2.90</td>
<td>2.91</td>
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<tr>
<td>Using Google Docs</td>
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<td>2.91</td>
<td>2.96</td>
<td>2.90</td>
<td>2.91</td>
<td>2.96</td>
<td>2.90</td>
<td>2.91</td>
</tr>
<tr>
<td>Getting feedback from instructors</td>
<td>2.90</td>
<td>2.96</td>
<td>2.91</td>
<td>2.96</td>
<td>2.90</td>
<td>2.91</td>
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<tr>
<td>Getting extra credit</td>
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<td>2.91</td>
<td>2.96</td>
<td>2.90</td>
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<tr>
<td>Seeing exam questions</td>
<td>2.90</td>
<td>2.96</td>
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“Studying questions collaboratively was an important tool to help organize and classify the data from the project. I really learned well having to critically analyze the material myself in order to make questions.”

DISCUSSION

1) Comparisons of students’ prior abilities were inconclusive. Average entering DAT score is slightly higher for the intervention group, but statistically significant, while differences in entering GPA were not significant (Table 1).

2) Student-generated exams were written at higher cognitive levels and students performed better on them, suggesting increased learning (Figure 3A and 3B).

3) Students’ perceptions of the exercise were overall positive. A repetition effect – i.e., seeing the questions before the exams – could potentially explain the increased performance on exam questions, but as indicated by Table 2, students did not perceive this to be the case. This component was not rated significantly differently than other aspects of the learning experience.

Overall, students generated higher cognitive-level exam questions and performed better on them, suggesting that student-driven, collaborative assessments are an important tool for building critical thinking skills in dental classrooms.

REFERENCES


ACKNOWLEDGEMENT

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