An Examination and Evaluation of Question Preparation for Computer-based Testing in Dental Education

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Abstract
Faculty members of each university are responsible for preparing and implementing shared testing. While the questions for computer-based testing (CBT) are publicly gathered and prepared by each university every year, the effort to prepare questions for CBT is said to be meaningful not only in improving the question preparation skill of the faculty members but also in improving educational awareness and strengthening collaborations among different fields. In the present study, we evaluated the effects on educational activities and the awareness of the faculty members responsible for question preparation. A survey was conducted among faculty subjects who were responsible for CBT question preparation. The rates of positive responses received regarding question preparation for CBT were high, and no significant rate difference was observed between the items. The scores in the basic department group and the clinical department group regarding the level of understanding of the dental education model core curriculum, the level of understanding of the importance of education, and the effect on improving the awareness of education were each significantly higher in the basic department group than in the clinical department group (p < 0.05). Among the overall positive responses, there were no significant differences between the basic department group and the clinical department group, while the negative responses (items needing study and improvement) were significantly different (p < 0.05) between the two groups.

These results suggest that the preparation of questions for CBT contributes to increased effects on and consciousness of educational activities, and the effects were particularly high in the basic department group. In addition, in the clinical departments, there was a high rate of items needing study and improvement, as clinical department faculty members have clinical practice as well as education and research to manage, which requires considerable effort and hinders the pursuit of other tasks. The study results also indicated that our faculty’s system for the preparation of questions needs to be not only maintained but also further improved to increase the understanding and consciousness of education and to reduce the burden of education, as there were some items showing less educational effects, understanding, and change.

Keywords:
question preparation,
computer-based testing,
dental education,
committee of CBT

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Introduction

With the objective of constructing a system to appropriately evaluate the knowledge, attitude, and skills that students are expected to have before entering clinics, the establishment of a common testing shared among universities was proposed for common national standard evaluation testing compliant with the model core curriculum (1,2). Computer-based testing (CBT) is a method of evaluating knowledge that is commonly used by universities throughout the world (3–5). After 4 years of common testing of CBT over a trial period starting in 2002, CBT was effectively implemented in December 2005 (Year 2006 of common testing). The persons in charge of the preparation and operation were faculty members of the participating universities (1,2,6,7).

Faculty members of each university are responsible for preparing and implementing shared testing. While the questions for CBT are publicly gathered and prepared by each university every year, the effort to prepare CBT questions is said to be meaningful not only in improving the question preparation skill of the faculty members but also in improving educational awareness and strengthening collaborations among different fields (1,2,8–10). The present study evaluated the effects on educational activities and the awareness of the faculty members responsible for CBT question preparation.

Materials and Methods

An anonymous self-recorded survey was conducted among 31 subjects (basic department: 9 subjects, clinical department: 22 subjects) who were responsible for CBT question preparation in fiscal year (FY) 2013 and 2014.

Details of the questions were as follows: responsibility for education for undergraduate students (responsibility for lectures and practical training, responsibility for comprehensive lectures (CBT measures lectures) for fourth-year students), and school years involved with the preparation of comprehensive end-of-year testing. The examination contents included the number of questions prepared for the CBT, as well as the level of understanding of the dental education model core curriculum, the level of understanding of the importance of student-oriented education, the effect on improving awareness of education, and the change in daily educational activities (e.g., classes), through the preparation work as a member responsible for CBT question preparation. In addition, questions were asked about the existence of positive responses (positive items) and negative responses (items needing study and improvement) through CBT question preparation. If there were any specifics, these were also described. Parts of the content were prepared in reference to the report by Nakayama et al. (11) and the white papers on dental education (1,2), with non-responses and incomplete responses excluded.

For statistical analysis, Fisher’s exact probability test was used to compare ratios between two groups, and the t-test was used to compare mean values between two groups.

Results

The most common method used by faculty members for student education was seminars, at 100%. Approximately 30% of faculty members were involved in comprehensive lectures (Table 1). The academic year containing the most students with respect to preparation of comprehensive end-of-year testing was the third year (Table 2).

The mean number of questions prepared in the basic course group was Type A, 3 questions, whereas in the clinical department group, the mean numbers were Type A, 2 questions; Type L, 1 question; Type W, 1 question; and Type Q, 1 question; with a mean number of 3 subjects in the basic department group and 5 subjects in the clinical department group responsible for question preparation.

Regarding understanding of the dental education model core curriculum through CBT question preparation work, it deepened in 26% of faculty subjects and slightly deepened in 55%. Regarding understanding of the importance of education through CBT question preparation work, it was understood in 23% of faculty subjects and generally understood in 61%. With respect to improving awareness of education, CBT question preparation work was effective in 36% of subjects and generally effective in 42% of subjects. In regard to change in daily educational activities (e.g., classes) through CBT question preparation work, daily educational activities greatly changed in 7% and slightly changed in 65%, with no significant rate difference observed between the items (Table 3).

The scores (mean ± SD) in the basic department group and the clinical department group regarding the level of understanding of the Dental Education Model Core Curriculum through CBT question preparation work (3.4 ± 0.5, 2.8 ± 0.8) (Fig. 1), the level of understanding of the importance of education through CBT question preparation work (3.4 ± 0.5, 2.8 ± 0.8) (Fig. 2), and the effect on
improving the awareness of education (3.6 ± 0.5, 2.9 ± 0.8) (Fig. 3), were each significantly higher in the basic department group than in the clinical department group (p < 0.05).

The rate of positive responses (positive items) in all subjects was existence of positive responses (64.5%), and non-existence of positive responses (35.5%). On the other hand, the rate of negative responses (items needing study and improvement) in all subjects was existence of negative responses (58.6%), and non-existence of negative responses (41.4%) (Fig. 4). In the overall positive responses (positive items), there was no significant difference between the basic department group (existence: 88%, non-existence: 12%) and the clinical department group (existence: 55%, non-existence: 45%) (Fig. 5), while the overall negative responses (items needing study and improvement) showed a significant difference (p < 0.05) between the basic department group (existence: 22%, non-existence: 78%) and the clinical department group (existence: 73%, non-existence: 27%) (Fig. 6). In terms of the described contents, while there were positive opinions such as being able to expect an increase in overall awareness of the faculty members and question preparation level, there were also responses related to points for study and improvement, such as the considerable amount of effort required despite the limited time available, or that it created an obstacle to pursuing other tasks such as clinical practice (Table 4).

**Discussion**

Past surveys (1,2,11) have found that 71% of faculty subjects provided both lectures and seminars as education for undergraduate students, while 19% provided only seminars, 5% provided only lectures, and 5% did not provide either. The present survey found that 90% of faculty subjects were responsible for both lectures and practical training. Compared to past surveys, a greater percentage of subjects were responsible for both lectures and practical training and in addition, they were responsible for multiple school years. Nineteen of the 24 universities that provided responses and all 15 of the private universities that provided responses reported that they implemented unique objective testing (1,2). Even at the Nihon University School of
Dentistry at Matsudo, objective testing was conducted with the exception of the fourth year, during which CBT question preparation is conducted for comprehensive lectures at the end of the year. In the present survey, the rate of subjects involved in question preparation was 42% for the third year. However, while more than half of these subjects were involved in question preparation for multiple school years, there were some that were involved for only a single year, as well as for lectures where the work was split up to some degree. Through the implementation of CBT, changes have been made to the supported curriculum, initiatives towards classes, comprehensive year-end testing (multiple choice questions (MCQ) based on CBT), and so on; each faculty member has seen major changes in educational activities such as changes or increased participation in lectures or seminar contents. Very substantial personnel and materials...

Table 3. The rate of understanding and improvement of awareness through computer-based testing question preparation work

| 1. understanding of the dental education model core curriculum |
|---------------------------------------------------------------|
| deepened                                                     | 25.8 |
| slightly deepened                                            | 54.8 |
| did not really deepen                                         | 16.1 |
| did not deepen                                                | 3.3  |
| 2. the understanding of the importance of education           |
| understood                                                   | 22.6 |
| slightly understood                                          | 61.3 |
| did not really understand                                     | 13.9 |
| did not understand                                           | 3.2  |
| 3. improving the awareness of education                      |
| effective                                                    | 35.5 |
| slightly effective                                           | 41.9 |
| not really effective                                         | 22.6 |
| not effective                                                | 0.0  |
| 4. the change in daily educational activities                 |
| greatly changed                                              | 6.5  |
| slightly changed                                             | 64.5 |
| No change                                                    | 29.0 |

NS: not significant

1. Understanding the dental education model core curriculum: Rate of understanding the dental education model core curriculum using computer-based testing preparation
2. Understanding the importance of education: Rate of understanding of the importance of education through computer-based testing preparation
3. Increasing awareness of education: Rate of understanding of the improving awareness of education through computer-based testing preparation
4. Change in daily education activities: Rate of changes in daily educational activities (e.g. classes) through computer-based testing preparation
resources are required for carrying out common testing, but the present survey also indicated that there has been an increase in the educational load in clinical lectures in particular. More efficacious educational activities are believed to be necessary in view of the balance between education and clinical practice.

In previous studies (1, 2, 11), positive responses received regarding question preparation for CBT included: gained deeper understanding of the dental education model core curriculum ("deepened" + "slightly deepened," 95%); understood the importance of student-oriented education ("understood" + "slightly understood," 91%); improved awareness of education ("effective" + "slightly effective," 81%); and brought about a change in daily educational activities (e.g., classes) ("greatly changed" + "slightly changed," 57%). In our faculty, positive replies accounted for 81% of all replies regarding the level of understanding of the Model Core Curriculum, 84% of replies regarding the level of understanding of the importance of education, and 77% of replies regarding an increase in consciousness of education, being lower by approximately 5% to 15% than previously reported rates, thus calling for future consideration. The 71% of replies regarding any change in routine educational activities including tuition was positive in our faculty, being approximately 15% higher than the previous rate. In comparison with previous reports (1, 2, 11), some items demonstrated less educational efficacy, understand-
ing, or changes, indicating that in addition to question preparation, it is also necessary to improve the preparation program. The fact that CBT question preparation is decreasing the efficiency of daily educational activities, resulting in a burden being placed on the subjects, cannot be denied. With some faculty subjects responding that there was no effect in terms of improving awareness of education or changing education, the necessity to discuss improving

Table 4. Specific details from subjects responding concerning positive points and items requiring study and improvement through computer-based testing question preparation (multiple answers possible)

(1) Positive Items
- I became passionate about education.
- Work got done smoothly thanks to experienced guidance.
- It was good practice at creating simple problems and multiple-choice questions.
- The ability to hear about key points in education in other fields during brush-up is a good thing.
- It was good to be able to reference lectures or exam questions from other than the target school year.
- It has become easier to consider basic evidence after diagnosis and examination, and link basic with clinical.
- The Model Core Curriculum can have items added in just the right portions when creating syllabi or giving lectures.
- I could contribute to improving the effects and awareness provided to CBT question preparation and educational activities.
- I was able to understand the main points of exam question preparation and apply to question preparation for other school years.
- The rotation of the people in charge of question preparation means we can expect improvements in overall awareness and question levels.

(2) Items needing study and improvement
- The questions themselves are stuck in a rut.
- There is a tendency to have the same content each year.
- The awareness of the question creator needs to be improved.
- Photography of visual materials affects clinical practice efficacy.
- Everyone seems easily swayed by the opinions of experienced members.
- It takes time to correct written work that has little to do with the question.
- The scope for questions is too restricted and it is hard to come up with them.
- We are running out of ideas for question preparation and questions are similar in each school year.
- There is a tendency to feel that the educational goals are dominated by the Model Core Curriculum.
- There is no feedback to allow the question creator to see what the question was finally changed to.
- Despite the limited period available, considerable effort is required and effects on other tasks such as clinical practice are unavoidable.
- Due to being the busy period in the new academic year, there is a problem with lack of manpower and minor hindrances to the pursuit of other tasks.
- If visual materials are required for the questions within the scope of the core curriculum, then the questions inevitably end up being unevenly distributed.

Fig. 5. Comparison of the rate (existence) of the positive responses (positive items) between the basic department group and the clinical department group

Fig. 6. Comparison of the rate (existence) of the negative responses (items needing study and improvement) between the basic department group and the clinical department group
awareness and decreasing the burden was suggested.

Questions are publicly sought from all universities every
year by the Common Achievement Tests Organization,
after which they are modified by members of the brush-up
committee. Since faculty members with different expertise
backgrounds gather questions through this process, benefits
such as building a sense of togetherness, exchanging
educational information, and discussing educational issues
have been reported (1,2,11). In our department, faculty
members with different specialties are carrying out this
brush-up as well, which we believe is generating similar
educational effects.

Questions in CBT can be categorized into 4 types (1,2).
In these types, Type A (a simple question to select the best
option among 5 options) is the most standard type used in
national examination for dental practitioner and various
MCQs (12,13). The higher scores among faculty who teach
basic subjects are considered to be due to the high
educational effects of the preparation of Type A questions,
which is the only activity in which they are involved. Faculty
who teach clinical subjects spend much time not only on
research and education, but also on clinical practice.
Conversely, faculty who teach basic subjects put more effort
into education, and this could be another cause of the higher
scores.

Negative aspects have been reported (1,2,14,15), such as
responses that there was little acknowledgment of the work
considering the effort spent on CBT question preparation. In
our faculty as well, similar responses have been seen, but
there have been a considerable number of negative
responses, such as the effects on clinical practice due to
gathering visual materials, running out of ideas for question
preparation, the similarity of the questions in each school
year, the feeling of faculty members that the educational
goals are dominated by the Model Core Curriculum, the
considerable effort required and the unavoidable impact on
other tasks, and the lack of manpower and the minor
hindrances to the pursuit of other tasks. In the clinical
department group in particular, there was a high rate of
items needing study and improvement, as these faculty
members have clinical practice as well as education and
research to manage, which requires considerable effort and
hinders the pursuit of other tasks. Specifically, it cannot be
denied that CBT question preparation work, such as the
collection and organization of visual materials targeted at
patients, negatively affects daily educational activities and
clinical practice efficiency and causes a burden, suggesting
the necessity for studying appropriate and effective systems
for mitigating this burden. However, there are a number of
areas which require reappraisal, such as the mutual
relationship between questions and question preparation
experience of faculty members targeted in this survey, as
well as inadequate surveying and analysis of cross
tabulation. Therefore, this present study should be treated
as preliminary research, and further investigation and study
involving a larger number of subjects are considered
necessary.

In conclusion, these results suggest that the preparation
of CBT questions contributes to increased consciousness of
educational activities, and the effects are particularly high
among the basic departments. In addition, for the clinical
departments, there is a high rate of items needing study and
improvement, as these faculty have clinical practice as well
as education and research to manage, which requires
considerable effort and hinders the pursuit of other tasks. It
is also suggested that our faculty's system for the
preparation of questions needs to be not only maintained but
also further improved to increase the understanding and
consciousness of education and to reduce the burden of
education, as there are some items showing less educational
effects, understanding, and change.

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