Effectiveness of Computer-Based Testing Workshops in Dental Education

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Abstract
In workshops (WSs) that are part of faculty development, it is first important to set an objective, and then for small numbers of participants to engage in effective and efficient within-group discussions in order to achieve that objective. Generally, tasks in WSs are performed in order to achieve the objective, and WS participants must present feasible products through an on-site learning process in a limited amount of time. They then engage in discussions with other WS participants. Regarding the specific methods and materials for assessing a WS and evaluating its effects on participants, analyses of the WS products and questionnaires, which provide a good general overview, have been carried out and reported. However, studies on the assessment of computer-based testing (CBT) WSs in dental medicine and its effects are extremely limited. Therefore, in the present study, with the objective of achieving further progress and improvement in dental education, we evaluated the effects of CBT WSs on the education and awareness of participants, and report the results herein. An examination regarding the level of understanding achieved according to type of question or educational activity was carried out on participants both pre- and post-WS. In the overall post-WS assessment, the mean scores regarding the value and appropriateness of the content were high, and the WS method was highly evaluated in terms of effectiveness. The mean scores for level of understanding attained through question types were significantly higher post-WS than pre-WS (P < 0.001). The mean scores for level of understanding regarding the Model Core Curriculum for Dental Education and the importance of student-oriented education, as well as self-evaluations of the level of educational awareness were also significantly higher post-WS than pre-WS (P < 0.001). These results suggested the value and appropriateness of the WS content, as well as the effectiveness of the WS as a study method. The results also indicated that WSs contribute to deeper educational understanding and improved awareness, as they were shown to be both useful in helping participants better understand CBT-related questions and effective in helping participants master alternative questions with high applicability.

Introduction
In order to foster outstanding physicians and dentists capable of responding effectively to requests from citizens and larger society, the establishment of an evaluation
system that can be commonly used by each university has become necessary (1,2). Computer-based testing (CBT), Objective structured clinical examinations (OSCE) and portfolios are the methods currently used to evaluate the knowledge, skills, and attitudes of students, respectively. However, evaluation methods vary widely; for example, one learner assessment tool, work-based assessment (WBA), is the method primarily used at medical sites (3-10).

In this study, we publicly sought questions for use in CBT from all universities in Japan. Next, the questions were reviewed and revised by the CBT Implementation Subcommittee, which is made up of university faculty members delegated by a common testing implementation mechanism, before being used as test questions (1,2). New questions are requested from universities annually, but since high quality questions are required, each university holds in-school workshops (WSs) and establishes committees for brush-ups to improve the educational capability of faculty members (1,2).

Moreover, in WSs that are part of faculty development (FD), it is important to set objectives, and then for a small number of participants to each engage in effective and efficient within-group discussions in order to achieve those objectives. Generally, tasks in WSs are aimed at achieving an objective, and WS participants must present feasible products through an on-site learning process in a limited amount of time before engaging in discussions with other WS participants (1,2). Concerning the specific methods and materials for assessing a WS and evaluating its effects on participants, analyses of the WS products and questionnaires, which provide a good general overview, have been carried out and reported (11-15). However, studies on the assessment of CBT WSs in dental medicine and its effects are extremely limited. Therefore, in the present study, with the aim of achieving further progress and improvement in dental education, we evaluated the effects of CBT WSs on the education and awareness of participants.

**Materials and Methods**

An anonymous self-report examination was carried out on participants (nineteen teachers of the Nihon University School of Dentistry at Matsudo) during a CBT WS in 2014. The examination was designed to assess the level of understanding attained according to type of question or educational activity, and was carried out on participants before and after Workshops (pre-WS and post-WS). Items commonly included on the pre- and post-WS examinations were: "level of understanding according to question type (Type A, Type L, Type W, and Type Q)"); "level of understanding of the Model Core Curriculum for Dental Education"; "level of understanding of the importance of student-oriented education"; and "self-evaluated level of awareness of education". Items included on only the post-WS examination were: "evaluation of the value of the content"; "evaluation of the amount of time needed to understand the content"; "evaluation of the level of difficulty of the content"; "effectiveness of the WS-style studying method"; and "interest in the content of the WS". All items were evaluated on a Likert-type scale ranging from 1 to 10 points. Portions of the content were created in reference to the White Paper on Japanese Dental Education (1,2) and the report by Nakayama et al. (4). Non-responses and incomplete responses were excluded from analyses.

For statistical analysis, the Mann-Whitney U test was used to compare the mean pre- and post-WS score.

**Results**

In the overall post-WS assessment, the mean scores (± standard deviation [SD]) for "value of the content", "appropriateness of the content", and "effectiveness of the WS-style studying method" were all high, at 7.8 ± 1.4, 7.0 ± 1.6, and 7.3 ± 2.1, respectively (Fig. 1). Regarding "evaluation of the amount of time needed to understand the content", 59% of the participants considered the amount of time appropriate, while 29% did not feel as though enough time had been provided. Furthermore, 59% of the participants felt as though the level of difficulty of the content was appropriate, whereas 41% thought it was too difficult.

The mean pre- and post-WS scores for level of understanding according to question type were as follows: Type A (5.1 ± 2.5 → 8.4 ± 1.2); Type L (3.0 ± 2.0 → 7.4 ± 0.9); Type W (3.0 ± 1.9 → 6.9 ± 1.2); and Type Q (3.2 ± 2.0 → 7.0 ± 1.2). These findings indicated significant increases in level of understanding post-WS compared with pre-WS (Fig. 2; P < 0.001). In addition, the mean pre- and post-WS scores for "level of understanding of the Model Core Curriculum for Dental Education", "level of understanding of the importance of student-oriented education", and "self-evaluated level of awareness of education" were 3.7 ± 2.4 → 6.8 ± 1.4 (Fig. 3; P < 0.001), 4.7 ± 2.1 → 7.4 ± 1.4 (Fig. 4; P < 0.001), and 5.2 ± 2.0 → 7.6 ± 1.4 (Fig. 5; P < 0.001), respectively. These findings also indicated significant
Fig. 1  Mean overall assessment scores after the workshop

Fig. 2  Mean pre- and post-WS scores for level of understanding according to question type

Fig. 3  Mean pre- and post-WS scores for level of understanding of the Model Core Curriculum for Dental Education

Fig. 4  Mean pre- and post-WS scores for level of understanding of the importance of student-oriented education
increases post-WS compared with pre-WS.

Discussion

An increase has been observed in the knowledge and consciousness of faculty education in Japanese universities as a result of FD workshops, which in turn facilitated substantial improvements in teaching skills and communication among faculty members(1,2). More concretely, FD workshops have allowed a smooth exchange of educational information via the standardization of education-related terminology. In addition, a number of studies have reported finding a higher quality of education and of educational organizations after FD workshops(14-16). The present study assessed the effects of FD workshops on participants through pre- and post-WS evaluations of education levels, which differs from previous studies that have generally analyzed only the WS products and conducted only post-WS questionnaires.

A previous study involving an online class reported that the mean score for "self-evaluated level of awareness of education" was 7.6 on a 10-point-scale(16), which was similar to the high score observed in the present study. Regarding "level of understanding of the Model Core Curriculum for Dental Education", "level of understanding of the importance of education", and "assessment of the level of consciousness of education", the first endpoint showed a lower correlation with the other endpoints, with a difference in and singularity of the first endpoint compared with the other endpoints. Similarly, the pre-WS scores for "level of understanding of the Model Core Curriculum for Dental Education" were significantly lower than those for the other endpoints; however, this difference was no longer significant post-WS, suggesting that WSs are particularly effective in improving "level of understanding of the Model Core Curriculum for Dental Education".

Questions in CBT can be categorized into the following four types: Type A (simple questions for the best answer is selected from among five options), which is the most standard type of question used in the National Dental Practitioners Examination and various other multiple choice examinations; Type L (two consecutive questions with multiple options), which simulates a clinical setting where diagnostic and therapeutic strategies must be selected from among many options; Type W (two consecutive questions that must be answered sequentially), which are basically a combination of questions on clinical dentistry and basic science (basic medicine and dentistry) directly associated with the first question; and Type Q (four consecutive questions that must be answered sequentially), which basically represent a form of clinical reasoning that follows the process of examination, diagnosis, and treatment (1,2,17-19).

In the evaluations by WS participants, Types L, W, and Q, which are unique to CBT, demonstrated a lower level of understanding prior to participating in the WS than Type A; this lower level of understanding for Type A questions remained even after participating in the WS. Many of the participants in the present study had less WS experience and fewer years of question preparation; this could explain the substantial increase in the mean post-WS scores regarding the importance and awareness of education, and the understanding of the Model Core Curriculum for Dental Education. The high level of understanding and proficiency for Type A questions is thought to contribute to their application and general-purpose use in preparation for tests that do not involve CBT. Among those targeted in this investigation, numerous areas, including experience in question preparation, require reappraisal. An additional survey with a larger number of participants is therefore considered necessary. In conclusion, the results of the present study suggest the value and appropriateness of the WS content, as well as the effectiveness of the WS as a study method. The results also indicated that WSs contribute to deeper educational understanding and improved awareness, as they were shown to be both useful in helping participants better understand CBT-related questions and effective in helping participants master alternative questions with high applicability.
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References