

## 델파이 기법을 이용한 치과기공사의 교육 평가 시스템 개선 방안에 관한 연구

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### A study on the improvement of educational evaluation system in dental technician using Delphi technique

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#### [Abstract]

**목적:** 본 연구는 실무 현장과 교육 현장의 조사를 통한 종합적인 의견을 수렴하여 합리적인 치과기공사 양성 및 배출을 위한 개선안을 도출하고자 한다.

**방법:** 3회에 걸쳐 설문조사가 진행되었으며, 1차는 개방형 문항으로 조사되었고, 2차, 3차는 폐쇄형 문항으로 조사되었다. 델파이 조사를 위한 조사 인원 선정을 100명(정책집단: 20명, 교육집단: 20명, 임상가 집단: 60명)으로 지정하였다. 1차 개방형 조사결과를 토대로 2차 설문문항을 작성하였으며, 2차 설문조사 결과를 토대로 3차 설문문항을 작성 후 조사하였다. 수집된 자료의 분석은 통계패키지 프로그램 SPSS Ver. 21.0를 활용하여 델파이 기법(Delphi Method)을 활용한 연구 결과에서 전문가 집단의 의견을 수렴하기 위해 빈도분석과 기술통계분석을 실시하였다.

**결과:** 현 교육체계의 문제점은 임상현장과와의 차이와 실무능력저하, 국가시험위주의 교육이 문제점으로 대두되었으며, 현행 평가제도의 문제점은 임상현장을 충분히 반영하지 못한 점, 실무능력이 미 반영된 실기평가로 지적되었다.

**결론:** 결론적으로 치과기공사의 교육과정과 평가제도는 현실적인 내용을 고려하면서 임상 실무와의 연계성을 높이는 방향으로 개선되어야 할 것으로 사료된다.

○ **주제어:** 치과기공학, 치과기공사, 국가시험, 한국보건의료인국가시험원

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## I. Introduction

According to the job description composed by the Korean National Health Personnel Licensing Examination Board in 2000, a dental technician is “a skilled professional who helps restore patients’ oral health and function by fabricating dental prostheses and appliances based on individual patients’ dental impressions while using scientific methods”(Brown, 1965).

In fact, dental technicians perform many duties, which include the following: pouring dental plaster into a dental impression obtained from the patient’s oral cavity for the purpose of fabricating dental prostheses or appliances; simulating a patient’s dental occlusion while using a virtual articulator and the patient’s dental model; fabricating a wax model of a patient’s dental prostheses; finishing prostheses while using various materials, including metal, resin, and ceramic; fabricating orthodontic appliances designed to improve occlusion; polishing and finishing dental prostheses while using a variety of polishing tools; repairing partial and full dentures; steam cleaning of finished dental prostheses; operating and maintaining cutting-edge dental instruments; and enhancing relations with dental practices (Kim et al, 2005).

Dental technology has been developing rapidly in recent years. Reflecting this trend, many colleges have expanded their dental technology programs from 3 to 4 years or have started to offer an elective fourth year for those who choose to deepen their knowledge of their subject. However, clinical experts would

like to see more practical and specialized college-level education programs that produce graduates who are prepared to perform on the job while fully utilizing the special skills and knowledge they acquired in school. Despite past and on-going changes in the workplace, the national dental technician licensing exam has not kept pace with advancements in the field, which has stalled progress in curriculum development and implementation. In contrast to the education and assessment systems, which have stagnated for a prolonged period of time, the industry’s work environment has gone through a rapid transformation.

Clearly, there is a need for a comprehensive review of the current dental technician education and licensing system to nurture a stable and quality workforce with skills relevant to current industry practices. In other words, a study is needed that can present policy recommendations designed to strengthen the educational system by identifying problems and drawing up potential solutions upon a thorough system review. Furthermore, to improve the quality of the dental technician workforce in Korea, general measures for improvement must be determined for the educational programs offered in institutes, the national exam, and general license management. Based on these suggested improvements, policy recommendations can then be made from an informed perspective.

The present study surveys the current state of dental technology education and clinical practices in an effort to tease out the improvement measures required for minimizing the gap between education and workplace practices, which will help nurture a steady

supply of high-quality dental technicians in Korea.

## II. Materials & Methods

### 1. Study design

Using the Delphi method, experts in dental technology were surveyed, with the goal of teasing out the improvement measures necessary to nurture a stable workforce of high-quality dental technicians in Korea. To this end, survey data were thoroughly analyzed and evaluated, and some educational environments, education systems, and curricula were identified as advantageous for current and emerging practices were presented. The validity of the current assessment system and method were analyzed, and the key factors most critically needed at this point were identified via expert consensus.

### 2. Study participants

Informed consent are the ethical and legal requirements for study involving human participants. As recommended by Thompson (Thompson, 2009), to achieve adequate

validity in a Delphi study, expert groups must represent a variety of backgrounds. Therefore, the expertise and suitability of panel members must be thoroughly considered. Panel members may be selected by researchers themselves, or they may be nominated by relevant individuals associated with the field who have been selected by the researchers according to a certain set of qualification criteria. The present study adopted the latter method to compose its expert panel. With reference to previous studies, the researchers surveyed the nominators, who had been selected based on certain qualification criteria. The present Delphi study's participant selection criteria are displayed in Table 1.

### 3. Data collection method

To gather and converge expert opinions on policy factors and measures beneficial for nurturing a stable workforce of high-quality dental technicians, the present study conducted a 3-round Delphi survey. In Delphi studies, there is a chance that close personal contact between researchers and research participants may develop, potentially affecting the data. Therefore, various potential ethics issues must

Table 1. Participant selection criteria and the number of participants

category	selection criteria	institute/organization	no. of persons
policy group	Board members of central committees or local chapters of policy-making bodies concerning dental technology, or individuals performing a similar line of work	Korean Dental Technologist Association, Korean Academy of Dental Technology	20
clinical practice group	Clinical practitioners in the field of dental technology (managers or department heads)	general hospitals, private hospitals, dental labs	60
education group	Educators, scholars, or researchers employed at dental technology education institutes	colleges, research institutes	20

be thoroughly considered in advance (Linstone and Turoff, 1975). The present Delphi study was conducted in a way that took into account the following points. First, during participant selection, informed consent was obtained from each of the participants. Also, data collection fully accommodated the participants' schedules. Second, participants were assured of confidentiality and anonymity, and the researcher committed to preventing any leakage of personal data and to maintaining confidentiality. Third, in order to ensure the accuracy of the responses, the participants were involved in the review and correction process as well as in continued discussion and verification.

#### 1) Designing the first round's open-ended questionnaire

A panel was created consisting of dental technology experts and members of pertinent interest groups that correspond with this study's focus, from which a series of responses and opinions was collected with the prepared open ended-questions. The panel members were not allowed to contact each other during this round. The initial survey is an important starting point from which to attain a wide range of predictions and viewpoints, while working towards the ultimate goals of a Delphi study, which are to determine expert consensus and predict future needs. An open-ended questionnaire is well suited to encouraging panel experts to converge their views after considering their own initial thoughts and opinions. An overly structured and detailed questionnaire in the first round would risk a reduced response rate, which in

turn limits the scope of possible solutions. As such, an open-ended questionnaire was desirable.

#### 2) Designing the second round's closed-ended questionnaire

Unstructured responses collected from the previous round's open-ended questions were edited into structured questionnaire items, which were subsequently rated by the panel members to show the extent to which they agreed or disagreed with the statements. In the second round, the panel members were asked to reevaluate their responses from the previous round; the results from the first round were broken down by individual factors, and the panel members were asked to rate the items based on that already provided information.

#### 3) Designing the third round's closed-ended questionnaire

In the third and final rounds of the survey, policy ideas expressed by the panel members based on the results of previous rounds were corralled towards convergence. The panel members were notified of the summarized survey results, and then were asked for their opinions. In this round in particular, a personal opinion section was added to eliminate the possibility of excluding minority opinions from potential best predictions or solutions, which can happen during written communication.

### 4. Statistics

To analyze and converge the collected expert opinions, frequency analysis and descriptive

statistics analysis were performed using SPSS Ver. 21.0.

### III. Results

#### 1. Results of the first Delphi survey

The first round involved a total of 71 participants: 25 clinical practitioners, 21 educators, and 25 policy-makers. The survey consisted of open-ended questions designed to solicit personal opinions regarding the current education system and curriculum and the current assessment system and method. Following this process, the 2 most prevalent themes for each topic were determined (Table 2).

the clinical practitioner group gave the highest score (3.48), followed by the policymaker group (3.36) and the educator group (3.10). Regarding the level of satisfaction with current class sizes, participants as a whole gave a score of 2.92, lower than the median score of 3 points. In terms of each subgroup's satisfaction level regarding this point, clinical practitioners gave the highest score (3.00), followed by policymakers (2.96) and educators (2.76). Overall, participants ranked their level of satisfaction with the current curriculum with a score of 3.47, higher than the median score. In terms of each subgroup's satisfaction level regarding the same topic, the policymaker group gave the highest score (3.56), followed by the clinical practitioner group (3.48) and the

Table 2. Issues facing current systems

education system and curriculum	
No.1	Adopting digital dentistry (the need to develop teaching materials, etc.)
No. 2	Producing graduates with low professional competency
assessment system and method	
No.1	assessment system and method
No. 2	Producing graduates with low professional competency

#### 2. Results of the second Delphi survey

Responses for the previous round's open-ended questions were analyzed and then categorized into 2 factors and 10 items. In the second round, each item's average satisfaction score pertaining to the previous round's results was examined. As a group, the participants gave a score of 3.32 for their satisfaction regarding the current dental technology education system, higher than the median score of 3 points (fair). In terms of the satisfaction level expressed by each subgroup,

educator group (3.33). Overall, the participants expressed their satisfaction with the current national exam subject, with a score of 3.48, higher than the median score of 3.0 (fair). By subgroup, the highest satisfaction level was found in the clinical practitioner group (3.72), followed by the policymaker group (3.44) and the educator group (3.24). Overall, the participants expressed their satisfaction with the current national exam questions with a score of 3.58, higher than the median score. By subgroup, clinical practitioners expressed

the highest level of satisfaction (3.80), followed by policymakers (3.52) and educators (3.38), (Table 3).

CAM. To increase dental technology graduates' professional competency, the clinical practitioner group and the policy-maker

Table 3. Results of the second survey

Category	Very satisfaction	Satisfaction	Normal	Dissatisfaction	Very dissatisfaction	Total
Current dental technology education system	4.2%	47.9%	29.6%	12.7%	5.6%	100%
Current class sizes	5.6%	21.1%	36.6%	32.4%	4.2%	100%
Current curriculum	5.6%	49.3%	32.4%	11.3%	1.4%	100%
Current national exam subject	5.6%	49.3%	33.8%	9.9%	1.4%	100%
Current national exam questions	5.6%	54.9%	31.0%	8.5%	0%	100%

### 3. Results of the third Delphi survey

In this round, panel members were informed of the results obtained during the previous survey rounds and had the opportunity to converge their final stances, opinions, and suggestions.

#### 1) Education system and curriculum

Among those who reported dissatisfaction with the current education system, members of the clinical practitioner group and the educator group found the duration of clinical training to be the most problematic issue, whereas the policymaker group was most concerned about class size. Among those who were dissatisfied with the programs currently being offered, all 3 groups pointed out that adding more practical courses was the most urgently needed change. In terms of the courses that should be added, the most prevalent response for all 3 groups was the need to prioritize dental CAD/

group predominantly selected the improvement measure “practical training using real-life clinical cases,” whereas the educator group selected “experiencing a variety of clinical cases.”

#### 2) Assessment system and method

When it came to improving the current national exam, all 3 groups said that improving the quality of practical courses was a priority. All 3 groups selected that the most pressing priority for the practical exam portion of the current national exam was to improve the way it is administered. Both the clinical practitioner group and the educator group felt that it was important to prioritize the improvement of practical courses on the complex model, whereas the policy-maker group reported that courses on crown/bridge prosthodontics, dental ceramics, and metal structure fabrication should be prioritized. As

for new practical courses, all 3 groups selected that CAD dental prosthesis design courses should be prioritized.

3) Priorities among improvement measures pertaining to the education and assessment systems

Upon summarizing the survey results and the experts' opinions, the issues facing the current education and assessment systems were identified and possible solutions were suggested (Tables 4 and 5).

#### IV. Discussion

For effective execution of the Delphi survey whose results are considered here, the current work environment in the Korean dental technology industry was reviewed and trends in current and emerging practices were identified; then, existing domestic and international data regarding dental technician competencies were analyzed, and exemplary cases in which education and assessment of dental technology students are closely integrated with one another were considered in order to further discuss the competencies

Table 4. Issues facing the current education system and solutions

issue	suggested improvement measures/policy recommendations
Difference between school and clinical field	<ol style="list-style-type: none"> <li>1. Enforce mandatory adoption of digital dentistry courses, which include CAD/CAM, 3D printing, etc.</li> <li>2. Increase the number of courses pertaining to acquiring skills and knowledge highly demanded on the job, such as implants</li> </ol>
Decreased clinical competency	<ol style="list-style-type: none"> <li>1. Improve certain aspects of clinical training (extend the hours, etc.)</li> <li>2. Actively utilize of clinical models during practical training</li> </ol>
Education/training centering on the national exam	<ol style="list-style-type: none"> <li>1. Improve the national exam</li> <li>2. Actively incorporate current industry practices into the exam</li> </ol>

Table 5. Issues facing the current assessment system and solutions

issue	suggested improvement measures/policy recommendations
Current practices are not adequately incorporated into theory assessment	<ol style="list-style-type: none"> <li>1. Ensure coverage of theory courses pertaining to acquisition of frequently performed skills on the job in the national exam</li> <li>2. Incorporate theory courses pertaining to dental CAD/CAM, 3D printing technology, dental implants, etc.</li> <li>3. It remains to be determined whether courses should be added as stand-alone courses or as part of existing courses</li> </ol>
Inadequate practical exam that fails to effectively assess professional competency	<ol style="list-style-type: none"> <li>1. The current practical exam is overly simplistic. It must be improved so as to allow more holistic assessment of professional competency</li> <li>2. Other countries' practical exams may be used as a benchmark</li> <li>3. The current practical exam does not adequately assess the ability to utilize a variety of dental instruments. Various dental instruments, such as the articulator, must be incorporated into the practical exam</li> </ol>

sought in high-quality dental technicians. The current education system, educational institutes, degree system, and curriculum, as well as assessment goals and changes in the national exam system, were discussed, and a system of educating and cultivating a high-quality dental technician workforce is discussed and reviewed for effectiveness. Expanding on these plans for dental technician education, curriculum, assessment, and methods suitable for the industry's current work environment and practices are suggested as improvement measures that can nurture a stable and high-quality dental technician workforce.

Integration of IT into the dental technology industry is changing the structure of education in this field; it has led to unprecedented advancement in dental technology and is demanding continued evolution. A dental technician's license, which can be obtained by those who complete a 2-, 3-, or a 4-year dental technology program, is a product of the licensing system, designed to verify the graduates' job competency and ensure that they have the knowledge level required in the field of dental technology (Kim et al, 2007). Education and training preparing students for this license are currently being offered at several 3-year colleges (n=16) and 4-year colleges (n=4) nationwide. Although the dental technology education that prepares students for the licensing exam currently covers both theory and practice, it is not clear whether or not it adequately reflects current realities in the industry. Thus, it is necessary to reflect on the progress made in meeting the industry's needs (Lee et al, 2007).

The link between current industry practices

and job skills and the 4 areas of dental technology currently being assessed in the national exam (5 questions on crown/bridge prosthodontics, including dental ceramics; 5 questions on partial dentures; 5 questions on complete dentures; and 3 questions on complex topics) is not as sound as it needs to be. To strengthen it, clinical courses must be made more relevant to current industry practices; furthermore, the current method of assessment, in which the test-taker is asked to take both the written and practical exams, each covering 18 topics, in one day; thus, the exam falls short of adequately assessing the individual's skills, and these exams should be spread out over multiple days. In addition, the current assessment model needs to gradually shift towards a practical exam model like that adopted in many countries, which is more effective at assessing overall job competency than the current model. However, revising assessment items to more effectively evaluate students' skills and/or shifting to a multi-day assessment system would require additional assessment time, which would make it difficult to hold the exams in middle and high school (Nam et al, 2013). Furthermore, because the use of personal alcohol lamps (for sterilization of instruments) at exam sites causes safety issues, utilizing the dental technology labs of local colleges may be considered as an option under the current circumstances, in which the exam is held regionally. In addition, although the use of a dental articulator is not necessary under the current situation, in which exam items are designed to assess only certain aspects of desired professional competencies, revised assessment items in the future may



require articulator to be evaluated also.

## V. Conclusion

The gap between the current educational system and clinical practice, decreased professional competency, and education centering on the national dental technician exam were identified as the main challenges. In terms of the current assessment system, failure to adequately incorporate current clinical practices and a practical exam that falls short of effectively evaluating professional competency were identified as the main concerns.

The current dental technician education and assessment systems should be revised in a way that improves their connection to current clinical practice while also taking into account other relevant circumstances.

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