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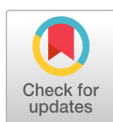
Analysis of liberal arts education based on NCS and K-CESA in dental hygiene

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ABSTRACT

Objectives: This literature review seeks to identify the current status of the liberal arts education of dental hygiene majors offered by universities in Korea and the U.S. and provide a comparative analysis of the data on liberal arts education in both countries. **Methods:** From April 3, 2017 to May 1, 2017, research data on curriculum topics were collected from 60 selected universities. The data were collected from university websites, which also provided the universities' emails and dental hygiene major descriptions. We calculated the descriptive statistics of the variables and performed independent t-tests on the data. **Results:** In all the domains of the NCS and K-CESA, the dental hygiene major currently offers courses on language and communication and general education, focusing on self-management and development. Few universities offer subjects from other disciplines. **Conclusions:** Pro-actively exploring strategies is a prerequisite to the systematic operation of standardized dental hygiene education. It is imperative to conduct research consistently on relevant topics, such as teaching methods, general education standards, and connectivity between major subjects and the goals and effects of exposure to a general education.

Key Words: Dental hygiene, Korea collegiate essential skills assessment (K-CESA), Liberal arts education, National competency standards (NCS)

Introduction

In the twenty-first century, a surge in social networking service (SNS) users has activated the exchange of information. The public's dental knowledge has also matured, as oral health information is more readily available. In addition, dental hygienists, a professional workforce that deals with numerous personalities, need not only oral knowledge but also the virtues of liberal arts, such as personal maturity and ethics. Universities must constantly develop their major educational

programs as well as their liberal arts provisions.

Since the late 1970s, national industry advancements and a growing interest in oral health have resulted in a need for a more specialized dental, medical workforce. Specialized colleges have extended their educational programs from 2 years to 3 years for the specialization of education in dental hygiene since 1994. After the first establishment of a 4-year dental hygiene course, at Yonsei University, Hanseo University, and South Seoul University, followed by opening their own departments in 2003, the number of schools with dental hygiene programs has increased to 26 today [1]. As dental hygiene education continues to grow, it has reached a point when university curriculum needs not only qualitative development in major education but also the systematization of liberal arts education so that professional ethics can be fostered. With the beginning of the fourth industrial revolution, based on artificial intelligence, robots, and 3D printing, a new era has opened in the world of professions. A new educational curriculum is needed to reflect this phenomenon. The field of medicine is drawing attention, and dental hygienists are expected to increase in number by 2.1% annually over the next 10 years [2].

College curricula are generally composed of liberal arts and major education. Although it would be ideal to provide a proper distribution of liberal arts and major education, the current university curriculum emphasizes professional education. Therefore, the proportion of liberal arts education at universities has gradually decreased, and major education (i.e., specialized vocational education) has grown [3]. Likewise, Son and Ji [4] emphasized that liberal arts education at universities has been disproportionately centered on job searching and test preparation, which goes against the educational nature of liberal arts. It is highly likely that students will be trained as workers who simply enter society. However, their education should not be for employment alone. Liberal arts education is currently implemented as a low-level supplement to the major education of students, simply maintaining the basic structure [5]. Today, university liberal arts education is facing several problems. First, there is significant variation in the conditions of liberal arts degrees. Second, although each university has departments or organizations dedicated to liberal arts, it is likely that the lack of continuity across liberal arts programs will reduce the quality of efficient liberal arts education. Third, compared to 4-year universities, specialized colleges may lack a system for liberal arts education, and thus the curriculum may be organized in such a way that it lacks practical applications for liberal arts education [6].

Liberal arts education should provide a scholarly approach for combining the basic knowledge and the character that students need to pursue their dreams in various employment options; they need to learn not only technical skills but also skills related to all other aspects [7]. Future dental hygienists who plan to be active in public and clinical settings must be able to succeed in diverse environments, and therefore they need a liberal arts education to foster a sense of professional ethics, sensitivity, and maturity. One report showed that 4-year programs had higher-quality liberal arts education in their university dental hygiene majors than did the 3-year programs and that there are large variances among universities [8]. However, there is very limited interest in liberal arts education, and research on this topic is lacking compared to that on major or other types of education [9].

Dental hygiene majors categorized into 3- or 4-year programs do not show many differences in major class offerings [10]. Thus, schools are focusing on major education and minimizing the hours spent on liberal arts. Both major classes and liberal arts education are important for controlling the quality of advanced and differentiated dental hygiene education. First, a careful analysis of the current state of university management is needed.

The purposes of this study are as follows. First, we seek to examine the current state of liberal arts education in dental hygiene majors. We identify open credits according to the competency areas defined in NCS and K-CESA and differences in credits based on school year system. Then, we compare classes in the liberal arts education in the dental hygiene majors at American and Korean universities.

Methods

1. Study design

This literature review seeks to identify the distribution of competency areas as defined in NCS and K-CESA in liberal arts education courses in the dental hygiene major offered by universities in Korea and compare the liberal arts education courses in the dental hygiene majors offered at American and Korean universities.

2. Research subjects

Nationwide, 60 of the 82 3- and 4-year universities in Korea have education curriculum data available on their dental hygiene major programs. We investigated the credits of major and liberal arts courses from each of the university curricula. The courses and their credits were excluded if they were available only when a number of student elect to take them or if it was ambiguous whether students actually took them. Then, 8 Korean universities were selected from each district, and 5 U.S. universities that were listed on the American Dental Hygienists Association (ADHA) website were selected for analysis and comparison of the current status of the liberal arts education courses of their dental hygiene departments.

3. Variables

For general characteristics, the school year system and the location of each school were investigated. We used National Competency Standards (NCS)[11] and Korea Collegiate Essential Skills Assessment (K-CESA)[12] as the standards for academic categorization of liberal arts courses. NCS is the national systematization of knowledge, skills, and attitudes required to perform a job. It comprises the following 10 competency areas: communication skills, self-development, technical capability, organizational competence, information ability, interpersonal skills, problem-solving, numeracy, resource management, and professional ethics. Competency refers to the common ability to do a job, and collectively it encompasses the knowledge, skills, and attitudes professionals require to perform their occupations.

K-CESA is a diagnostic tool developed with support from the Korean Educational Evaluation Society and experts under the leadership of the Ministry of Education, Science and Technology, and the Korea Research Institute of Occupational Education and Evaluation. It seeks to help universities strengthen their educational competency by identifying the level of students' essential skills. K-CESA is comprised of a total of 6 competencies.

4. Data collection

From April 3, 2017 to May 1, 2017, out of the 82 universities that operate dental hygiene majors in Korea, we collected data from the 60 that showed their curricula on their websites. We consulted with 2 education experts to categorize the liberal arts education courses collected from each university into the competency areas defined by NCS and K-CESA. Then, we selected 5 U.S. and 8 Korean universities, which have dental hygiene majors and collected data on their education curricula. Liberal arts courses were categorized into mandatory or other.

5. Statistical analysis

The collected data were analyzed with SPSS (SPSS 21.0 for windows, SPSS Inc, Chicago, USA) to calculate the descriptive statistics of the measured variables. Credits for major and liberal education courses by school year system and competency areas of the liberal education courses based on NCS and K-CESA were compared and analyzed with independent t-tests. In addition, the liberal education courses that are open for dental hygiene majors in American and Korean universities were compared.

Results

1. General characteristics

The distribution of school year systems showed that there were more (42) 3-year (70.0%) courses than 4-year (30.0%) courses. By area, the greatest number of universities were in Honam (26.7%), at 16, followed by 14 in Dongnam (23.3%), 12 in Daejeon, Chungcheong (20.0%), 10 in Daekyeong (16.7%), and 8 in Seoul, Gyeonggi (13.3%) <Table 1>.

Table 1. General characteristics of subjects

Characteristics	Division	N	%
School year system	3-year	42	70.0
	4-year	18	30.0
Area	Seoul, Gyeonggi	8	13.3
	Daejeon, Chungcheong	12	20.0
	Daekyeong	10	16.7
	Dongnam	14	23.3
	Honam	16	26.7

2. Comparison of credits for major subjects and liberal arts in the dental hygiene major in 3-year and 4-year programs

<Table 2> shows the comparison of credits for major and liberal arts courses at universities that offer a dental hygiene major according to the school year system. There were significantly more credits available for liberal arts courses in 4-year programs, at 20.94, than there were in 3-year programs, at 13.68 ($p=0.022$). Credits for major courses were higher for 3-year programs, at 100.38, than for 4-year programs, at 97.25. However, the difference was not statistically significant ($p=0.425$).

3. Analysis of liberal arts courses based on NCS and K-SESA by school year system

The distribution among areas was determined by performing a categorization of competencies based on NCS and K-CESA in all liberal arts courses open to dental hygiene majors.

<Table 3> shows the analysis of liberal arts credits based on NCS at each school. The topic of communication skills was the most selected of the 10 competencies by universities and was a part of the liberal arts courses at 50 schools. The number of credits designated for the course varied greatly from university to university, ranging from 2 to 24, and the mean credit was the highest at 5.64. The competency that received the second highest number of credits was self-development; it ranged from 1 to 18 credits, 4.64 on average. Technical capability was next at 4.13 credits on average. Organizational competence was 3.20 credits on average, information ability was 2.56 credits on average, interpersonal skills received 2.50 credits on average, problem-solving was 2.19 credits on average, numeracy was 2.00

Table 2. Comparison of credits in major and liberal arts courses in dental hygiene 3- and 4-year programs
Unit: Mean \pm SD

Characteristics	N	Major	Liberal arts
3-year	42	100.38 \pm 13.94	13.68 \pm 4.71
4-year	18	97.25 \pm 13.54	20.94 \pm 11.16
p^*		0.425	0.022

* by the independent t-test at $\alpha=0.05$

Table 3. Dental hygiene liberal arts credits based on NCS

Characteristics	N	Min	Max	Mean \pm SD
Communication skills	50	2.00	24.00	5.64 \pm 4.05
Self-development	47	1.00	18.00	4.64 \pm 3.71
Technical capability	23	1.00	10.00	4.13 \pm 2.62
Organizational competence	10	1.00	6.00	3.20 \pm 1.55
Information ability	27	2.00	4.00	2.56 \pm 0.80
Interpersonal skills	30	1.00	8.00	2.50 \pm 1.53
Problem-solving	16	1.00	5.00	2.19 \pm 1.05
Numeracy	6	1.00	3.00	2.00 \pm 0.89
Resource management	6	1.00	3.00	1.83 \pm 0.75
Professional ethics	31	0.00	4.00	1.74 \pm 0.89

credits on average, and resource management was 1.83 credits on average. The competency with the lowest number of credits was professional ethics, which was selected by 31 universities; it received credits ranging from 0 to 4 and had 0.89 on average.

The results of analyzing the mean credits by NCS competencies according to school year system, as seen in <Table 4>, show that liberal arts credits for communication skills ($p=0.017$), technical capability ($p=0.015$), and problem-solving ($p=0.015$) were higher in 4-year dental hygiene programs than in 3-year dental hygiene programs.

<Table 5> shows the results of categorizing the courses based on K-CESA. K-CESA is comprised of a total of 6 competencies: Global competence, comprehensive thinking, self-management, interpersonal competency, utilization capability of resource information technology, and communication skills. Self-management was in the highest number of universities and received a range of credits, from 1 to 18 and 5.00 on average. Second, global competence was in 44 universities, with credits ranging from 2 to 20. Similar to self-management, global competence showed a large variance in credit assignment; on average, 4.98 credits were assigned to self-management. Utilization competence of resource information technology was also in 44 universities, like global competence; the mean credit it received was 4.34. Interpersonal competency and communication skills were in the same number of universities (36), but the mean credit for interpersonal competency was 2.61, while for communication skills it was 2.39. Comprehensive thinking was in 16 universities and had the lowest number of credits at 2.31 on average.

Table 4. Comparison of liberal arts credits based on NCS in dental hygiene 3- and 4-year programs
Unit: Mean \pm SD

Characteristics	3-year	4-year	p^*
Communication skills	4.36 \pm 1.66	8.93 \pm 6.18	0.017
Self-development	4.32 \pm 3.31	5.46 \pm 4.67	0.353
Technical capability	3.07 \pm 1.67	6.13 \pm 3.00	0.015
Organizational competence	1.67 \pm 0.58	7.00 \pm 2.83	0.076
Information ability	2.50 \pm 0.80	2.80 \pm 0.84	0.460
Interpersonal skills	2.19 \pm 0.90	4.50 \pm 3.11	0.234
Problem-solving	1.70 \pm 0.48	3.00 \pm 1.26	0.015
Numeracy	1.33 \pm 0.58	2.67 \pm 0.58	0.047
Resource management	1.80 \pm 0.84	2.00 \pm 0.00	0.752
Professional ethics	1.88 \pm 0.83	1.17 \pm 0.98	0.079

* by the independent t-test at $\alpha=0.05$

Table 5. Liberal arts credits based on K-CESA in dental hygiene programs

Characteristics	N	Min	Max	Mean \pm SD
Self-management	53	1.00	18.00	5.00 \pm 3.70
Global competence	44	2.00	20.00	4.98 \pm 3.67
Utilization capability of resource information technology	44	2.00	12.00	4.34 \pm 2.66
Interpersonal competency	36	1.00	8.00	2.61 \pm 1.52
Communication skills	36	1.00	4.00	2.39 \pm 0.80
Comprehensive thinking	16	1.00	5.00	2.31 \pm 1.25

<Table 6> shows the result of analyzing the differences in mean credits appointed among K-CESA competences according to school year system. Credits for global competence ($p=0.006$), utilization capability of resource information technology ($p=0.013$), communication skills ($p=0.008$), and comprehensive thinking ($p=0.017$) were significantly higher in 4-year dental hygiene courses than in 3-year dental hygiene courses.

4. Status of liberal arts courses in the United States

To determine the status of liberal arts courses in U.S. dental hygiene majors, 5 universities from the ADHA website were selected along with 8 Korean universities to compare whether there are liberal arts course correlates between Korea and the U.S., as shown in <Table 7>. According to the Commission on Dental Accreditation (CODA), U.S. liberal arts education must include psychology, communication, and sociology. All 5 universities included all 3 areas in their implementation of liberal arts education. There were 10 or more liberal arts courses offered at each university, which is more than the amount offered at Korean universities. Thus, the proportion of liberal arts courses was found to be relatively larger. The number of major courses in the U.S. was much smaller than the number of major courses in Korean universities, showing that the efficiency of major implementation was higher in the U.S. universities than in the Korean universities. There were few liberal arts courses in common between the Korean and the U.S. universities. English and communication courses are offered in Korean universities, showing that both U.S. and Korean schools deem English and communication to be important.

Table 6. Comparison of liberal arts credits based on K-CESA in dental hygiene 3- and 4-year programs
Unit: Mean \pm SD

Characteristics	N	3 year	4 year	p^*
Self-management	53	4.87 \pm 3.40	5.36 \pm 4.55	0.678
Global competence	44	3.63 \pm 1.70	8.58 \pm 5.05	0.006
Utilization capability of resource information technology	44	3.61 \pm 2.03	6.55 \pm 3.17	0.013
Interpersonal competency	36	2.27 \pm 0.98	4.33 \pm 2.50	0.100
Communication skills	36	2.16 \pm 0.69	2.91 \pm 0.83	0.008
Comprehensive thinking	16	1.67 \pm 0.50	3.14 \pm 1.46	0.017

* by the independent t-test at $\alpha=0.05$

Table 7. Status of Korean and U.S. liberal arts

Division	Subjects*	Korea								U.S.				
		A	B	C	D	E	F	G	H	I	J	K	L	M
C O D A	Psychology					O	O				O	O	O	O
	Introduction to General Psychology					O	O				O	O	O	O
	Introduction to Counseling									O				
	Oral & write communication	O	O	O	O		O					O		
	English	O	O	O	O		O					O		
	English Composition										O		O	
	Academic Writing						O	O						O
	Composition & Rhetoric									O				
	Human Communications	O		O	O	O					O			
	Public Speaking							O			O	O	O	
	Fundamentals of Speech													O
	Sociology											O		
	Human Concerns											O		
	Principles of Sociology									O	O		O	O
	Social and Cultural Issues										O			
	Science in Today's World										O			
	American Government										O			
	Human Behaviors/Social Institutions												O	
	Natural World												O	
	Non-Western Cultures												O	
E. T. C.	General education									O				
	First Year Seminar									O				
	Pacific Seminar											O		
	Capstone Seminar									O				
	Humanities										O			
	Literature										O			
	Humanities									O				
	Critical Thinking	O											O	
	Literary & Intellectual Traditions												O	
	The Study of Fiction, Poetry, Drama													O
	American History										O			
	Western or World Civilization										O			
	Quantitative Skills and Reasoning										O		O	
	College Algebra										O			
	Precalculus										O			
	Elementary Statistics	O					O				O	O		
	Intermediate Algebra									O				
	Engineering										O			
	First Year College Computer Studies										O			
	Computer Literacy	O	O						O				O	
Science	Information Literacy			O	O								O	
	Anatomy & Physiology									O	O	O		
	Medical Microbiology										O			
	Principles of Nutrition										O		O	
	Introductory Biology					O	O		O		O	O		
	Microbiology											O	O	O
	Elementary Human Anatomy and Physiology												O	O
	Applied Nutrition													O
	Elementary Microbiology									O				
	Oral Anatomy and Embryology									O				
	Science sequence (chemistry)										O	O	O	O
	Organic Chemistry					O	O					O		
	Introductory Chemistry for Health Sciences													O

* Liberal arts education in the U.S.

Discussion

As the public's interest in oral health grows, the nation's oral health-related policies also increase. Therefore, it is natural that public curiosity and knowledge about dental hygienists as professionals, are spreading. Local communities increasingly demand not only simple dental knowledge and skills but also ethical and personal maturity from dental hygienists. Therefore, universities that offer dental hygiene majors must provide high-quality education to foster mature dental hygienists.

Various studies have been conducted on dental hygienists' major education in clinical skills, but there is insufficient research on their liberal arts education, which can foster personal and ethical professionalism. Thus, the present study covered aspects of liberal arts education in dental hygiene majors and identified the current status of such courses in Korean universities.

First, the results of the mean credits for liberal arts courses in 3- and 4-year programs in Korea show that the credits were higher in the 4-year programs at 20.94 than those of 3-year programs at 13.68. Won et al. [8] found that there were differences by school year system: 29 credits in 4-year programs and 13.2 credits in 3-year programs on average. The 9-credit difference that we found between the programs may be due to revisions in educational curricula or differences in elective liberal arts courses. Reviewing the proportions of major to liberal arts courses revealed that the credits for major courses were 97.25 for 4-year programs and 100.38 for 3-year programs on average. The 3-year programs offer more credits in majors and much fewer in liberal arts compared to 4-year programs, indicating that 3-year universities are neglecting liberal arts education. Kim et al. [13] found the same results in the ratio of major to liberal arts credits from a structural perspective. Although all nursing schools have transitioned into 4-year programs, they also appear to have a lack of awareness of liberal arts education, similarly to dental hygiene programs. In reality, the Korean universities that boast the employment rates of their graduates every year share the ultimate goal of nurturing their students into the professionals that the industries demand. Thus, it is necessary to evaluate how NCS skills, which the government uses for policymaking, are applied to liberal arts education. When we categorized the liberal arts courses based on NCS, communication skills were offered at the greatest number of universities and were allotted the highest number of credits at 5.64 on average. This result indicates that many universities emphasize communication skills. Likewise, people who actually work in the industry think that interpersonal competency and communication skills are the most important factors [14]. The skills that received the highest to the lowest mean credits were in the following order: communication skills, self-development, technical capability, organizational competence, information ability, interpersonal competency, problem-solving, numeracy, resource management, and professional ethics. However, the Development Committee, which is comprised of departmental professors and industry experts, posits that the essential skills, which are the most important to learn in dental hygiene majors, should be ranked as such: professional ethics, problem-solving, technical capability, communication skills, resource management, organizational competence, interpersonal competency, self-development, numeracy, and information ability [15]. This arrangement contrasts with the educational curricula that

are actually implemented at universities today. The present study found communication skills and self-development to have the largest number of credits. Thus, the research results show a mismatch between the actual implementation of education curricula and the direction that universities desire.

K-CESA refers to the essential skills university students should develop. Most students do not understand or recognize their competences. Therefore, students identify their competences through a K-CESA diagnosis. The findings can contribute to academic advancements and lead to effective results in competency-based education curricula and university course operations in the future [16]. Thus, competencies that cannot be learned in major courses can be obtained by taking liberal arts courses. Communication skills is a necessary competency in dental hygienists, who will face various types of patients in clinical practice. Currently, the focus in the area of communication skills is a foreign language (English). Despite the importance of Korean communication skills as a job competency and in school, it remains excluded [17]. In fact, most foreign language courses that are currently run by the dental hygiene majors are related to English, and classes with the same content are often opened under different course titles. The majority of dental hygiene students are not satisfied with their English education, and students responded that they only experience a slight increase in skills learned from English lectures [18]. The lack of efficiency in the operation of English courses, which account for most of the foreign language options, and the futility of learning English is apparent. Kim [19] also showed a significant difference in the credits for English courses among universities. It may be related to the current study's findings that the credits for NCS communication skills and K-CESA global competence, which include foreign language courses, have a large difference. When categorizing liberal arts courses into many areas to establish a standard of liberal arts education, the credits from one university to the next vary greatly. There was a 22-credit range for NCS communication skills and an 18-credit range for K-CESA global competence. It is difficult to determine the basis for an appropriate number of credits for the liberal arts education required for college graduation, especially when seeking to achieve well-roundedness and general growth as well as major-specific expertise and skills. However, these findings show the need to set the percentage of credits in the liberal arts education by determining a reasonable basis or a standard for calculating the credits at each university [20] in response to the diversity in liberal arts education, which operates under each university's regulations. A clear standard for credits is needed.

Implementing the right direction in education can happen only when education operates according to a clearly defined purpose and understanding of the objectives of liberal arts. However, it is difficult to maintain consistency and operate the educational system because of the diversity of educational ideologies and the directions of each university. It does not suffice to recognize consistency in the purpose of liberal arts education. Different schools express different goals for their liberal arts offerings, and students have difficulties selecting liberal arts courses because of the very large number of options. Therefore, it is unclear which subjects have been opened for students [21]. In contrast, the courses that must be taken are defined by the CODA for U.S. liberal arts education: sociology, psychology, and communication must be completed. All 5 universities in the present study offered courses related to

communication, sociology, and psychology. However, there are no clear standards for liberal arts courses in Korea, and they are distributed in many areas. In the 2 standards reflected in the present study (NCS, K-CESA), there were no areas that were operated by all 60 universities. Self-management (K-CESA) was found at the highest number of universities (53). There is a lack of unity in the liberal arts education dental hygienists receive. Their education should foster professional dental hygienists by forming a clear mission-driven curriculum. Currently, each school follows a different curriculum.

In the case of the United States, each school's curriculum is clear due to the accreditation system. In Korea, the minimum curriculum has yet to be finalized due to the lack of an accreditation system and clarity on essential skills. Major courses focus on a national examination, indicating that they are relatively uniform compared to the liberal arts education currently offered. In the latter case, each school opens a large number of courses that differ from each other, because they are run per each university's mission and focus on essential skills. Thus, an appropriate standard is necessary. Dental hygiene majors, which train professional personnel, are specialized educational institutions and should operate according to a curriculum based on a clear set of essential skills that reflect the specific purpose of the education and goals that are distinct from other departments.

First, it is important to maintain a desirable ratio of major to liberal arts courses. Korean university education comprises mainly major courses. In particular, one piece of evidence is that the major credit requirement for graduation from a 3-year university is higher than that for a 4-year university. Subjects with similar characteristics are not combined, and thus, each school has different credit requirements for the same subject. The ratio of liberal arts to major courses should be raised by advancing criteria for the efficient operation of major courses and credit requirements. The major courses were similar across schools because of the characteristics of the department. A study is needed to identify whether the liberal arts courses currently run in Korea reflect the characteristics of the department.

Second, there is a need for a system for evaluating and certifying dental hygiene education in Korea, in which efforts are constantly undertaken. The essential skills of dental hygienists must be clearly established and the stable establishment and development of dental hygiene education must be ensured. The department must implement its own assessment within dental hygiene majors based on a standard of national dental hygiene education and qualitative improvement in the field.

Third, the study combined the two standards, because each has its own purpose. The courses were categorized considering the characteristics of each sub-area. From NCS, communication skills appeared in 50 universities, self-development was found in 47 universities, professional ethics was in 31 universities, and interpersonal competency was in 30 universities. From K-CESA, self-management was in 53 universities, global competence and utilization capability of resource information technology were in 44 universities, and interpersonal competency and communication skills were in 36 universities. These areas accounted for more than 50% of the 60 universities' courses. The courses were clustered into groups of similar characteristics, such as language and communication, self-management and development, and interpersonal competency. However, not all the schools implemented them, so it is necessary to present areas that can be generally applied.

Fourth, with the increase in interest in the importance of the fourth industrial revolution, the scope of duties for dental hygienists is widening while that of dental engineers is narrowing in the world of dentistry. Ultimately, as dental engineers' work becomes mechanized, their jobs are transitioning into the role of dental hygienists in dental offices. This phenomenon means longer facetime with patients compared to now, which puts dental hygienists in more diverse situations. Digital machines, 3D printing, and one-day systems are becoming increasingly common in the dental industry. For example, traditional dental impressions can cause discomfort to patients, such as a foreign sensation, olfactory irritation, time consumption, and pain. In turn, oral scanners are becoming more popular as digital machines for resolving these shortcomings [22]. Education must reflect this new era, and the current curricula in dental hygiene majors do not account for these new circumstances. There is an important convergence between the two types of courses. Indeed, this study revealed that all universities, except one, were opening courses associated with the fusion and convergence of the field. There was a correspondence with sector 5 and the liberal arts courses of H university. However, the sub-courses did not reflect the current era. It is not only a problem for liberal arts but also for the major curricula.

The discussion points indicate that the liberal arts education of dental hygiene majors needs a general reorganization, as follows. First, in accordance with the CODA, American universities offer a comprehensive education, which is comprised of 4 categories: liberal arts education, biomedicine, dentistry, and dental hygienic science. Korean dental hygiene programs need to construct a comprehensive structure to reset the proportion of major to liberal arts courses. Second, a standard for all schools is needed for Korean liberal arts education. Combining NCS and K-CESA, most schools provide courses on the following three areas: communication skills and language, self-development and management, and interpersonal competency and professional ethics. It is imperative to establish a curriculum that reflects the characteristics of dental hygienists in these 3 areas. Third, clear goals and purposes need to be established for the field of dental hygiene so that the major curricula can define essential skills. Fourth, the curricula must reflect the new era. Universities are lacking courses that reflect the gradually changing characteristics of the times. Specifically, liberal arts education needs to address the fourth industrial revolution, and major education needs to include specific courses on the digitalization of dentistry.

This study is significant in that it provides basic data that support previous studies that were limited. Its comparison of liberal arts education in dental hygiene programs and research on the standards and directions of liberal arts education more broadly highlight the absence of a clear set of essential skills for the field of dental hygiene.

There are a few limitations to this study. First, this study does not cover all dental hygiene programs in Korea, so it is difficult to generalize about the liberal arts education provided across the nation. Second, we did not examine the elective courses that students can select voluntarily, so the results may not be generalizable to all liberal arts courses. Third, because the research was conducted on curriculum data from university websites, the published curriculum may differ from the education that is actually implemented. Finally, the standards for a clear categorization of courses remain unclear, so it was

difficult to categorize the courses. We categorized the data by defining each standard and consulting with experts. To overcome these limitations, a follow-up study could observe the educational curriculum that is actually implemented at each university and review previous studies. Likewise, further research on course classification standards in developed countries may help to clarify standards and increase content validity.

Conclusions

This literature review sought to identify the status of the liberal arts courses and their credits in dental hygiene majors currently offered by universities in Korea, categorize liberal arts courses, and push Korean liberal arts education in a desirable direction. From April 3, 2017 to May 1, 2017, education curricula were collected from the websites of 60 selected universities that offer dental hygiene majors. For each education curriculum, courses were categorized on the basis of the standards of NCS and K-CESA. Then we analyzed the liberal arts and major courses and their credits. Finally, we compared the liberal arts courses from 8 Korean universities with those of 5 U.S. universities.

1. In NCS, communication skills were taught at 50 universities and were given the highest number of credits at 5.64 on average. Second, self-development (4.64 credits on average) was taught at 47 universities. Professional ethics received the lowest number of credits at 1.74 on average, and a total of 31 universities provided courses on the topic. Numeracy and resource management were taught at the fewest number of universities (6 each).

2. In K-CESA, in first place, self-management (5.00 credits on average) was taught at 53 universities. Next, global competence averaged 4.98 credits and was offered at 44 universities. Comprehensive thinking had the lowest number, averaging 2.31 credits, and was taught at the fewest universities (16).

3. Eight Korean universities (3- and 4-year) were selected. Their liberal arts courses were categorized on the basis of NCS and K-CESA for comparison. Communication skills and self-development in NCS as well as global competence, self-management, and utilization capability of resource information technology in K-CESA were offered at all universities. When we categorized the courses based on K-CESA, we found that the eight universities applied most of the areas.

4. According to the CODA, American dental hygiene programs must include communication, psychology, and sociology courses. All five universities provided liberal arts education that included those 3 areas. In contrast, 2 of the Korean universities offered psychology courses, 7 had communication classes, and none taught sociology.

The results of this study indicate that there are no clear regulations or standards for the liberal arts education of Korean dental hygiene programs. The lack of unity in liberal arts education and clarity in goals makes it difficult to research the field. Furthermore, previous studies have focused heavily on major education, placing importance only on the skills and knowledge required to be a dental hygienist. There is insufficient liberal arts education, and it is needed to foster basic morals, ethical behavior, and consciousness. Thus, universities must recognize the necessity of liberal arts education, broaden their

perceptions, and encourage their students to participate in various clinical practices as professionals. They must provide their students not only with the special knowledge and skills required of a dental hygienist but also morals and ethical consciousness. Enabling a more systematic operation of dental hygiene education is necessary, and it requires continuous research on creating continuity between major courses and the goals and desired effects of liberal arts education, teaching methods, and the establishment of standards and future plans.

Conflicts of interest

The authors declared no conflict of interest.

AUTHORSHIP

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