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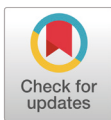
Association between interpersonal relationships and 4C (communication, critical thinking, collaborative self-efficacy, and creative problem-solving) core competencies of dental hygiene students

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ABSTRACT

Objectives: This study aimed to investigate the association between interpersonal relationships and the 4C core competencies of dental hygiene students. It also examined how interpersonal competence can be enhanced by the development and application of programs so that the 4C core competencies of university students can be improved. **Methods:** A survey was conducted from March to May 2019 on students from the Department of dental hygiene in Busan, South Korea, and 177 valid responses were analyzed. The general characteristics of the students were calculated using frequency and percentage, and their degree of 4C core competencies and interpersonal abilities were expressed as means (\pm standard deviation). Multiple regression analysis was used to analyze the effects of interpersonal competence on the 4C core competencies. **Results:** The findings revealed the factors affecting the 4C core competencies as; (a) communication ability was affected by interpersonal cognition and confidence building; (b) critical thinking ability was affected by person-oriented, self-expression, and confidence building; (c) creative problem-solving ability was affected by self-confidence, person-orientation, self-expression, and confidence building, and (d) cooperative self-efficacy was affected by person-oriented and confidence building. **Conclusions:** Based on the above findings, it is necessary to develop systematic program items and education systems that can effectively develop interpersonal competency, and thereby improve 4C core competencies among students.

Key Words: Collaborative self-efficacy, Communication, Creative problem solving, Critical thinking, Interpersonal abilities

Introduction

The college life of a student is a period of transition from being a minor to becoming an adult. Although most of the physical growth of an individual is complete by then, there is much immaturity in the economic, social, and psychological aspects of their development [1]. It is also the most confusing period of life cycle developments. If one fails to develop intimate and efficient interpersonal relationships, it can result in psychological confusion, such as feelings of isolation or emptiness. College students entering the early stages of adulthood have to experience various aspects of a new environment, form relationships with one another, and communicate with each other [2]. In other words, students do not learn the skills for improving interpersonal relationships through entrance examinations, before joining a university, neither do they have opportunities to build various types of human relations naturally as they are under the care of their parents, mostly in a nuclear family [3]. The overall satisfaction or dissatisfaction of university students can also have an impact on their social life after graduation [1]. Unsatisfactory university life can cause mental and social problems due to feelings of isolation and lack of companionship, loss of interest in studying, and poor sexual performance, thereby posing a negative influence on society by impairing an individual's potential.

Because the fourth Industrial Revolution era is an intelligent information society, it is expected that many changes will occur in education to cultivate the necessary educational competency at this moment. Recently, in various countries such as Australia, Canada, and New Zealand, trying to new education methods in preparation for the intelligent information society, in order to restructure the centered curriculum on the future core competency. In Korea, the concept for core competency was partially reflected in the 2015 centered curriculum [4]. Also, the basic vocational skills required in the health sector are mentioned as communication skills, problem solving skills, and interpersonal relations skills [5]. In university education, communication skills are not only very important to improve core competencies, but also influence the formation of interpersonal relationships. Therefore, it is necessary to develop a systematic 4C education program.

The core competencies needed for the Fourth Industrial Revolution era are represented by the 4C, which includes communication, critical thinking, collaborative self-efficacy, and creative problem-solving [4]. Communication is a dynamic and complex function involving the exchange of one's thoughts with that of another and simultaneously accepting and conveying one's own message. Among college students, communication skills are essential for effective learning satisfaction [2].

Critical thinking involves determining the logical structure and meaning of content and making the best judgment after considering the evidence, methods, etc. regarding actions to be taken [6]. Studies have found that college students believed that opportunities for critical thinking arise when they were given problems that allowed them to think and seek for solutions in the course of their work [7]. Furthermore, dental hygienists must possess high critical thinking in clinical hygiene work to have the required objectivity to solve problems and influence quick and efficient decision-making. Creative problem-solving skills is an important skill to be honed through college education leading to the ability to resolve problems and adapt to changes [8]. Since most students majoring in dental hygiene work as

dental hygienists in clinical practice, it is important that they have problem-solving skills to resolve patient problems. Collaborative self-efficacy refers to a learner's personal belief in his or her ability to successfully perform team-specific tasks that contribute to performing cooperative activities. Classes of college students actively participate in group activities to achieve their goals and increase their self-efficacy when they play their part [9]. Future dental hygienists would need to have a high level of self-efficacy in dental hygiene activities for effective patient management.

Previous studies on college students have not fully explored the relationship between interpersonal ability and 4C core competency although there have been studies on the relationship among communication ability, critical thinking ability, self-efficacy, and problem-solving ability [7]. In addition, in order to maintain close relationships with others, it is important to build interpersonal relationships, as university students are required to communicate and cooperate by participating in various teaching methods.

The purpose of this study is to understand the relationship between college students' interpersonal relationship skills and 4C core competency. We intend to communicate and cooperate through teaching methods that can cultivate 4C core competencies in school education. In addition, it is intended to be used as basic data to prepare classes or programs that can improve interpersonal skills.

This study was aimed to investigate the association between interpersonal relationships and 4C (communication, critical thinking, collaborative self-efficacy, and creative problem-solving) core competencies of dental hygiene students.

Methods

1. Participants

The survey questionnaire was distributed to only those who agreed to participate in the survey, and 177 valid responses from 200 questionnaires were collected from March 4 to May 30, 2019 (IRB No. 1041449-201902-HR-004). The subject sample size was derived from Cohen's power analysis using G^* power 3.1.3, and the minimum sample size required was 177 persons under conditions of significance level 5% (both sides), statistical power 80%, and effect size of 0.15, but 200 persons were examined considering the dropout rate.

2. Study methods

Among the 4C core competencies, to measure communication ability and creative problem-solving ability tools developed by Lee et al. [10], which comprised 49 and 45 questions, respectively, were used. Critical thinking was measured using a tool developed by Yoon [11] and it consisted of 27 questions. The content of the critical thinking ability variable questionnaire was organized in a sound meeting with intellectual fairness, objectivity, systematicity, prudence, intellectual passion, and confidence.

Collaborative self-efficacy variables were measured using a tool developed by Alavi and McCormick [12] comprising 19 questions. The content of the questionnaire on cooperative self-efficacy variables consisted of opinion integration, opinion evaluation, opinion exchange, and leadership exercise.

Interpersonal ability variables were measured by a tool developed by Park et al. [13], which had 33 questions. The score for each item was to be marked on a 5-point Likert scale. The content of the questionnaire on interpersonal ability variables was confidently composed of person-oriented, self-expression, interaction, and trust formed.

Cronbach's alpha for each item was as follows: communication skills 0.856, critical thinking skills 0.885, creative problem-solving skills 0.893, cooperative self-efficacy 0.910, interpersonal skills, the reliability coefficient of 0.800 to 0.812 showed a high internal consistency.

3. Data analysis

Collected data were analyzed using the IBM SPSS statistics version 25.0 (IBM Corp, Armonk, USA) program and tested at the significance level of 0.05. The general characteristics of dental hygiene students were calculated in terms of frequency and percentage. Multiple regression analysis was used to analyze the effects of interpersonal competence on the 4C core competencies. As a result of diagnosing multicollinearities in order to judge the suitability of the independent variables input to the regression analysis, the VIF coefficients of all the factors are displayed below 10 which is the criterion for collinearity judgment. It turned out that there was no problem of multicollinearity.

Results

1. General characteristics

<Table 1> shows the general characteristics of the study subjects. Females comprised 96.0% of the subjects; 56.5% were in the 3rd grade and 43.5% in the 2nd grade.

Table 1. Characteristics of the subjects

Characteristics	Division	N (%)
Gender	Male	7 (4.0)
	Female	170 (96.0)
Grade	2	77 (43.5)
	3	100 (56.5)
Total		177 (100.0)

2. 4C Core competence and interpersonal ability of dental hygiene students

<Table 2> shows the 4C core competencies and interpersonal abilities of dental hygiene students. Among them, critical thinking ability was the highest at 3.43 points, creative problem-solving ability 3.42 points, cooperative self-efficacy 3.41 points, and communication ability 3.18 points. Interpersonal competence was 3.25 points, and among other sub-factors of interpersonal ability, person-oriented was the highest at 3.95 points, followed by self-expression 3.88 points, trust formed 3.33 points, interaction 3.18 points, and confidence 2.18 points.

Table 2. 4C Core competence and interpersonal ability of dental hygiene students

Variables	Division	Mean ± SD
4C	Communication	3.18 ± 0.97
	Critical thinking	3.43 ± 0.41
	Creativity problem solving	3.42 ± 0.32
	Collaborative self-efficacy	3.41 ± 0.45
Interpersonal abilities	Confidence	2.18 ± 0.71
	Person-oriented	3.95 ± 0.49
	Self-expression	3.88 ± 0.57
	Interaction	3.18 ± 0.67
	Trust formed	3.33 ± 0.66
Total		3.25 ± 0.35

3. Impact of interpersonal skills on communication skills

The sub-factors of interpersonal competence on communication ability are shown in <Table 3>. Multiple regression model explaining communication ability was statistically significant ($F=15.193$, $p<0.001$) with 29.7% explanatory power. The significant predictors of communication ability were person-oriented ($p<0.01$) and trust formed ($p<0.001$).

Table 3. Impact of interpersonal skills on communication skills

Independence variables	B	S.E	β	t	VIF
Constant	1.910	0.220		8.677 ^{***}	
Confidence	-0.039	0.036	-0.093	-1.074	1.780
Person-oriented	0.144	0.052	0.237	2.752 ^{**}	1.776
Self-expression	0.054	0.045	0.102	1.204	1.720
Interaction	0.015	0.037	0.034	0.413	1.600
Trust formed	0.160	0.031	0.354	5.075 ^{***}	1.162

Dependent variable: communication skills, ^{**} $p<0.01$, ^{***} $p<0.001$

$F=15.193$, $p<0.001$, Adjusted $R^2=0.297$

Data were analysed using multiple regression analysis.

Variables that are not statistically significant ($p>0.05$) are not shown.

4. The effect of interpersonal ability on critical thinking ability

The sub-factors affecting critical thinking ability are as shown in <Table 4>. Multiple regression model explaining critical thinking ability was statistically significant ($F=19.283$, $p<0.001$), and it had 35.1% explanatory power. Predictive factors of critical thinking ability were person-oriented ($p<0.001$), self-expression ($p<0.05$), and trust formed ($p<0.01$).

Table 4. The effect of interpersonal ability on critical thinking ability

Independence variables	B	S.E	β	t	VIF
Constant	1.082	0.287		3.774 ^{***}	
Confidence	0.034	0.047	0.059	0.726	1.699
Person-oriented	0.323	0.071	0.391	4.521 ^{***}	1.943
Self-expression	0.151	0.061	0.206	2.451 [*]	1.847
Interaction	0.014	0.047	0.023	0.303	1.517
Trust formed	0.110	0.041	0.183	2.707 [*]	1.188

Dependent variable: critical thinking ability, ^{*} $p<0.05$, ^{**} $p<0.01$, ^{***} $p<0.001$

$F=19.283$, $p<0.001$, Adjusted $R^2=0.351$

Data were analysed using multiple regression analysis.

Variables that are not statistically significant ($p>0.05$) are not shown.

5. The effect of interpersonal ability on creative problem solving ability

The sub-factors that influence the creative problem-solving ability of the lower factors of interpersonal relations are as shown in <Table 5>. Multiple regression model that explained creative problem-solving ability was statistically significant ($F=21.210$, $p<0.001$), and it had 37.1% explanatory power. It was found to be person-oriented ($p<0.001$), self-expression ($p<0.001$), and trust formed ($p<0.01$).

Table 5. The effect of interpersonal ability on creative problem solving ability

Independence variables	B	S.E	β	t	VIF
Constant	1.278	0.232		5.507 ^{***}	
Confidence	0.098	0.038	0.208	2.602 ^{**}	1.744
Person-oriented	0.224	0.055	0.333	4.055 ^{***}	1.830
Self-expression	0.179	0.046	0.316	3.907 ^{***}	1.775
Interaction	-0.012	0.037	-0.024	-0.318	1.503
Trust formed	0.116	0.033	0.235	3.543 ^{**}	1.199

Dependent variable: creative problem solving ability, ^{**} $p<0.01$, ^{***} $p<0.001$

$F=21.210$, $p<0.001$, Adjusted $R^2=0.371$

Data were analysed using multiple regression analysis.

Variables that are not statistically significant ($p>0.05$) are not shown.

6. The effect of interpersonal ability on cooperative self-efficacy

The factors affecting cooperative self-efficacy of the sub-factors of interpersonal competence are as shown in <Table 6>. Multiple regression model explaining cooperative self-efficacy was statistically significant ($F=15.289$, $p<0.001$) with 29.3% explanatory power. The significant predictors of cooperative self-efficacy were person-oriented ($p<0.05$) and trust formed ($p<0.001$).

Table 6. The effect of interpersonal ability on cooperative self-efficacy

Independence variables	B	S.E	β	t	VIF
Constant	1.724	0.334		5.168 ^{***}	
Confidence	-0.031	0.054	-0.048	-0.568	1.711
Person-oriented	0.207	0.080	0.224	2.599 [*]	1.807
Self-expression	0.124	0.068	0.154	1.819	1.754
Interaction	-0.088	0.054	-0.129	-1.624	1.541
Trust formed	0.223	0.048	0.322	4.658 ^{***}	1.162

Dependent variable: cooperative self-efficacy, ^{*} $p < 0.05$, ^{**} $p < 0.01$, ^{***} $p < 0.001$

F=15.289, $p < 0.001$, Adjusted R²=0.293

Data were analysed using multiple regression analysis.

Variables that are not statistically significant ($p > 0.05$) are not shown.

Discussion

This study identified the relationship between students' interpersonal skills and their communication skills, critical thinking skills, collaborative self-efficacy, and creative problem-solving abilities.

In this study, the interpersonal ability of dental hygiene students was found to be 3.25 points, critical thinking ability was the highest at 3.43 points among 4C core competencies, creative problem-solving ability 3.42 points, cooperative self-efficacy 3.41 points, and communication ability was 3.18 points.

In the Bak [14] study, the communication ability score of nursing students was 3.93 points, and the communication and interpersonal ability scores of Na and Na [1] college students in nursing and health were 3.39 and 3.38 points, respectively. These were higher than the results of this study. Communication is the most important basic skill required for dental hygienists to become professional dental hygienists. In addition, interpersonal competence was reported to be significantly different in major satisfaction and clinical practice satisfaction [15]. Interpersonal skills are also expected to have a positive effect on class participation.

Factors affecting communication ability were interpersonal orientation ($p < 0.01$) and confidence building ($p < 0.001$). In the study by Bak [14], the factor influencing interpersonal relationships among nursing students was communication ability, which showed similar results. Interpersonal relationships provide a fundamental understanding of the causes of conflict within groups in terms of communication and play an important role in resolving group conflicts. In addition, the improving interpersonal skills of nursing college students was inextricably linked to improving the quality of nursing service [16]. Also reported that dental hygienists interpersonal and communication skills are associated with work and job satisfaction [17].

Therefore, interpersonal competence has long-term consequences, and hence, it is necessary to develop a variety of teaching-learning strategies and interpersonal competency improvement programs in university education and to systematically and continuously manage interpersonal competence.

Factors affecting critical thinking ability were interpersonal orientation ($p<0.001$), self-expression ($p<0.05$), and confidence building ($p<0.01$). Building critical thinking skills requires opportunities for finding and thinking about problems and resolving them [7], as well as sharing them with others with whom one has good interpersonal relationships. Factors affecting creative problem-solving ability were self-confidence ($p<0.05$), person-oriented ($p<0.001$), self-expression ($p<0.001$), and confidence building ($p<0.01$). Son's [3] research showed that interpersonal relationships among college students had a positive effect on their problem-solving ability. When college students find difficulties in problem solving, it has been found that they tend to work alone or avoid solving the problem if they do not have interpersonal skills [3]. Therefore, program must be developed to facilitate interpersonal relationships among college students so that they learn to express their opinions confidently and to build confidence in others. This would help them in the problem recognition, problem analysis, and the problem-solving processes. In addition, improving interpersonal abilities of dental hygiene students can have a significant effect on improving the quality of their future dental hygiene service.

Factors affecting cooperative self-efficacy were interpersonal orientation ($p<0.05$) and confidence building ($p<0.001$). Self-efficacy is developed when students actively participate in achieving their goals and fulfill their roles in a given environment [9]. In addition, group teaching, as one of the teaching and learning methods, will help students share learning through discussion, thereby increasing their level of cooperative self-efficacy by organizing and evaluating group members' opinions [7]. Hence, there is a need for skills and quality education in interpersonal relationships. Furthermore, Dental hygienists will most likely have time to share opinions through discussions with members of the organization to solve problems and share opinions by team. In other words, it is believed that it will have a positive effect on the core competencies required in the 4th Industrial Revolution only when the interpersonal skills are smoothly implemented.

This study also has its own limitations in that there is a limit to generalizing the results of the random sampling since we only considered students of dental hygiene from some parts of Busan. Subsequent research will need to expand the area and research subjects, and it will be necessary to develop and apply interpersonal skills improvement programs and to clarify their causal relationship to 4C core competencies.

Conclusions

1. For a smooth approach to develop interpersonal skills among college students, various teaching methods and programs must be implemented to improve 4C core competencies within the school.
2. By developing a sense of trust in others through effective communication and cooperation, efficient work can be achieved. Furthermore, improving the interpersonal ability of dental hygiene students will have a positive effect on the quality of their dental hygiene services.
3. This study suggests that interpersonal competence is a factor affecting communication ability, critical thinking ability, creative problem-solving ability, and cooperative self-efficacy.

4. Interpersonal competence was a factor influencing 4C core competencies, this study aimed to provide basic data for developing systematic programs and education systems that can effectively develop interpersonal competency and 4C core competencies.

Conflicts of Interest

The authors declared no conflict of interest.

Authorship

Conceptualization: JS Kim; Data collection: JH Lee; Formal analysis: KA Jang; Writing - original draft: KA Jang; Writing - review & editing: KA Jang, JH Lee, JS Kim

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