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Analysis of Domestic Research Trend in Self-Leadership Found among NURSING Students in Republic of KOREA

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Abstract

Purpose; The purpose of this study was to analyze papers on the self-leadership of nursing students, which were included in domestic academic journals over the past 15 years, in an attempt to determine the research trend. Methods: This is a descriptive research study that analyzed 41 papers included in domestic academic journals over the past 15 years(2003-2018). Results: The studies related to the self-leadership of nursing students numbered five(12.2%) between 2009 and 2014 and 36(87.8%) between 2015 and 2018. As to the distribution of the papers by journal, 10 papers(24.3%) that were largest in number were included in the Journal of Korea Academia- Industrial Cooperation Society. Concerning variables related to self-leadership, critical thinking disposition was a major variable that was covered in 10 papers(24.3%) that were largest in number, and another major variable was self-efficacy that was covered in seven(17.5). As a result of analyzing the papers by research method, every study was quantitative research that numbered 41(100%). Out of them, the descriptive research studies were most common, and the experimental studies numbered 17(17.0%). In regard to sample size determination, G*Power was used the most in 31 papers(75.6%). Regarding institutional review board, eight(19.5%) out of the 41 papers were implemented with the approval of IRB. As for data analysis in the studies using descriptive statistics, t-test was used mainly in 35 papers(85.3%); ANOVA, in 26(63.4%); Pearson correlation coefficient, in 26(63.4%). In the experimental studies, x2-test was dominant, which was used in 10 papers(24.3%) . Conclusion: The findings of the study are expected to provide some information on how to nurture the self-leadership of would-be professional nurses to step up their competency development to affect their clinical performance in a positive way and on how to set the right directions for the development of nursing to make a contribution to the improvement of the quality of nursing.

[Keywords] *Nursing Students, Self-Leadership, Domestic Research Trend, Analysis, In Republic of Korea*

1. Introduction

A core task in college years for successful entry into society is to lay the foundation for growth by building one's own identity and by making the right career choice[1].

Due to the relatively high employment rate, many nursing college students had their sights set on finding a job easily or economic stability when they chose their major, instead of taking their own aptitude and interest into account or carefully considering what major they should choose[2]. Moreover, they think they have already chosen their occupation as soon as they enter college, and they just follow the typical path toward hospital employment without discreetly deliberating on their career or attempting to approach it in diverse ways[3].

The goal of nursing education is to teach nursing students to be equipped with the core competencies that are necessary to

perform their roles well as professional nurses after graduation[1]. Leadership is defined by Korea Institute for Curriculum and Evaluation(2013) as one of the core nursing competencies that nursing students should have before they graduate. In order to properly respond to and cope with the situations they face during clinical practice, they are in need of self-leadership that features autonomy which stimulates oneself to exert leadership from within, not the existing kind of leadership that is disposed to be heteronomous[2].

Self-leadership, which is an autonomous leadership, can be said to mean an influence that organizational members wield on themselves to motivate them to perform their duties and carry out instructions. That is, it can be said that it refers to the kind of leadership that makes one take the initiative in himself or herself[4]. As the recent advancement of medical technology has heightened expectations for medical services, the members of a nursing organization is definitely required to develop their leadership, and self-leadership that can lead to successful problem solving or creative job performance is increasingly emphasized[5].

In particular, it's quite critical for nurses to have good relationships with people around them because their occupation is to deal with humans. Relationships with patients, caregivers and doctors and relationship building in the nursing organization are direct causes of stress, tension and anxiety, and furthermore, these things may provoke turnover. So leadership is one of the crucial competencies for nurses to have to improve their occupational adjustment and quality of life[4]. It's reported that self-leadership is linked to nursing performance, and that better self-leadership is followed by better nursing performance[6][7][8].

Han & Yu[9] argued that when self-leadership is better, there are less stress, less tension and less anxiety that are caused by relationships with patients, caregivers and doctors and by relationship building in the nursing organization, and that what's more, turnover may be decreased. Thus, self-leadership is one of the vital competencies that nurses should have to ensure their

successful occupational adjustment and quality of life.

Indeed, self-leadership enables nursing students to achieve results by mapping out a higher-level employment strategy and by learning with interest. That encourages them to be more satisfied with their department, to be responsible for themselves and to pursue their goal with autonomy and enthusiasm[8]. Self-leadership has such a great positive impact on personal growth and assists college students in improving their competencies. Therefore lots of research efforts should be channeled into that from diverse angles. An analysis of domestic research trend is one of the ways to extend the sphere of the body of knowledge in a discipline, and it is said to be of great importance to analyze earlier studies, synthesize the findings, confirm the accumulated knowledge and explore the right directions for future research and for the creation of a new body of knowledge[7]. As no analytic research on the self-leadership of nursing students has yet been implemented, it will be of use for the development of future self-leadership research when studies of self-leadership that is part of leadership are analyzed in a synthetic and systematic way to inquire into the research trend. This study was implemented to analyze the trend in studies on the self-leadership of nursing college students presented in our country between 2000 and July of 2018 according to the selected classification criteria in order to discuss what implications the studies would have for future challenges and the right directions for research into the self-leadership of nursing students.

Purpose

The purpose of this study was to analyze the trend in domestic studies on the self-leadership of nursing students and to suggest some of the right directions for future research. To be specific, the purpose of the study was three-fold:

1. Analyze the types of domestic studies on the self-leadership of nursing students by year and the research designs of the studies by research type.

2. Investigate the concepts, instrumentation and analysis methods of the studies.

3. Suggest some of the right directions for research into the self-leadership of nursing students in the future.

2. Experimental Methods

2.1. Research design

This study is a descriptive research to analyze the research trend in papers whose themes were related to the self-leadership of nursing students.

2.2. The subjects and data collection

41 papers were analyzed, which were found to have been presented in our country between 2003 and July of 2018 and were related to the self-leadership of nursing students. As for the retrieval of the papers, Korea Education and Research Information Service, the National Assembly Library, Korean Studies Information Service System, the National Digital Science Library and the databases of academic journals that were under the umbrella of Korean Society of Nursing Science including the Journal of Korean Academy of Nursing were used to do searches by words that were self-leadership, the self-leadership of nursing students, the leadership of nursing students and nursing self-leadership.

The papers that were discovered were analyzed to find out about their sources, subjects, intervention methods and findings. Among the papers, the papers whose original texts were impossible to collect were excluded.

2.3. Data analysis

The collected papers were classified and analyzed according to the research trend analysis of You, So and Kim[10], and the analysis method was modified and complemented in part by this researcher as occasion demanded.

1. As for the time for the implementation of the research, the studies were divided by five-year time period depending on when they were conducted, and the types of the studies were classified again by the types of the journals that carried them.

2. In regard to research design, the studies were classified into quantitative research, qualitative research and other research. The quantitative studies were classified into two: the studies of experimental design and those of non-experimental design, and the studies of non-experimental design were classified into research studies and other studies.

3. The major concepts, related concepts, specific designs, analysis methods and instruments that were used in the studies were all analyzed.

3. Results

3.1. The type of the studies by year

There were no papers on research into the self-leadership of nursing students before 2003. Five studies(12.2%) were carried out be-tween 2009 and 2014, and there has been a rapid increase in the number of the studies since 2015, as 36 studies(87.8%) were con-ducted between 2015 and 2018 <Table 1>.

Table 1. The types of the studies by publication year(n=41).

Variable	Category	n	%
Publication year	2003 <	0	0
	2009-2014	5	12.2
	2015-2018	36	87.8

3.2. The distribution of the papers by journal

As for the distribution of the papers by journal, there were 10 papers(24.3%) from the Journal of Korea Academia-Industrial Cooperation Society; eight(19.5%), from the Journal of Korea Nursing Education Association; four(9.75%), from the Journal of the Korean Data Analysis Society; three(7.3%), from the Journal of the Kore-an Academy of Nursing Administration; two(4.87%),

from the Journal of Digital Convergence; two(4.87%), from the Korean Journal of Health Service Management; two(4.87%), from the Journal of Korea Entertainment Industry Association; two(4.87%), from the Journal of Korea Academy of Psychiatric Mental Health Nursing, and one each(2.4%), from the Journal of Korea Wellness Society, the Journal of Basic Nursing Academy, the Journal of Ewha Women's University Nursing Academy, the Journal of the Korean Society of Nursing Science, the Journal of the Korean Society of Clinical Health Science, the Journal of Korea Contents Association, the Journal of the Korean Society of Clinical Health Science, the Journal of the Korean Society of Humanities and Sociology, the Journal of East-West Nursing Research Institute, the Journal of Health Informatics and Statistics, and Traffic Culture Research <Table 2>.

Table 2. Type of research according to published journal(n=41).

Varia-ble	Category	n	%
Pub-lished jour-nal	- Journal of Korea Academia-Industrial Cooperation Society	10	24.3
	- Journal of Korea Nursing Education Association	8	19.5
	- Journal of the Korean Data Analysis Society	4	9.75
	- Journal of the Korean Academy of Nursing Administration	3	7.3
	- Journal of Digital Convergence - The Korean Journal of Health Service Management - Journal of Korea Entertainment Industry Association	2	4.87
	- Journal of Ewha Women's University Nursing Academy - Journal of Korea Wellness Society - Journal of Basic Nursing Academy - Journal of the Korean Society of Nursing Science - Journal of the Korean Society of Clinical Health Science - Journal of the Korean Society of Clinical Health Science - Journal of the Korean Society of Humanities and Sociology - Journal of East-West Nursing Research Institute - Journal of Health Infomatic and Statistics Traffic Culture Research	1	2.4
		41	100

3.3. Analysis by research theme

The themes of the studies were analyzed by selecting research variables based on titles and keywords that were presented in the literatures, and 45 theme words that repeatedly appeared in the studies were extracted <Table 3>. Concerning the distribution of variables related to self-leadership, critical thinking disposition was covered in 10 studies(25%); self-efficacy, in seven(17.5%); stress over clinical practice and view of the nursing profession, in four each(10%); interpersonal relationships, satisfaction with college life, career decision-making self-efficacy, and college adjustment, in three each(7.5%);

stress- coping skills, academic self-efficacy, self-directed learning, ego-resilience, empowerment, clinical performance, problem-solving skills and ego-identity, in two each(5%): other, in one(2.5%) <Table 3>.

Table 3. The types of the studies by keyword(n=41).

Varia-ble	Category	n	%
The types of research by keyword	Critical thinking disposition	10	24
	Self-efficacy	7	17
	Stress over clinical practice, Satisfaction with clinical practice, View of the nursing profession	4	10.0
	Interpersonal relationships, Career decision-making self-efficacy, College adjustment	3	7.5
	Academic self-efficacy, Stress-coping skills, Clinical performance, Satisfaction with college life, Self-directed learning, Ego-resilience, Empowerment, Problem-solving skills, Ego-identity	2	4.8
	Decision-making style, Confidence performance, Personality traits, Career preparation behaviors, Career decision level, Professor-teacher interactions, Positive emotions, Perceived career barriers, Empathy skills, Mentoring experience, Self-leadership, Learning awareness, Information literacy, Emotional intelligence, Resilience, Leadership life skills, Self-esteem, Professional self-concept, Mental health, Self-esteem, Communicative competency, Nursing performance, Meta-cognition, Achievement functions, Learning flow, Debriefing satisfaction, Self-exposure, Employment stress	1	2.4

3.4. Analysis by research design

As a result of analyzing the papers ac-cording to the selected research method, the quantitative studies numbered 41(100%). Every study was quantitative research. Among these studies, 34 studies(82.9%) that were non-experimental research were descriptive research studies that were largest in number, and the experimental studies numbered 17(17.0%) <Table 4>.

As to the descriptive research studies, the research studies numbered 29(70%), which was the largest number. Among the experimental studies, nonequivalent control group pretest-posttest experimental design was used in four(9.7%) that were largest in number.

In terms of measurement, no studies reported validity, and five studies(12.1%) reported reliability. The sample sizes were determined by G*Power in 31 studies(75.6%), which was the most common case. As to institutional review board, eight(19.5%) out of the 41 papers received the IRB approval. Concerning data analysis in the studies using descriptive statistics, t-test was mainly carried out in 35 studies(85.3%); ANOVA, in 26(63.4%); Pearson correlation coefficient, in 26(63.4%); Scheffe test, in 20(48.7%). In the experimental studies, $x2$-test was used a lot in 10 studies(24.3%); paired t-test, in three(7.3%); Fisher's exact test, in three(7.3%); Sobel test, in three(7.3%).

Table 4. The types of the studies by design(n=41).

Variable	Category		n	%
Research type		Descriptive research study	34	82.9
		Experimental study	7	17.0
Research design	Descriptive research study	Research study	29	70
		Descriptive causal relationship study	1	2
		Path analysis	1	2
		Mediation analysis	3	7.3
	Experimental study	Nonequivalent control group pretest-posttest experimental design	4	9.7
		Control group pretest-posttest time series experimental design	1	2
		Nonequivalent pretest-posttest quasi-experimental design	1	2
		Nonequivalent control group posttest design	1	2
Measurement		Validity Reported	0	
		Reliability Reported	5	12.1
Sample size determination		G*Power	31	75.6
		Cohen power analysis	2	4.8
		Parameter estimation	1	2
Institutional Review Board; IRB		Yes	8	19.5
		No	0	
Data analysis	Descriptive statistics	t-test	35	85.3
		ANOVA	26	63.4
		Correlation	1	2
		Regression	1	2
		Logistic regression	1	2
		Duncan test	7	17
		Multiple regression analysis	3	7.3
		Independent t-test	6	14.6
		Path analysis	1	2
		Pearson correlation coefficient	26	63.4
		Hierarchical regression analysis	3	7.3
		Scheffè test	20	48.7
		One-way ANOVA	6	14.6
		Stepwise multiple regression	14	34.1
		LSD post-hoc test	1	2
	Experimental study	Paired t-test	3	7.3
		χ^2-test	10	24.3
		difference t-test	1	2
		Fisher's exact test	3	7.3
		Linear by linear association test	1	2
		ANCOVA	2	4.8
		Kolmogorov-Smirnov test	1	2
		Mann Whitney U-test	1	2
		Wilcoxon Signed Rank test	1	2
		Kolmogorov-Smirnov test	1	2
		Sobel test	3	7.3

4. Discussion

In current nursing education, self-leadership is required as one of the basic qualifications of professional nurses, which enables them to make self-directed and responsible judgments and decisions[11]. Lee, Park & Kim's[11] study found that self-leadership makes it possible for individuals to achieve results by raising the level of their employment strategies and by learning with more interest, and that it has positive impacts on their personal growth by stimulating them to be satisfied with the nursing department and keep on going. When the research trend in nursing science papers related to self-leadership that were published in our country was analyzed, there had been no papers of this approach before 2003, but the number of these papers tended to rapidly in-crease up to 36(87.8%). It seemed that this phenomenon reflected social needs for nursing and fast-growing concern for the academic circles of nursing. As nursing students started in 2015 to be employed after undergoing clinical practice, self-leadership is needed as one of the basic qualifications of professional nurses, and the importance of it is increasingly stressed.

When the distribution of the papers by journal was analyzed, 10 studies(24.3%) that were largest in number were included in the Journal of Korea Academia-Industrial Cooperation Society, and eight(19.5%) that were second largest in number were included in the Journal of Korea Nursing Education Association. The others were mostly included in the journals of fields other than nursing science. Because the weight of leadership papers related to nursing students is lately on the rise, more research efforts should be directed into self-leadership, and efforts should be made to have more papers included in international journals as well as domestic nursing journals.

As a result of confirming the themes of the studies, critical thinking disposition was most widely covered as a variable related to self-leadership in 10 studies(25%), followed by self-efficacy in seven(18.5%) and view of the nursing

profession in four(10%). Studies found that there is a close correlation between critical thinking disposition and self-leadership[12][13]. Therefore when educational programs and extracurricular programs are developed to improve the self-leadership of nursing students, these programs should be designed to develop the kind of ability that is to analyze and criticize one's own problems and foster positive thinking faculty[13]. Kim and Park's study[14] found that self-efficacy is correlated with self-leadership. Self-efficacy is an autonomous power to enable oneself to be a high performer, and in order to boost the self-leadership of nursing students, intervention by a program geared toward bolstering self-efficacy seems to be necessary.

Ham & Kim's[15] study found that view of the nursing profession affects self-leadership. Since the view of nursing students on the nursing profession might have a positive impact on their occupational satisfaction and adjustment after graduation, a variety of programs should be developed to improve their view of the nursing profession.

As to research design by the type of re-search, every study was quantitative re-search. Out of them, correlation studies were largest in number, which accounted for 50 percent or more. A few studies were experimental research, and there were neither qualitative research nor the other types of research[16]. To make a pro-found re-search into the nursing area related to self-leadership, it seems that re-searchers need to take various approaches.

In terms of research design, a genuine experimental study wasn't conducted in any of the papers that were analyzed in this study. This is lower than the number of genuine experimental study in Shu, et. al.'s[15] study that was one. In order to provide evidence-based nursing, more genuine experimental studies have recently been implemented to offer the best evidence, and genuine experiment should be considered in the future.

As for institutional review board(IRB), eight papers(19.5%) underwent the procedures of institutional review. This number is high, whereas in Kim, et. al.'s[17] study, just 4.6 percent of the papers investigated underwent the procedures. Since ethical considerations are considered to be important in research, it seems necessary to undergo the procedures of institutional review by an institutional review board to take research to another level.

As for sample estimation, 31 papers(75.6%) estimated the sample sizes by G*Power. This rate is sort of high when it is compared to that of Kim, et. al.(2010)'s[17] study that stood at 30.1 percent. As grounds for an ideal sample size are expected to raise the quality of paper and to spread awareness of the appropriateness of sample size among researchers, the importance of sustained sample estimation should be taken into consideration.

In terms of data analysis, difference verification, which is to compare the averages of the selected variables, and relationship verification, which is to analyze by focusing on the relationships of the variables, were mostly put to use. Specifically, the studies that used correlation analysis and regression analysis to address the research questions were dominant. It's necessary to research what variables regulate or mediate the relationships between self-leadership and other variables in nursing students by making a path analysis, which is increasingly used in the area of social sciences in recent years, and by making a model analysis, which is to test the model using structural equation modelling.

The above-mentioned findings of the study illustrated the domestic research trend in self-leadership. The competency of nursing students should be developed to foster their self-leadership, and there should be sustained efforts to take their self-leadership to another level as professional nurses.

This study has some limitations: First, it's necessary to make an effort to vitalize nursing research related to the self-leadership of nursing students. Second, evidence-based research

should be implemented in a systematic way.

5. Summary and Conclusion

Self-leadership enables individuals to achieve results by raising the level of their employment strategies and by learning with more interest, and it exerts a positive influence on their competency development as professional nurses.

In this study, nursing science papers related to self-leadership that were published in our country over the past 15 years from 2003 and 2018 were analyzed to determine the research trend. Since 2015, there has been a great increase in the number of self-leadership studies with the lapse of time. They were mostly descriptive research studies, and the subjects in the studies were mainly nursing students who experienced clinical practice. As for variables, critical thinking disposition, self-efficacy and view of the nursing profession were identified as major variables to affect self-leadership in a positive manner. As to research design, there was room for improvement in terms of ethical considerations or the securement of sample size. Given the findings of the study, research that is more objective and scientific in terms of research method and research variables should be conducted in the future.

This study is of significance in that it provided some information on how to foster the self-leadership of would-be professional nurses for their competency development to positively affect their future clinical performance and on how to set the right directions for the development of nursing to make a contribution to the improvement of the quality of nursing.

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A Study on the Simplification of Manufacturing Process of Tubular Batteries to Overcome CRISIS of Lead-Acid Battery Maker in KOREA

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Abstract

Manufacturers of lead-acid batteries have made great efforts to reduce the production cost of batteries. Simplifying the manufacturing process is an effective way to reduce costs. In general, it has been recognized that tubular electrode plates should be pickled after filling with the positive active material(PAM). This process requires a pickling and drying process. During this process, curing of the active material occurs. Generally, the curing process is the most time-consuming part of the lead-acid battery manufacturing process. This study deals with the simplification of the manufacturing process for lead-acid batteries using a tubular type positive plate. The effect on discharge capacity of pickling and curing time for the tubular plate was investigated. In this study, tubular positive plates filled with the active material were subjected to case formation(CF) by assembling the cell without pickling. The investigation illustrated that pickling conditions were a determinant for modifications of the chemical and phase composition of the PAM and for electrochemical performance. Thus, a better under-standing of the pickling mechanism is required in order to optimize the tubular positive plate's performance. It has been observed that the key to successful pickling is the maintenance of an exact balance between the con-centration of H_2SO_4, and the duration of the pickling process. The comparative study showed that longer pickling times and higher concentrations of H_2SO_4 do not necessarily result in electrodes with better first capacity perfor-mance. Also, it was noted that if the concentration of H_2SO_4 for pickling was too low or too high, the capacity of the battery was reduced. In this study, the best cell performance was obtained after 3 hours of pickling in H_2SO_4 solution with a specific gravity of 1.20 and after 16 hours of pickling in H_2SO_4 solution with a specific gravity of 1.10. This result will be commercially valuable to tubular type lead-acid battery manufacturers in terms of sim-plifying the manufacturing process.

[Keywords] *Crisis, Manufacturing Process, Pickling, Tubular Positive Plate, Lead-Acid Battery*

1. Introduction

The capacity of the lead-acid battery has in-creased following advances in manufacturing technology, and the performance and the life-time of the battery have been significantly im-proved by revealing the reaction mechanism of the electrodes. In addition, much research has been conducted on the parameters affecting the performance and lifetime of lead-acid batteries in connection with the manufacturing process [1][2][3][4][5][6][7].
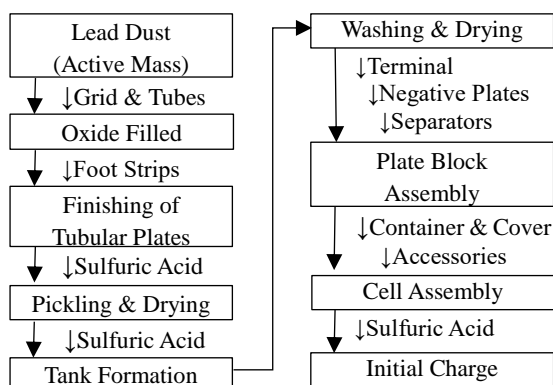
The main problems associated with lead-acid batteries are mainly related to the positive elec-trode plates succumbing to grid corrosion and shedding of active material[8][9][10]. A physical method to reduce the electrode's susceptibility to these problems involves pressing the active material between the electrodes using a porous mass[11]. This method is mainly applied for starting, lighting, and ignition(SLI) batteries such as used in automobiles. Another method is to in-sert the active material into a pipe form woven with acid resistant fiber[12]. This porous tube

provides good resistance to the expansion force of the active material, thus preventing the active material from shedding. It can improve the lifetime and capacity characteristics of lead-acid batteries. These electrodes are therefore used for high-capacity energy storage system(ESS) batteries such as used in uninterruptible power supplies(UPS), solar and load-levelling systems.

In general, the manufacturing process, including the mixing of electrode active materials, curing, formation, and commissioning, is a very important consideration in improving the characteristics and lifetime of lead-acid batteries. The electrode properties are improved when cured at low temperatures due to the formation of 3BS, and high-temperature curing is known to be advantageous for battery life due to the formation of 4BS[6][7][12][13][14][15].

There have been many studies performed on the manufacturing process for tubular type electrodes[15]. <Figure 1> shows the most common tubular type electrode manufacturing process. As shown in <Figure 1>, the manufacturing process for the tubular type lead-acid battery is made up of various steps including active material filling, pickling, drying, formation, washing, and drying. Here, the soaking stage involves leaving the electrode plates of the lead-acid battery in the H_2SO_4 solution for several minutes to several hours without supplying electric current to them. The subsequent drying process generally involves partial curing effects. The curing process is designed to make the paste bond with the grid and also to convert the paste into a cohesive, porous material.

Figure 1. Flow diagram for the production of tubular electrode plates[18].

Curing is an important and time-consuming aspect of the manufacture of lead-acid batteries because the wet active material precursor is cured and converted to a dry porous material.

The tank formation process converts electrical energy into chemical energy. During this step, most of the positive active materials are converted to PbO_2. The formation of the tubular type plate is more difficult and time-consuming than that of the paste type plate. After the formation process is complete, the electrode is rinsed and dried to remove the sulfuric acid remaining on its surface. Finally, the assembled cells are once again filled with a sulfuric acid electrolyte. After the initial charge and commissioning charge is applied to the battery, it then becomes usable. These processes require a relatively long period of time. Nevertheless, they have been recognized as indispensable for achieving superior performance by improving battery characteristics such as capacity and lifetime.

In recent times, tank formation is occasionally omitted and the CF or circulating case formation (CCF) method is applied. These are methods in which the formation and initial charge stages are simultaneously carried out by assembling the cell with the electrode after having completed the soaking process as shown in <Figure 1>. These methods are widely used in spite of the problem of deterioration of the electrode characteristics due to the simultaneous formation process because of the effective simplification of the manufacturing process.

In this respect, the study of the simplification of the manufacturing process is of great interest to lead-acid battery manufacturers and is of great economic significance. This study was therefore concerned with the effects of curing and pickling on the performance of the tubular plates and the simplification of the manufacturing process for the benefit of tubular lead acid battery manufacturers.

2. Experiments
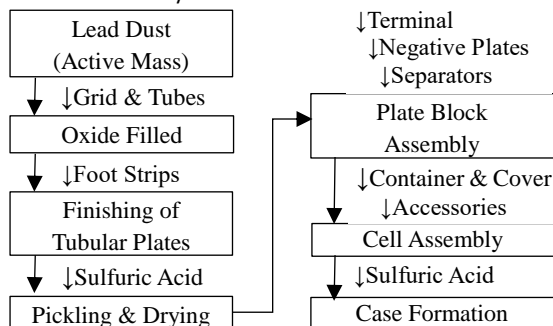
2.1. Plate and cell preparation

The tubular positive plates were prepared by filling with an active material containing 70% by weight lead oxide, namely ball-mill, and 30% red lead. The filling density of active material for the positive plate was 3.4 g/ml. And the plates were prepared without deviation in PAM weight.

Some of these positive plates were pickled and dried before assembling the cell. The conditions for the pickling and drying were as follows: pickling in H_2SO_4 solutions with specific gravity of 1.10 for 6 hours, rinsing, curing for 48 hours at 40°C ± 3°C and 90% ± 5% humidity and drying for 24 hours at 45°C ± 3°C. The negative plates were prepared using a conventional lead-acid battery process. The specifications for the negative plate, including the weight, were the same as for the positive plate.

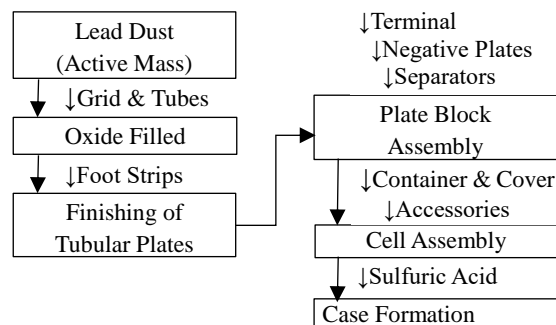## 2.2. Setup of manufacturing process

Two types of manufacturing processes were set up which were dependent on whether or not the positive plates were pickled before assembling the battery. One of the processes is shown in <Figure 2>. This process has commonly been applied to lead-acid battery manufacturing. It involves pickling and drying after the positive plates have been filled. The conditions of the process mentioned above were applied to this study. This process is known to increase the initial performance of the cell due to the formation of 3BS[17].

Figure 2. Flow diagram for conventional tubular lead-acid battery manufacture.

<Figure 3> shows the manufacturing process for the newly proposed tubular-type lead-acid battery examined in this study. The cell was assembled without incorporating the pickling step in the preparation of the tubular plates.

Figure 3. Flow diagram for the newly proposed tubular lead-acid battery.

2.3. Experiment

The changes in capacity of the cell as well as the structure of the PAM and the crystal morphology of the positive plates during the 24 hour pickling process in H_2SO_4 solution were investigated. The specific gravities of the H_2SO_4 solutions used in pickling were 1.05, 1.10, 1.20, and 1.30. The pickling was performed for a certain time period in H_2SO_4 solution with open circuit conditions before switching on the current for the formation of the active mass of the tubular lead-acid battery. Formation was then carried out for 20 hours at a current of $1.4 \times C_{10}$ ampere and for 24 hours at a current of $0.6 \times C_{10}$ ampere without a rest time. The total formation time was 48 hours.
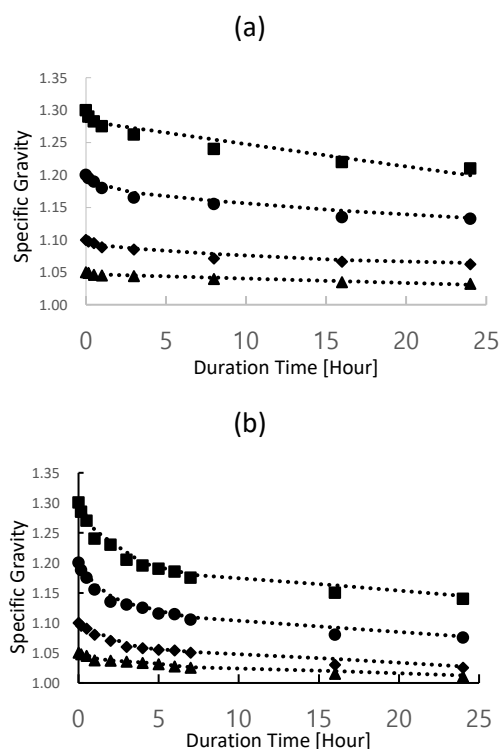
The specific gravity of the cell was then adjusted to 1.285 at the end of the formation process. The commissioning cycles were not applied. After the formation, a charge-discharge cycle was carried out under the same conditions. Cyclic charge-discharge operations were repeated 5 times. These operations involved discharging up to 1.75 vpc with C_3 ampere and recharging to 110% of the measured capacity with a current of $0.8 \times C_3$ ampere. During the cycle, the specific gravity of the H_2SO_4 solution in all cells was readjusted to 1.285 at the end of the recharge phase. All tests were carried out at room temperature without cooling.

3. Results and Discussion

In order to clearly understand the effect of the pickling conditions on the performance of the cell, information on the concentration of electrolytes used in pickling and the picking time must be provided. This is a performance limitation of

the cell. This requirement was technically real-ized by examining the functional relationship of each electrolyte concentration over time. <Fig-ure 4> shows the change in the specific gravity of the electrolyte with respect to the pickling time of cells fabricated using the two different pro-cesses.

Figure 4. Variations in the specific gravity of the cells; (a) made using the process shown in <Figure 2>, (b) made using the process shown in <Figure 3>.

(a)

(b)

In all cases, the specific gravity of the electro-lyte decreased rapidly within the initial few hours and continued to reduce with duration time. The decrease in specific gravity was greater for higher specific gravities of the electrolyte. This chemical reaction proceeded steadily from the electrode surface to the inside of the elec-trode. As this process progressed, the specific gravity of the cell decreased. As shown in <Figure 4(b)>, the batteries using non-pickled plates had a marked reduction in their specific gravity when compared to the cells using the pickled plates shown in <Figure 4(a)>. In particular, as shown in <Figure 4(a)>, there was almost no difference between the initial and final specific gravity dur-ing the pickling process using an electrolyte with specific gravity of 1.05.

The active material which was subjected to

the pickling and drying process before assem-bling the cell, had already undergone a signifi-cant chemical reaction process. The chemical re-action was thus small even though the additional pickling process was performed.
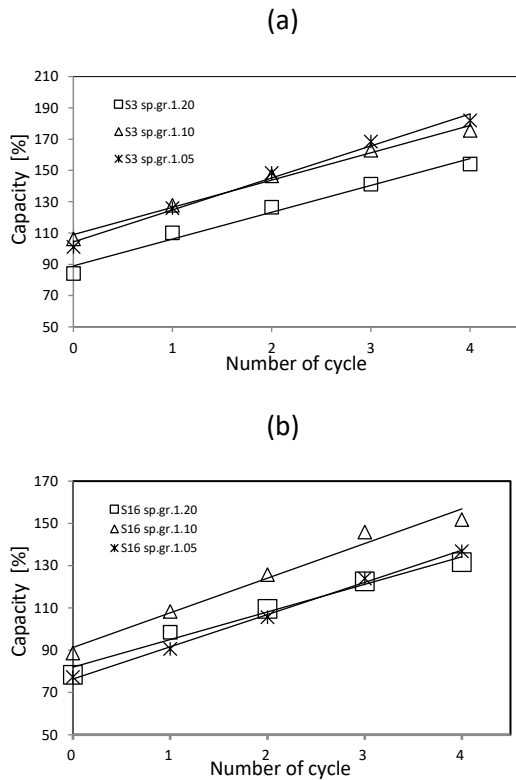
Evidence was noted of the fact that a chemical reaction between the oxide and red lead inside the plates occurred constantly during pickling in the H_2SO_4 solution. This has been found to be the result of the chemical reaction of sulfation, since PbO and basic lead sulfate are unstable while present in the H_2SO_4 solution[16][17].

<Figure 5> shows the cycle performance of the cell manufactured using the method shown in <Figure 2>. <Figure 5(a)> shows the change in the capacity of the cells with current applied af-ter 3 hours of pickling. The cells pickled in elec-trolytes with specific gravities of 1.05 and 1.10 had an initial capacity of 100% or more of the nominal capacity and increased in capacity as cy-cles were repeated. In particular, the perfor-mance of the cell pickled in an electrolyte with a specific gravity of 1.05 was very similar in behav-ior to the study of M. Dimitrov et al.[17]. Since the positive plates used in this cell were cured at a low temperature, the PAM mainly consisted of 3BS.

However, the cell with the high specific gravity of 1.20 had an initial capacity approximately 20% lower than the other two cells.

On the other hand, as shown in <Figure 5(b)>, the initial capacities of the cells in which the for-mation was carried out for 16 hours showed less than 100% of nominal capacity for each specific gravity. After 3 cycles, however, the cells showed more than 100% nominal capacity. In addition, these cells showed a lower capacity compared to the cells pickled for 3 hours.
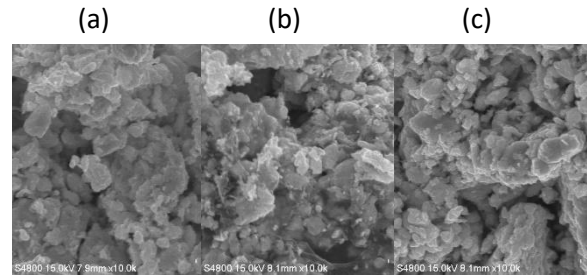
Figure 5. Capacity variation of the cells made using the process shown in <Figure 2>; (a) pickled for 3 hours, (b) pickled for 16 hours.

Figure (a) graph: Capacity [%] vs Number of cycle, with series □S3 sp.gr.1.20, △S3 sp.gr.1.10, ✕S3 sp.gr.1.05.

Figure (b) graph: Capacity [%] vs Number of cycle, with series □S16 sp.gr.1.20, △S16 sp.gr.1.10, ✕S16 sp.gr.1.05.

<Figure 6> shows SEM images of the positive active material made using the process shown in <Figure 2> and pickled in the electrolyte for 3 hours. As shown in the figure, the structure of the active material was similar to that of the active material subjected to the low temperature curing process[17].

As shown in <Figure 6>, the mass structure of 3BS, the porosity of the active material, and the skeleton of the active material were well-formed. The higher the specific gravity of the pickling electrolyte, the larger the particle size. The larger particle size meant that the BET of the electrode was reduced. Therefore, these results could be explained by the results of the capacity performance of the cells that were pickled at each specific gravity as shown in <Figure 5(a)>. These results are also well explained in studies by D. Pavlov, E. E. Ferga et al.[15][16].

Figure 6. SEM images of the PAM pickled for 3 hours at the following specific gravities: (a) 1.05, (b) 1.10, (c) 1.20.
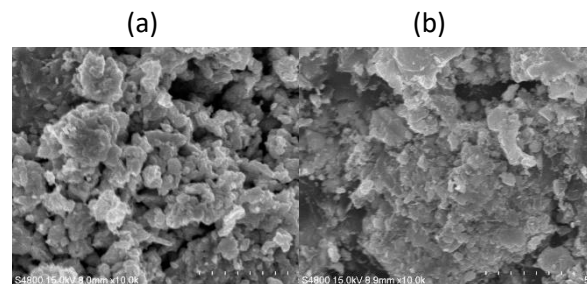
<Figure 7> shows the structure of the positive active material pickled for 16 hours at each specific gravity of H_2SO_4 solution. The structural and morphological changes of the PAM were compared with the PAM pickled for 3 hours.

At a sulfuric acid specific gravity of 1.20, the particle sizes were smaller, and the cohesive strength was lower than that which was pickled for 3 hours. These particles were as hard as sand and showed evidence of grain refinement. These cells showed a significant rise in electrolyte temperature during pickling and cycling. Therefore, as shown in <Figure 5(b)>, the capacity of the cell was low.

In addition, the softening of the PAM was observed at an H_2SO_4 pickling solution specific gravity of 1.05. For this reason, the capacity of these cells was relatively small.

Figure 7. SEM images of the PAM pickled for 16 hours at the following specific gravities: (a) 1.20, (b) 1.05.

<Figure 8> shows the performance of the cells manufactured using the process shown in <Figure 3>. The initial capacity of the cells that were pickled for 3 hours in H_2SO_4 solutions at specific gravities of 1.20 and 1.30 was about 80% of the nominal capacity, and the capacities of the cells gradually increased as the charge and discharge cycles were repeated.

The initial capacity of the cells that were soaked for 3 hours in H_2SO_4 solutions at specific

gravities of 1.05 and 1.10 was about 40% of the nominal capacity, and the capacity of these cells decreased as the cycles were repeated. For these cells, <Figure 9> gives some indication of why the capacity did not increase after repeating the charge-discharge cycle.

Figure 8. Capacity variation of cells pickled for 3 hours and made using the process shown in <Figure 3>.

As shown in <Figure 9>, the chemical reaction of the tubular electrode proceeded from the surface of the electrode to the inside of the electrode and the active material on the surface of the electrode showed a morphological change as a result of a chemical reaction. However, the active material in the inner part of the electrode had a grain size and morphology similar to that of the mixed powder state. This indicated that the active material inside the plate experienced no chemical reaction. These cells were insufficiently charged due to the soaking conditions at low specific gravity and reduced time, resulting in low initial capacity of the cells and no increase in the capacity during the charge-discharge cycles.

Figure 9. SEM images of the PAM pickled for 3 hours at the following specific gravities: (a)1.05, (b)1.10, made using the process shown in <Figure 3>.
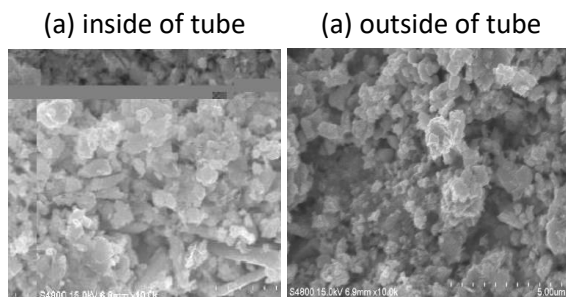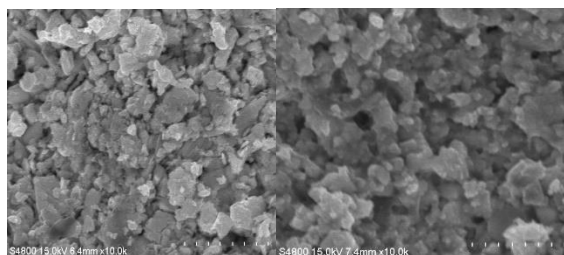
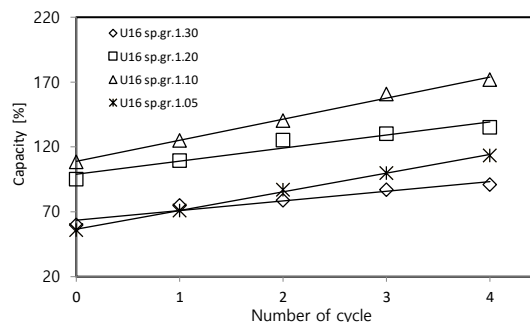(a) inside of tube   (a) outside of tube

(b) inside of tube   (b) outside of tube

On the other hand, <Figure 10> shows the charge-discharge cycle performance of cells subjected to formation after 16 hours at each specific gravity. These cells used the positive electrode plates made using the process shown in <Figure 3>. These cells gradually increased in capacity as the charge-discharge cycles progressed. In particular, the initial performance of the cell using the H_2SO_4 solution with specific gravity of 1.10 exceeded 100% of the nominal capacity, and the capacity constantly increased with each cycle. The initial capacity of the cell with specific gravity of 1.20 was 100% of the nominal capacity, but the capacity growth rate with each cycle was lower than that of the cell containing the H_2SO_4 solution with the specific gravity of 1.10. The initial performance of cells containing H_2SO_4 solutions with specific gravities of 1.05 and 1.30 was 60% of the nominal capacity, and these two cells dropped under 100% of the nominal capacity after 5 cycles.
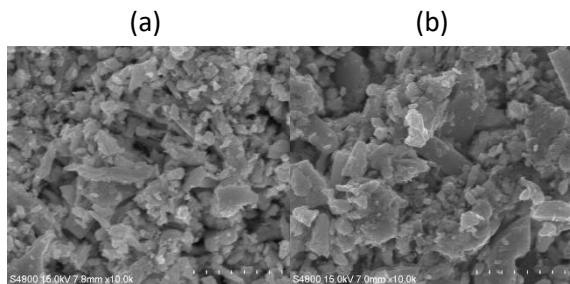
Figure 10. Capacity variation of the cells pickled for 16 hours and made using the process shown in <Figure 3>.

<Figure 11> shows the SEM images of the PAM taken from the cells made using the process shown in <Figure 3>. The crystal structure of the PAM of these electrodes was changed through chemical reaction. The size of the particles showed evidence of growth and recrystallization.

The capacity of the battery is related to BET. The larger the BET of the electrode while under the same conditions, the higher the capacity[18]. Therefore, the cell containing the H_2SO_4 solution with the specific gravity of 1.10 demonstrated better performance than the cell containing the H_2SO_4 solution with the specific gravity of 1.20. This result was consistent with <Figure 10> and <Figure 11>.

Figure 11. SEM images of the PAM pickled for 16 hours at the following specific gravities: (a) 1.10, (b) 1.20, made using the process shown in <Figure 3>.

(a)   (b)

Since the specific gravity of the sulfuric acid in the cell was too high, the reaction between the electrode active material and the sulfuric acid solution was rapid and excessive heat was generated. In this process, the paste bond between the active materials was poor due to the formation of hard particles. This was investigated by disassembling the tubular plates as part of this study.

However, the particles of PbO and Pb_3O_4 within the tube made without applying the curing process showed evidence of recrystallization by chemical reaction and formation of large particles after a certain period of time in the H_2SO_4 solutions. No softening and refinement of the particles was observed in the cell which demonstrated excellent performance. After the 5 charge-discharge cycles, disassembly analysis of the cell showed that there was no shedding of the active material.

4. Conclusion

The effects that changing the pickling conditions for the tubular positive electrode plate had on the discharge capacity were investigated. The above investigation illustrated that the pickling conditions for the tubular plates are important

parameters which affect the performance of the cell. Thus, a better understanding of the pickling mechanisms is required in order to optimize the performance of the tubular positive electrode plate. It has been observed that the key to successful pickling is the maintenance of an exact balance between the concentration of H_2SO_4 solutions and the duration of the pickling process. The comparative study showed that longer pickling times and higher concentrations of H_2SO_4 solution did not necessarily result in electrodes with better first capacity performance. Also, if the concentration of the H_2SO_4 solution for the pickling of the cell was too low or too high, the capacity of the battery was reduced.

The manufacturing process for the tubular positive electrode plate is the most time-consuming technological procedure in the process of lead-acid battery manufacture. These results will be commercially valuable to tubular lead acid battery manufacturers for simplification of the manufacturing process.

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A Study on Nursing College Students' Knowledge, Attitude, Confidence in Performance and Practice on Patient SAFETY Management in KOREA

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Abstract

This study was a descriptive study conducted to investigate nursing college students' degree of patient safety management during their clinical training. This study aimed to provide a baseline data for developing systematic nursing educational curriculum for the enhancement of competence in nursing college students' fundamental patient safety nursing intervention.

The participants consisted of 372 senior nursing college students who have had clinical practice at a nursing college in Gwangju metropolitan city. The data was collected from December 4th to 28th in 2017 at the end-point of their clinical training education in nursing college, and convenience sampling was the method of investigation for this research. For the assessment of patient safety management knowledge(PSM-K), instrument modified by Choi & Lee(2015) from Park & Park(2014) was used. The instrument for patient safety management attitude(PSM-A) assessment was by Chenot & Daniel(2007), for confidence in performance of patient safety management(PSM-CP) by Park(2011), and for patient safety management practice(PSM-P) by Yoo & Lee(2014). The collected data was analyzed with SPSS 19.0 using descriptive statistics, t-test, One-way ANOVA, and Scheffé test.

The results of this study indicated that the ratio of correct answers of PSM-K was 70.7%, PSM-A was 3.85, PSM-CP was 3.99, and PSM-P was 4.24 out of 5 points. And also in terms of the correlations between PSM-K, PSM-A, PSM-CP, and PSM-P, significant positive correlations existed between PSM-K and PSM-A($r=.28$, $p<.001$), PSM-CP and PSM-K($r=.19$, $p<.001$), PSM-CP and PSM-A($r=.48$, $p<.001$), PSM-P and PSM-A($r=.37$, $p<.001$), and PSM-CP and PSM-P($r=.37$, $p<.001$).

Therefore, in order to enhance nursing college students' competence in patient safety nursing intervention, nursing college students must experience various exercises and training for patient safety management during the clinical practicum as well as with scenario-based simulation. And nursing education facilities should develop educational contents about patient safety for nursing college students.

[Keywords] Patient Safety, Safety Management, Nursing, Nursing College Student, Republic of Korea

1. Introduction

A medical institution is obliged to provide its patients medical services of the highest level of safety and quality[1]. However, because of increased change during the progress of medical service and complexity, superfluous health care information, patients' increasing expectations of a perfect treatment result, increased medical severity and vulnerability of the patients visiting health care facilities, patient safety is being threatened during the process of being provided with medical service[2].

Patient safety accidents occurring in hospitals include, regardless of the damage on the patient, all sorts of errors, mistakes, accidents, eventually leading to considerable expenses, such as decrease in healthcare quality and financial loss[3]. In this context, patient safety is, first of all, chosen as a basic

and indispensable element for a nursing care of high quality[4]. Recently, for the settlement of patient safety culture, not only technical aspects, such as regulations, guidelines, or structured system programming regarding patient safety management, but also reinforcing the awareness about patient safety of healthcare providers through a fundamental change on perception are increasingly required[5]. Patient safety management is a responsibility of not only healthcare facilities, but also of all people associated with patient safety management in the institution, where nurses are of big importance[6]. Nurses take care of patients for a whole day in hospitals, and as an expert who sensitively perceive problems associated with patient safety management, interest and awareness plays an important role on improving patient safety[7].

A nursing education institution ensures students to receive alongside with theoretical education, practical education, which enables students to be in actual contact with patients in order to produce nursing college students who has competency in clinical practice[8]. Nursing college students are directly concerned with patient safety, since they perform not only interviewing the patients, supporting transfer, and monitoring vital sign check during clinical practice training, but also fundamental nursing practice under the supervision of an experienced nurse[2]. Therefore it is necessary to reinforce patient safety management knowledge and attitude, and to enhance confidence when in performance related to patient safety management knowledge practice of nursing college students[6]. Through this, nursing college students are expected to perform nursing care safely during the clinical practice training for 2 years, and, after graduating, by habituating themselves to patient safety management, they will grow up being a healthcare provider who performs patient safety management practice appropriately, putting patient safety management at the forefront[9]. The knowledge about patient safety management is a knowledge which nurses must acquaint themselves in order to protect patients from harmful dangers[10], and this knowledge affects patient safety management perfor-

mance[11]. In particular, confidence in performance an individual nursing college student has promotes the learning process of the individual by improving problem solving ability of the student, and also by assisting the acquisition of knowledge, attitude and skill necessary in clinical fields[12][13]. Therefore, in order to enhance patient safety management practice, it seems vital to learn the right knowledge about patient safety management, to form a positive attitude towards patient safety management, and to enhance confidence in performance so as to promote the above written process[9].

Accordingly, this research aims to confirm the knowledge about patient safety management, the attitude towards this subject, the confidence when in performance of nursing college students, the behaviors for patient safety management, and to grasp the relevance between them, therefore to provide the basic materials to develop a curriculum for the enhancement of patient safety management capability of nursing college students.

1.1. Objection

This research conducted investigates the knowledge about patient safety management, the attitude towards the subject, confidence when in performance, and behaviors for patient safety management; the specific objectives are as follows.

1)Investigation of knowledge about patient safety management, the attitude towards this subject, confidence when in performance and the degree of patient safety management behaviors.

2)Investigation of the difference between knowledge about patient safety management, the attitude towards this subject, confidence when in performance and the degree of patient safety management behaviors by general and characteristics of safety management .

3)Analyzation of correlations among knowledge about patient safety management, the attitude towards the subject, confidence

when in performance and the degree of patient safety management behaviors.

2. Method

2.1. Study design

The study was conducted as a descriptive survey to measure nursing college students' degree of knowledge, attitude towards this subject, confidence when in performance and practice on patient safety during nursing clinical training.

2.2. Data collection

Using G*Power 3.1.2 for power analysis, the power was .85 for linear multiple regression analysis, a medium effect size of .20, and a significance level of .05. The sample size of 218 was satisfactory to identify the affecting factors.

The study sample consisted of 372 senior nursing college students who have had clinical practice in nursing schools(A, B, C, D) in G metropolitan city. The subjects were selected by convenience sampling and volunteered to participate.

2.3. Measurements

2.3.1. PSM-K

The questionnaire was designed to measure degree of nursing college students' knowledge about patient safety management. The PSM-K refers to the measured score with the tool, which was reorganized to suit nursing college students by Choi & Lee[14], based on the nursing college student's knowledge measurement tool developed by Park & Park[2], taking reference from researches by IPSG(International Patient Safety goal) and Flin et al[15]. The tool consists of 10 items, and the answerer is asked to respond Yes, No, or No idea. Yes answers count for 1 point, No and No idea count for 0, and the points from 10 items are summed up.

2.3.2. PSM-A

PSM-A was developed by Chenot & Daniel [16]. The PSM-A consists of 16 items based on awareness, attitude, method when coping with medical errors, which are rated on 5-point Likert scale(1=absolutely not, 5= absolutely yes), and average scores were used. A higher average scores indicated a higher PSM-A. The questionnaires were found to have a Cronbach's α of .66, thus confirming the reliability and homogeneity of the questionnaire.

2.3.3. PSM-CP

PSM-CP is a tool revised and complemented by Park and Park[2], taking reference from Patient Safety/Medical Fallibility Assessment Curriculum Survey and IPSG(International Patient Safety Goal) developed by Madgisky et al[17] for the assessment of knowledge about patient safety management, the attitude towards the subject, and medical affiliated college students' ability during performance.

The 10 questions asked the students about response to medical errors, accurate patient identification during clinical practice, reducing healthcare associated infections, and nursing interventions for a lower fall risk.

The reliability of the tool was, according to Cronbach's α, of .85 by Park & park[2], and Cronbach's α .87 in this study.

2.3.4. PSM-P

The questionnaire was designed to measure the degree of nursing college students' practice for protection of patient safety from medical accidents or errors. The questionnaire was developed to measure the extent of nursing college students' PSM-P, Kim et al[18] tool for measuring patient safety management practice and the elements of the international patient safety goals outlined by JCI (Joint Commission International). And PSM-P means the scores measured by Yoo & Lee[19] using a tool that has been reorganized to measure the degree of patient safety management practice for nursing college students based on tool of Kim et al[18]. The PSM-P consists of 15 items which are rated with 5-point Likert scale(1=absolutely not, 5= absolutely yes), and average scores were used. A higher average scores indicated a higher practice of PSM. The questionnaires were

found to have a Cronbach's α of .91, thus confirming the reliability and homogeneity of the questionnaire.

2.4. Procedures

The data were collected from December 4th to 28th, 2017. Before starting the study, approval was obtained from the institutional review board of nursing college of G University. For data collection, researchers visited each nursing education institution, explained the objectives of the study, received his/her permission to collect data, and obtained data.

2.5. Data analysis

The collected data were analyzed using SPSS statistics version 19.0. Descriptive statistics(frequency & percentile) were used to report participants' general characteristics. And nursing college students' knowledge, attitude, confidence in performance, and practice of patient safety management was calculated by mean score and standard deviations. Knowledge, attitude, confidence in performance, and practice of patient safety management depending of characteristics of the participant were analyzed t-test or one-way ANOVA. Post test of different groups was followed by Scheffé test.

2.6. Ethnical considerations

The researcher contacted A, B, C, and D nursing college and obtained permission to recruit participants. The participants were informed about the purposed of the survey and asked to sign a written consent form. The survey was then completed anonymously. Participants' personal information were coded and encrypted for statistical analysis, and only the researcher had access to the data.

3. Results

3.1. Participant characteristics

Of the 372 participants, 94.4% of them were female, and 29.0% were christian. For the level of academic grade, 192(51.6%) had a score from 3.5 or higher to below 4.0. Most of them were 'Satisfactory'(52.7%) with their

major study, while most of the assessment during clinical practice were 'Mediocre' (58.6%).

The status of experiences concerning safety management education were divided into 'have experienced'(74.2%) and 'have not experienced'(25.8%). Regarding whether the students experienced safety accidents, 30(8.1 %) students answered that they have experienced safety accidents, and the others, 342(91.9%) students, answered that they have not experienced safety accidents. Among the 41 students who experienced safety accidents, those who answered that they have experienced such accidents 'once' were 36(87.8%) and those who answered 'twice' were 5(12.2%), and the average number of times of safety accidents was 1.1 times for those 41 students. The most common type of safety accidents experienced was related to 'an injection needle / ampule stab'(70.8%) <Table 1>.

3.2. PSM-K

How well the questionnaires knew about patient safety management for this study was given in Table 2. The score to judge the knowledge ranged from 1 to 10. The average score of patient safety management knowledge(PSM-K), was 7.30 out of 10. The items which over 90% of the questionnaires answered positively were 'Fall prevention' (97.6%), 'Oral/phone order prescriptions' (94.2%), 'Glove & hand hygiene'(93.1%), 'Inputting instructions into a computer' (91.8%), and 'Medical error report'(91.8%). On the other hand, the item which showed the lowest correct answer rate was 'Checking the patient with the bedside number and the name of the patient', with a percentage of 20.4% <Table 2>.

3.3. PSM-A

The attitudes toward patient safety management for this study were as shown in Table 3, the average score was 3.76 out of 5. On the basis of the five-point scale, an average score of 4 or higher were 4.38 for 2nd question(the priority for patient safety management in the nursing performance is

Table 1. General characteristics of the participants. $\qquad$ N = 372

Characteristics	Categories	n	%
Gender	Male	21	5.6
	Female	351	94.4
Religion	Buddhism	39	10.5
	Christianity	108	29.0
	Catholic	48	12.9
	Have no religion	177	47.6
Academic grade	GPA of 4.0 or higher	45	12.1
	GPA 3.5 or higher ~ below 4.0	192	51.6
	GPA 3.0 or higher ~ below 3.5	115	30.9
	GPA Below 3.0	20	5.4
Major satisfaction	Satisfactory	196	52.7
	Mediocre	153	41.1
	Unsatisfactory	23	6.2
Satisfaction of clinical practice	Satisfactory	126	33.9
	Mediocre	218	58.6
	Unsatisfactory	28	7.5
Safety management education status	Have experienced	276	74.2
	Have not experienced	96	25.8
Safety accident experience	Have experienced	30	8.1
	Have not experienced	342	91.9
Number of safety accident	Once	36	87.8
	Twice	5	12.2
Safety accident type	A needle prick	34	70.8
	Medical equipment damage	5	10.4
	Patient identification error	4	8.3
	Oral administration error	3	6.3
	Antiseptic item contamination	2	4.2

higher), while 10th question(the task guide lines for patient safety management should be mitigated) had the lowest <Table 2>.

Table 2. The level of PSM-K.

Items	Correct rate (%)
Fall prevention	97.6
Oral/phone prescriptions	94.2
Glove and hand hygiene	93.1
Inputting instructions into a computer	91.8
Error report	91.8
Near miss	67.5
Adverse event	62.1
Medical wastes separation	65.4
Privacy protection	46.5
Patient identification	20.4
Mean ± SD	7.30±1.24

3.4. PSM-CP

The confidence in the performance of the patient safety management was 3.92 out of 5. The high score items were 'When moving a patient to a moving bed of wheelchair, always secure the foot switch'(4.58), 'Bed with patients are kept raised at all times and the importance of handrails is checked'(45.2), 'Proper hand hygiene methods are known and performed'(4.39), and 'Contaminated waste should be separated into general contaminants and shipment of hospital supplies'(4.28), whereas the lowest item was 'The medical institution correctly prepares the event report in a medical error <Table 3>.

3.5. PSM-P

The average score of patient safety management practice was 4.21 out of 5 <Table 3>. The most commonly performed practices for patient safety management were 'Be sure to check the patient before administrating drugs or blood'(4.86) and 'Be sure to check the patient before performing any nursing

activities(procedures & treatments)'(4.60). But patient safety management practice such as 'Check that there is no risk of fire'(2.98) and 'The medical institution verifies that there are no abnormalities when using the medical device'(3.92) were performed less frequently <Table 3>.

Table 3. The level of PSM-A, PSM-CP, and PSM-P.

Variables	Mean ± SD	Range
PSM-A	3.76±0.42	1~5
PSM-CP	3.92±0.71	1~5
PSM-P	4.21±0.57	1~5

3.6. Correlations between PSM-A, PSM- K, PSM-CP, and PSM-P

The patient safety management knowledge(PSM-K) showed significant quantitative correlation with patient safety management attitude(PSM-A)(r=.28, p<.001), confidence in performance of patient safety management(PSM-CP)(r=.19, p<.001), and patient safety management practice(PSM-P)(r=.22, p<.001).

The patient safety management attitude (PSM-A) showed a significant correlation between confidence in performance of patient safety management (PSM-CP)(r=.48, p<.001) and patient safety management practice(PSM-P)(r=.37, p<.001). In addition, patient safety management (PSM-CP) had a significant correlation with patient safety management practice(PSM-P)(r=.36, p<.001) <Table 4>.

4. Discussion

This study attempted to determine patient safety management knowledge, attitude, confidence in performance, practice among the nursing college students.

According to the study results, patient safety management knowledge(PSM-K) was 7.30 out of 10, or higher than average. Compared to the results of the study by Choi & Lee[5] and Park[12] toward the third and fourth graders, this study was highly limited

to the fourth grade students at nursing college students.

In this study, questions with a correct answer rate of more than 90% in patient safety management knowledge were 'fall prevention', 'oral or phone prescriptions', 'glove & hand hygiene', 'inputting instructions into a computer', and 'error report', and this was consistent with the findings by Choi & Lee[5] and Park[12]. The result of this studies was considered to have been learned sufficiently in the nursing education curriculum not only fundamental nursing practice training and Simulation labs in the college but also clinical practice in the thorough practical training.

On the other hand, the lowest answer was 'patient identification'. For accurate patient identification, at least two of the patient names, date of birth, and hospital registration number should be used, and the patient's room number and location should not be used as indicators. Repeated training should be conducted throughout the clinical exercise to ensure accurate patient identification reflecting the results of this study.

The patient safety management attitude was 3.76 out of 5, higher than average. This was a similar result, with a score of 3.83 in Hyun[20] and a score of 3.59 Choi & Lee[5].

Table 4. Correlation between PSM-K, PSM-A, PSM-CP, and PSM-P.

Variables	PSM-K r(p)	PSM-A r(p)	PSM-CP r(p)	PSM-P r(p)
PSM-K	1			
PSM-A	.28(<.001)	1		
PSM-CP	.19(<.001)	.48(<.001)	1	
PSM-P	.22(<.001)	.37(<.001)	.36(<.001)	1

Note: PSM-K = patient safety management knowledge
PSM-A = patient safety management attitude
PSM-CP = confidence in performance of patient safety management
PSM-P = patient safety management practice

Choi & Lee[5] was in the 3rd and 4th grade, and in this study it was a different grade for 4th grade, but had a similar score in their patient safety management attitudes. It is considered that the nursing college students did not influence the patient safety management attitude during the clinical trial period. In the results of this study, administrative aspects of patient safety management attitude were assessed to be low, including guidelines for patient safety management, expertise of personnel, and consumption of associated costs. Therefore, there is a need to strengthen theoretical education to complement these problems.

The confidence in performance of patient safety management of nursing college students was 3.92 out of 5, higher than the score of patient safety management attitude. In particular, the results of this study was showed high scores relating to 'secure the foot switch', 'importance of side-rails', 'proper hand hygiene', and 'contaminated waste separation'. On the other hand, the items 'description of an accident report in case of medical error', 'situation analysis for investigating the cause of medical error', and 'report on medical errors and support from colleagues' were showed low confidence in performance of patient safety management level, were consistent with the result of Park[21]. It is believed that this results was mainly because of clinical nursing practice conducted by nursing college students. Therefore, since nursing college students lack experience in responding to

medical errors and in the reporting system, orientation should be provided before clinical practice to report and respond to medical errors.

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Strategic Approaches for University Financial CRISIS through Identifying the Characteristics of University Licensing Products in KOREA

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Abstract

The purpose of this study was to investigate the relationship between the team cohesiveness from the characteristics of university licensing products, school satisfaction, and purchase intention perceived by university students to give managerial suggestions for the self-reliance ratio of finance. A total of 243 valid data were collected from 260 university students using the questionnaire with the self-administration method and the data were analyzed by using descriptive statistics, exploratory factor analysis, and multiple regression. The results could be derived as follow. First, the team cohesiveness from the licensing products had an effect on the satisfaction of school. Second, the team cohesiveness of licensing products had an effect on the purchasing intention. Third, the satisfaction of school had an effect on the purchasing intention of university licensing products. As the previous study confirmed that the high level of team(university) cohesiveness gives a positive affection on the satisfaction of the school and purchase intention of their licensing products, the government of the university should have the managerial strategies to raise their team cohesiveness so that it makes positive team cohesiveness and total sales of licensing products. With the strategic plan to make high level of the team cohesiveness, the university government needs to attract talented student athletes for improving the quality of the games and other services so that general students and alumni give their support by watching the games and purchasing the licensing products of their school. Also, if the university pays attention to the revenue-making business through the efficient operation and to corporate sponsorship program with marketing activities, the university can be obtain the high level of cohesiveness, brand quality, and student attraction.

[Keywords] *Financial Crisis, Product Attribute, Team Cohesiveness, Licensing Product, Purchase Intention*

1. The Needs and Purpose of the Study

Universities need to move away from the traditional framework of educational institutions with the concept of being an educational service institution to compete with other universities to attract more students and build up the internal and external images of each university[1]. In addition, as a measure of securing financial independency and to participate more actively in marketing activities, licensing business is needed as a part of marketing using university sports teams[1]. Especially, the importance of incorporating university sports teams has been emphasized recently, and the introduction of management mind and activation of marketing have been accentuated. In this trend, licensing products that sell college logos, characters, and mascots attached to clothing and household goods are expected to help finance the university[3]. In licensing business, the longing and favorable images of enthusiastic fans admiring famous teams and excellent players are processed into purchase behavior[1]. In fact, university sports leagues have been introduced, giving the opportunity to get close to the students and sports. This is not only a stepping stone to university sports, but also a great opportunity to mass-produce potential

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sports fans. Also, because fans loyal to famous teams and excellent athletes tend to actively and positively watch games or purchase products, they make positive impacts on outcomes of the licensing business[1][3].

Therefore, this study aims to provide fundamental data about constructing university licensing product consumption market and present business strategy for financial independency of universities by examining the effects of the characteristics of university licensing products on team cohesiveness, school satisfaction and purchase intention.

2. Methodology

2.1. Subjects and sampling technique

In this study, 260 university students were surveyed by self-evaluation using the convenience sampling method. From the collected data, a total of 243 questionnaires were selected as valid samples, except for 17 questionnaires that were unfaithful or partially missing.

2.2. Measuring tools

First, for the attributes of licensing products, the questionnaire proposed by Jacoby & Olson(1985), developed by Shin(2017) and used by Kim & Lee & Kim & Kim(2010) was revised and fortified before used and composed of three factors of quality, aesthetic expression and price[2][3][4].

Second, for team cohesiveness, the questionnaire developed by Shrivastava & Sharma(2015) and used by Anderson & Spataro(2008) was revised and fortified before use and composed of two factors of social cohesiveness and task cohesiveness[5][6].

Third, for school satisfaction, the questionnaire used in studies such as those conducted by Lam & Shankar & Erramilli & Murthy(2004) and Seth & Deshmukh & Vrat(2005) was revised and fortified before use and composed of one factor of school satisfaction[7][8].

Fourth, for purchase intention, the questionnaire developed by Chang(2015), and used by Fink & Trail & Anderson(2002) was

revised and fortified before use and composed of one factor of purchase intention[9][10].

2.3. Data analysis

After collecting the distributed questionnaires and analyzable data were individually input into SPSS Program 23.0 which is a statistical package program per the purpose of data analysis to process the data from this study and statistically verified as shown below.

First, frequency analysis was conducted to understand the general characteristics of data.

Second, Cronbach's α coefficient was calculated to verify the reliability of the questionnaire.

Third, factor analysis was conducted to classify product attribute factors, team cohesiveness factors, school satisfaction factors, and purchase intention factors.

Fourth, correlation analysis was performed to examine the relationship between the variables.

Fifth, multiple regression analysis(significance level .05) was used to examine the effects of product attributes on team cohesiveness, school satisfaction, and purchase intention.

3. Results

3.1. Validity and reliability

First, according to the right angle rotation cause analysis on the licensing product attribute factors and the results from reliability verification, the eigenvalue of attribute factor was 5.624(α=.918) and aesthetic expression factor and price factor were 4.238(α=.825) and 3.657(α=.713) respectively. The rate of explaining the entire variables by the three factors was 46.728%.

Second, according to the right angle rotation cause analysis on the team cohesiveness factors and the results from reliability verification, the eigenvalue of social cohesiveness

factor and task cohesiveness factor were 4.139(α=.937)and 3.064(α=.951)respectively, and the rate of explaining the entire variables by the factors was 50.134%.

Third, according to the right angle rotation cause analysis on the school satisfaction factors and the results from reliability verification, the eigenvalue of school satisfaction factor was 3.762(α=.884) and the rate of explaining the entire variables by the factor was 43.189%.

Fourth, according to the right angle rotation cause analysis on the purchase intention factors and the results from reliability verification, the eigenvalue of purchase intention factor was 3.435(α=.935) and the rate of explaining the entire variables by the factor was 42.147%.

Fifth, correlation analysis results showed correlations between most of the constitutional concepts and it indicates that the direction of the relationship between the variables presented was consistent.

3.2. Effects of product attributes on team cohesiveness

Table 1. Effects of product attributes on social cohesiveness.

DV[1] IV[2]	Social cohesiveness			
	b	Std.E	β	t
Quality	.327	.058	.348	4.573***
aesthetic expression	.263	.051	.245	3.164***
price	.199	.047	.164	2.078**
R²	.296			
F	28.547***			

Note: [1]Dependent variable, [2]Independent variable
[3]*** p<.001, [4]** p<.01

<Table 1> shows that quality factor(β =.348), aesthetic expression factor(β=.245), price factor(β=.164) from product attributes have impacts on social cohesiveness. With coefficient of determination R² = .296, it shows an explanatory power of 29.6%.

<Table 2> shows that quality factor(β =.261), aesthetic expression factor(β=.194), price factor(β=.175) from product attributes have impacts on task cohesiveness. With coefficient of determination R² = .251, it shows an explanatory power of 25.1%.

Table 2. Effects of product attributes on task cohesiveness.

DV[1] IV[2]	Task cohesiveness			
	b	Std.E	β	t
Quality	.273	.062	.261	3.259***
aesthetic expression	.199	.053	.194	2.954**
price	.187	.070	.175	2.318**
R²	.251			
F	22.359***			

Note: [1]Dependent variable, [2]Independent variable
[3]*** p<.001, [4]** p<.01

3.3. Effects of product attributes on school satisfaction

<Table 3> shows that quality factor(β =.156), aesthetic expression factor(β=.227), price factor(β=.234) from product attributes have impacts on school satisfaction. With coefficient of determination R² = .354, it shows an explanatory power of 35.4%.

Table 3. Effects of product attributes on school satisfaction.

DV[1] IV[2]	School satisfaction			
	b	Std.E	β	t
Quality	.148	.043	.156	2.753**
aesthetic expression	.246	.062	.227	3.538***
price	.215	.051	.234	3.154***
R²	.354			
F	36.127***			

Note: [1]Dependent variable, [2]Independent variable
[3]*** p<.001, [4]** p<.01

3.4. Effects of product attributes on purchase intention

<Table 4> shows that quality factor(β =.252), aesthetic express factor(β =.335), price factor(β=.319) from product attributes have impacts on purchase intention. With coefficient of determination R²=.251, it shows an explanatory power of 25.1%.

Table 4. Effects of product attributes on purchase intention.

DV[1]	Purchase intention			
IV[2]	b	Std.E	β	t
Quality aesthetic expression price	.315	.116	.252	2.356***
	.331	.152	.335	3.174***
	.254	.054	.319	3.048***
R²	.251			
F	25.481***			

Note: [1]Dependent Variable, [2]Independent Variable

[3]***p<.001, [4]**p<.01

3.5. Effects of team cohesiveness on school satisfaction

Table 5. Effects of team cohesiveness on school satisfaction.

DV[1]	School satisfaction			
IV[2]	b	Std.E	β	t
Social co-hesiveness	.313	.064	.319	3.428***
Task cohe-siveness	.318	.056	.321	4.025***
R²	.337			
F	36.568***			

Note: [1]Dependent variable, [2]Independent variable

[3]***p<.001, [4]**p<.01

<Table 5> shows that social cohesiveness factor(β=.319) and task cohesiveness factor (β=.321) from team cohesiveness have impacts on school satisfaction. With coefficient of determination R²=.327, it shows an explanatory power of 32.7%.

3.6. Effects of team cohesiveness on purchase intention

Table 6. Effects of team cohesiveness on purchase intention.

DV[1]	Purchase intention			
IV[2]	b	Std.E	β	t
Social cohe-siveness	.310	.052	.314	3.592***
Task cohe-siveness	.303	.061	.320	3.752***
R²	.286			
F	35.267***			

Note: [1]Dependent Variable, [2]Independent Variable

[3]***p<.001, [4]**p<.01

<Table 6> shows that social cohesiveness factor(β=.314) and task cohesiveness factor(β=.320) from team cohesiveness have impacts on purchase intention. With coefficient of determination R²=.286, it shows an explanatory power of 28.6%.

4. Discussion

The studies by Cha(2003), Kim(2014), Shin & Jun & Kim(2009) showed the effects of product attributes on team identification[11][12][13]. Such findings support the study by Funk(2006) which argues factors such as quality, product and price related to licensing or merchandising and team image pursue pleasure as they are identified as the same as their favorite athletes and teams[14]. It also agrees with the findings by Griskevicius & Tybur & Sundie & Cialdini & Miller & Kenrick (2007) that show fans tend to use sports products related to their favorite teams and tend not to use sports products from other teams and such tendencies are found in loyal fans regardless of the performance of their teams[15].

Also, the study by Luo & Bhattacharya(2006) showing the level of satisfaction with group expectation has positive effects on identification can sufficiently explain the results from this Study[16].

Jeffrey & Hodge(2007) said product attributes which are factors related to the product have impacts on consumer flow and the study by Ahearne & Bhattacharya & Gruen(2005), Ozer & Argan(2006) illuminates that the licensing product attributes have effects on purchase behaviors[17][18][19]. In addition, it is consistent with the findings by Apostolopoulou & Papadimitriou & Damitsiou(2010) which present symbolic nature, design and function as the main factors inducing consumers to purchase licensing products[20].

Loyalty has been studied as being related to consumers' recurrent purchases and further treated as an important factor in sales. Aaker(1991) argues that loyalty is a consumer's attitude toward a particular brand, and

that persistent attachment to the particular brand appears as loyalty in purchase behavior[21]. Moreover, Palmatier & Dant & Grewal & Evans(2006) suggests that loyalty is a deep commitment to repurchase preferred products or services and become a regular customer and make loyal customers to repurchase from the same brand support the results from this Study, in spite of marketing attempts to attract loyal customers to a brand to another brand[22].

It was argued that utilizing sports products related to a team, suggesting to use other teams' sports products, remaining loyal regardless of the team's performance, purchasing tickets for the team, watching sports games, participating in sports games, reading magazines/newspapers related to sports and purchasing sports products should be measure and it should include measures in terms of attitudes, such as specific sports, personal choice for athletes, and sports-related conversations[23].

Fans with high club identification are more likely to visit stadiums, more sensitive to ticket purchases, spend more on purchasing club-related products, and remain loyal to the team regardless of team satisfaction and performance[24][25].

In the study conducted by Funk & James(2006), found that sports fans who have high team identification, show active supports to the team regardless of the team's performance and are so highly loyal that they are even insensitive to price fluctuation which are consistent with the results from this study[26].

Therefore, it is important for the organization which runs the college sports team to have a strategy to increase team identification. Identification is related to the concept of identity or belonging, and it is very important to make university students who are the fans of university sports proud by making good teams as a strategy of increasing team identification[1]. In addition, it is necessary to endeavor to establish and continue the tradition of college sports team. Also, it is important to make not only college students but

also alumni have consistent interests in university sports team by creating various events[11]. Therefore, the sports department, which is the main body of the college sports team, should develop various marketing strategies to increase team identification and to maximize team loyalty.

Gwinner & Swanson(2003) illustrate that fans with high identification for a sports team tend to be more willing to visit stadiums, spend more money purchasing items related to the team and remain loyal to the team[27]. In addition, Kwon & Trail & James(2007) reported that team identification closely affects the purchase of licensing products of the fans' favorite sport teams[28]. When fans feel unified with a sports team, they feel a sense of unity with the organization or the company running the sports team, and such a sense of unity of consumers with the company affects the attitude of the consumer(purchasing behavior) to the company.

If the university sports are activated, it will not only expand the demand base by vitalizing sports marketing but also increase the overall consumption base, resulting great contributes in vitalizing the college sorts industry. Especially, with the change of university sports system to incorporate leagues for some sports, it is important to grasp the motivation for participation of college student audiences in order to meet their desire. Thus efforts should be made by the department in charge of university sports to strengthen team attribute factors which have great impacts[1][11].

Inviting good athletes to represent the college sports team can be used as a strategy to strengthen the attribute factor. This will allow college students to feel homogeneous with the team and players as they will feel proud and call emotions by the fact that university students represent their school. Furthermore, it is anticipated that university students will visit the stadium to see the players, purchase products and have interests in related information. Also, in order to increase the team identification of college students who come to stadiums to watch games, improving performances of university sports

teams, having sports facilities with various fan services and convenient facilities will bring about the satisfaction of college students as well as the effect of sponsorship. And it is expected to play an important role in identifying as the same as the team[27][28].

5. Conclusion and Suggestions

First, team quality factor, aesthetic expression factor and price factor of licensing product attributes influenced social cohesiveness and task cohesiveness factors of team cohesiveness.

Second, team quality factor, aesthetic expression factor and price factor of licensing product attributes influenced school satisfaction factor of school satisfaction.

Third, team quality factor, aesthetic expression factor and price factor of licensing product attributes influenced purchase intention factor of purchase intention.

Fourth, social cohesiveness and task cohesiveness of team cohesiveness influenced school satisfaction factor of school satisfaction.

Fifth, social cohesiveness and task cohesiveness of team cohesiveness influenced purchase intention factor of purchase intention.

Consequently, it was found that licensing product attributes have impacts on team cohesiveness, school satisfaction and purchase intention factors. This means that licensing product attributes have positive effects on school satisfaction and purchase intention for licensing products. This means that universities should have a management strategy to increase team cohesiveness through the sale of licensing products. By having interests in licensing products and improving the quality of games and other services through attracting talented student athletes, schools can create profits and corporate sponsorship can also smoothly make via marketing activities.

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