A CASE STUDY ON THE LEARNING PATTERNS OF KOSEN STUDENTS IN PHYSICAL EDUCATION CLASSES: FOCUSING ON THE MODEL CORE CURRICULUM

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In 2017, national colleges of technology (KOSEN) developed a model core curriculum (MCC) (Organization of National Institute of Technology, 2017b). The MCC lists six qualities and abilities to be developed in physical education classes: "Independence," "Self-management skills," "Awareness of responsibility," "Teamwork skills," "Leadership," and "Ethics" as qualities and abilities to be developed in physical education classes. Therefore, it is necessary to realize physical education classes that can cultivate these qualities and abilities in KOSEN. However, few studies have examined the effectiveness of physical education classes at KOSEN, focusing on the qualities and abilities indicated in the MCC. Therefore, the purpose of this study was to examine the effectiveness of physical education classes at KOSEN by focusing on the qualities and abilities specified in the MCC.

An e-questionnaire survey was conducted on 109 1st-year students (81 males, 28 females) and 87 5th-year students (70 males, 17 females) belonging to X KOSEN. The students were asked to answer on a 4-point scale the degree to which they had attained the goals for each quality and ability. They were also asked to write freely about what they had learned and grown through the physical education classes. The analysis procedure was as follows. First, the mean value of the achievement level of each quality and ability was calculated. Next, a t-test with independent samples was conducted on the means of the 1st and 5th graders in order to examine grade differences. On the other hand, free statements were categorized inductively using categorical analysis (Otani, 2019).

The results of the analysis showed that the means for all six qualities and abilities were higher for the 5th graders than for the 1st graders. Furthermore, significant differences were found in the five qualities/abilities of "Independence," "Self-management skills," "Awareness of responsibility," "Leadership," and "Ethics." Therefore, it is possible that the continuation of physical education classes over a long period of time has affected the growth of the 5th graders. In addition, the results of the category analysis revealed that 5th graders placed more emphasis on *Leadership* and *Improvement of physical strength* in physical education classes compared to 1st graders. In light of the above, it can be concluded that students in KOSEN generally acquire the qualities and abilities indicated by the MCC throughout their five years of study.

Keywords: *Physical Education, KOSEN, model core curriculum*

Introduction

In 2017, MCC was established as the minimum standard that students belonging to KOSEN in Japan should master by the time they graduate (Organization of National Institute of Technology, 2017b). The MCC specifies the qualities and abilities that engineers should possess in each subject in order to achieve the goal of "diverse practical and creative engineers who are active in a wide range of fields at a higher level" required for technical college education (Tadano, 2019). In particular, in physical education classes, the six qualities and abilities to be developed are "Independence," "Self-management skills," "Awareness of responsibility," "Teamwork skills," "Leadership," and "Ethics." Therefore, it can be said that physical education classes that can foster these qualities and abilities in KOSEN are expected to be implemented effectively. However, it has been pointed out that the influence of MCC on physical education in KOSEN is limited due to the institutional characteristics of technical colleges, which are neither high schools nor universities (Shibayama et al., 2022). In KOSEN, ingenious physical education classes are

developed based on the elements of novelty, originality and research (Shibayama et al., 2022). Accordingly, more specialized physical education classes are conducted at KOSEN than at other schools (Fukuda et al., 2024). The foundation for quality assurance is MCC (Kobayashi et al., 2023). Therefore, it is important to clarify whether students are acquiring the qualities and abilities indicated in the MCC, and the state of their learning.

Accordingly, the purpose of this study was to verify the effectiveness of physical education classes at KOSEN, focusing on the qualities and abilities specified in the MCC.

Materials and Methods or Pedagogy

Survey Period and Participants: The survey period was from November 26 to December 8, 2021. The survey was administered to 109 1st-year students (81 male, 28 female) and 87 5th-year students (70 male, 17 female) belonging to X KOSEN. The valid response rate was 77%. We compared the results of the survey of 1st-year students and 5th-year students in order to clarify the learning styles in physical education classes at the KOSEN.

Survey Methods and Content: An e-questionnaire survey using Microsoft Forms was used as the survey method. The survey content was set as shown in Table 1, referring to Shibayama et al. The survey asked students to evaluate their level of achievement in the MCC at three levels (1: Knowledge and Memory Level, 2: Comprehension Level, and 3: Application Level). If the students did not reach any of the three levels, they were asked to answer "0". At X KOSEN, a variety of instructional strategies are implemented with a conscious emphasis on fostering key competencies (Organization of National Institute of Technology, 2017a). Specifically, the development of "Independence" is promoted through activities such as *collaboratively designing and executing warm-up and practice routines within teams* in ball games and ground golf (e.g., Weeks 3 to 5 of the second semester), providing students with opportunities to voluntarily engage in activities and make decisions. To foster "Self-management skills," students are required to observe a set of pre-class guidelines such as wearing appropriate athletic clothing, removing accessories, and maintaining personal grooming (e.g., trimming nails), thereby cultivating their ability to manage their own health and safety. With regard to a "Awareness of responsibility," students are assigned roles such as referee or scorekeeper during various sports sessions (e.g., Week 13 of the first semester, Week 2 of the second semester), enabling them to experience the responsibility involved in supporting the operation of athletic events. "Teamwork skills" is nurtured through activities in which students *work together to plan and execute warm-ups and practice routines* (e.g., Weeks 14 to 15 of the first semester, Weeks 3 to 5 of the second semester), thereby encouraging mutual cooperation and the exchange of ideas. "Leadership" is cultivated by giving each group the opportunity to develop their own practice menus and rotate leadership roles within the team, allowing students to practice organizing group efforts and guiding peers through planning and execution. Finally, the development of "Ethics" awareness is addressed by instructing students to embody the principles of sportsmanship, including fair play, adherence to rules, respect for referees, and consideration for opponents.

In addition, in order to examine in more detail the nature of the learning that students obtained through physical education classes, an open-ended question was asked, "Please enter one thing in particular that you were able to learn and grow through the health, sports, and health-related classes at the KOSEN.

Analysis Methods: The mean and standard deviation were calculated for each grade for the level of achievement toward the achievement goal obtained from the e-questionnaire. Next, independent sample t-tests were conducted to examine differences between 1st and 5th graders. Cohen's *d* was calculated for the effect size. t-test (Cohen's *d*) was interpreted as follows: $d<0.2$: "trivial", $0.2\leq d<0.5$: "small", $0.5\leq d<0.8$: "moderate", $0.8\leq d$: "large". For statistical analysis, JASP 0.17.2.1 (Shimizu and Yamamoto, 2022), which ensures the

Table 1 Goals by achievement level in survey item (Shibayama et al., 2024)

Level of achievement	1: Knowledge and Memory Level	2: Comprehension Level	3: Application Level
Independence	In the course of their work of proactive action, recognising the importance of independent action in carrying out their work.	Understanding the effects of taking their own initiative in doing their job and take basic actions.	Being able to act proactively in specific situations to demonstrate their own abilities to improve the situation around them.
Self-management skills	Coming up with matters to self-manage in the course of their work and recognising their importance.	Being able to take basic responsible action; self-management awareness, basic responsible behaviour.	Being able to manage their own behavioural, mental and health aspects of daily life and constantly strive to maintain themselves in a good state of health.
Awareness of responsibility	Recognising the importance of responsible behaviour, speech and actions and roles in carrying out their work.	Being able to act, speak and behave in a basic responsible manner and role within a limited scope.	Being able to act, speak and behave responsibly and play a role with awareness as a member of society.
Teamwork skills	Being able to explain the importance of teamwork in doing work and the roles and rules of being a member of a team.	Understanding the roles and rules for the effective functioning of an organization whose members have diverse expertise and understanding of problem solving and can act accordingly.	Respecting the opinions of others as a member of a team on a specific issue and work collaboratively with appropriate communication.
Leadership	In carrying out the work, being able to explain the role of the leader of the work.	Understanding the role of leaders in ensuring that an organisation comprising members with diverse expertise functions effectively.	Being able to model their own behaviour, encourage appropriate behaviour in others and promote collaboration and research.
Ethics	Being aware of their ideas about compliance with laws and regulations and their responsibilities as engineering technicians.	Being able to explain the idea of compliance with laws and regulations and the responsibilities as an engineering technician in basic examples.	Being able to be aware of the impact and effects of technology on society and nature, and be able to take basic actions based on the responsibility that engineers have to society.

credibility of the results, was used. The significance level was set at less than 5%. A categorical analysis (Otani, 2019) was conducted on the texts obtained from the free-text responces. Categorical analysis is characterized by collecting many concepts extracted from multiple data and proceeding with the analysis on the whole (Otani, 2019). Therefore, we determined that category analysis was suitable for achieving the purpose of this study, which was to examine the learning style of technical college students in physical education classes. The specific procedures of the categorical analysis are as follows. First, the contents of the free descriptions were coded and positioned as codes. For example, a response such as "My physical strength improved a little" was coded as "Improvement of physical strength." Next, we focused on the similarity of each code, and generated subcategories that encompassed multiple codes. For instance, the codes "The joy of sports" and "The joy of physical education" were grouped under the subcategories "The joy of exercise." Using the same procedure, categories were generated on top of the multiple subcategories. We then categorized the codes generated from the 1st grade descriptions and those generated from the 5th grade descriptions, and then calculated the ratio of each category. In addition to the first author, a university staff member specializing in physical education pedagogy and a health and physical education teacher from a technical college conducted the "peer validation" (Merriam, 2004) procedure, in which multiple investigators conducted the analysis in order to increase content validity.

Ethical Considerations: In conducting the questionnaire survey, the purpose of this study was explained to the target students in advance, and they were promised that the surveys and measurements involved in the study would have no bearing on their grades, and that the data obtained would not be used for any purpose other than the study. This study was conducted after obtaining approval from the research ethics review board of X KOSEN, where the subjects of the study are enrolled.

Results

T-test: A t-test with independent samples was conducted to examine the differences between 1st and 5th graders in their achievement goals in the qualities and abilities indicated in the MCC (Table 2). The results showed that the students' level of achievement in "Independence" (t=3.68, p<0.001, d=0.53), "Self-management skills" (t=2.06, p=0.04, d=0.30), "Awareness of responsibility" (t=2.72, p=0.007, d=0.039), "Leadership" (t=2.44, p=0.02, d=0.35), "Ethics" (t=3.55, p<0.001, d=0.51). Furthermore, a "moderate" effect size was confirmed for "Independence" and "Ethics".

Table 2 Results of t-test

	1st-year students M±SD	5th-year students M±SD	effect size (d)
Independence	1.53±1.01	2.02±0.81	0.53***
Self-management skills	1.76±0.89	2.01±0.79	0.30*
Awareness of responsibility	1.70±0.95	2.05±0.82	0.39**
Teamwork skills	1.94±0.91	2.10±0.81	0.19
Leadership	1.62±0.96	1.93±0.76	0.35*
Ethics	1.54±1.03	2.02±0.82	0.51***

***: p<0.001, **: 0.001≤p<0.01, *: 0.01≤p<0.05

A categorical analysis: Categories generated as a result of the categorical analysis of the free-text descriptions are indicated by [ ], subcategories are indicated by { }, and codes are indicated by < >. The total number of codes generated was 148, of which 81 were generated from the descriptions of 1st graders and 67 were generated from the descriptions of 5th graders (Table 3).

Discussion

A t-test analysis of the means of the achievement levels of the 1st and 5th graders revealed that the 5th graders had higher means than the 1st graders for all the qualities and abilities. In particular, significant differences were found in " Independence," "Self-management skills," "Awareness of responsibility," "Leadership," and "Ethics. In addition, "Independence" and "Ethics" showed a "moderate" level of effect size. These results suggest that the continuation of physical education classes over a long period of time has an effect on the growth of 5th graders. The characteristics of sports activities can be cited as a factor. According to Nishimura and Nagata (2023), involvement with peers and instructors through sports experience contributes to the development of independence and awareness of responsibility. It is also stated that "Ethics" in sports activities is not acquired through instruction, but is fostered through self-initiated efforts (Sugita, 2023). In summary, physical education classes are developed at KOSEN to foster "Independence" through sports, and this may lead to the fostering of "Ethics" at the same time. In Japanese schools, independent, interactive, and deep learning (MEXT, 2019) and ethics education are also being promoted (Fujimura et al., 2025). Based on the results of this study, it can be said that physical education classes that can cultivate these qualities and abilities are practiced at KOSEN. In addition, the lesson plan for 4th and 5th graders of X KOSEN includes creative sports, in which the goal is to work on sports in class (Organization of National Institute of Technology, 2017a). In this class, the students are divided into teacher and student roles, and the student who plays the teacher is in charge of the entire class, from preparation to clean-up. One of the advantages of this class is that the students experience the unfamiliar role of teacher, which helps them develop a sense of leadership and responsibility in the role of teacher, and a sense of ethics in the role of student, which helps them cooperate with the teacher and create an atmosphere conducive to teaching. Against this background, it can be inferred that the values for all the abilities were higher for the 5th graders.

The results of the category analysis showed that the percentage of [social skills] was higher in the 5th grade (53.7%) than in the 1st grade (39.5%). According to Bailey (2006), physical education classes function as a place to foster cooperation and leadership, and the effect

Table 3 Results of Category Analysis

categories	subcategories	codes	1st-year students			5th-year students		
			categories	sub-categories	codes	categories	sub-categories	codes
Social skills	Cooperation and communication skills	Teamwork	32 (39.5%)	29	17	36 (53.7%)	28	8
		Cooperativeness			9			9
		Communication skills			3			8
		Consensus building methods			0			1
		Sociality			0			1
		Respect for diversity			0			1
	Leadership and initiative	Independence		2	1		6	1
		Leadership			1			5
	Powers of observation	Powers of observation		1	1		0	0
	Ability to identify problems	Ability to identify problems		0	0		1	1
	Resourcefulness	Resourcefulness		0	0		1	1
Physical growth	Improvement of motor skills	Improvement of athletic performance	15 (18.5%)	13	7	16 (23.9%)	13	2
		Improvement of physical strength			4			10
		Motor ability			1			0
		Body manipulation			1			1
	Health maintenance and management	Importance of exercise		2	1		3	0
		Importance of stretching			1			0
		Review of lifestyle			0			2
		Importance of preparatory exercise			0			1
Relationships and sports attraction	Friendship and solidarity	Solidarity	14 (17.3%)	12	4	5 (7.5%)	4	0
		Importance of collective action			3			3
		Expansion of friendships			2			0
		Consideration of surroundings			2			1
		Friendship			1			0
	Sports integrity	Sportsmanship		2	1		1	0
		Compliance with rules			1			0
		Etiquette			0			1
Interest in and enjoyment of sports	New discoveries	Discover new sports	12 (14.8%)	6	5	7 (10.4%)	1	1
		Type of sport			1			0
	The joy of exercise	The joy of sports		5	2		4	3
		The joy of team sports			2			0
		The joy of physical education			1			1
	Interest and desire to compete	Growing interest in sports		1	1		2	1
		Increased motivation for sports			0			1
Spiritual growth		The difficulty of the effort	8 (9.9%)	8	2	3 (4.5%)	3	0
		Self-management skills			1			1
		Stress management			1			0
		Maintaining Awareness of responsibility			1			0
		Sense of accomplishment			1			0
		Positive thinking			1			0
		Mental toughness			1			0
		The importance of challenges			0			2

become more pronounced as students move up through the grades. Kato et al. (2023) also stated that leadership behavior increases as students move up through the grades. Findings suggests that physical education classes at KOSEN similarly contribute to the cultivation of student leadership.

On the other hand, the 5th-year students were more likely to write about <Improvement of physical strength>. This may be due to the fact that X KOSEN has a department of merchant marine, and about one-third of the survey subjects belong to this department. The curriculum of the department of merchant marine includes on-board training on a training ship for all grades, with 1st-year students spending about one week during class and 5th-year students spending about one week during class, as well as six months in the second semester of the 4th year. Tamura et al. (1994) reported that one month of onboard training affects students' physical fitness, and since 5th-year students experience six months of onboard training in the second semester of their 4th year, they are more likely than 1st-year students to feel a decline in physical fitness during this period. Against this background, it can be inferred that 5th-year students wrote more about <Improvement of physical strength> than 1st-year students.

On the other hand, the percentage of the 1st graders' comments on {friendship and solidarity} was higher than that of the 5th graders. It has been reported that physical education classes in the lower grades tend to function as an opportunity to build friendships, while the impact of physical education classes in the upper grades is relatively low because of the already established relationships (Smith, 2003). According to Michael et al. (2023), students affected by the COVID-19 pandemic were more likely to develop friendships at school when they had greater opportunities to attend physical education classes and engage in physical activity. The first-year students in this study began their new academic year in an environment where communication with others was limited due to the impact of COVID-19. Therefore, it is possible that the 1st-year students wrote more frequently about {friendship and solidarity} in their reflections compared to the 5th-year students. These results indicate that learning through physical education classes varies by grade level, with 1st graders focusing on the formation of friendships, whereas 5th graders show more advanceddevelopment in areas such as cooperation, leadership, and physical strength. These changes suggest that the physical education class is not just a place for exercise, but is deeply involved in the process of growth.

Conclusions

The purpose of this study was to examine the effectiveness of physical education classes at KOSEN, focusing on the qualities and abilities specified in the MCC. The results of the survey showed that the mean values of all the qualities and abilities were higher in the 5th grade than in the 1st grade. In particular, significant differences were found in “Independence,” “Self-management skills,” “Awareness of responsibility,” “Leadership,” and “Ethics,” and many 5th-year students were aware of the increase in their <Leadership> and <Improvement of physical strength>. These results indicate that KOSEN students are acquiring a variety of learning through physical education classes, as indicated the MCC.

However, some issues remain in this study. Since this study is a case study of one KOSEN, there are limitations in its generalizability. In order to grasp learning outcomes of KOSEN students more clearly, it will be necessary to conduct surveys at several KOSEN. In addition, this study compared 1st-year students and 5th-year students, and it is possible that different results would be obtained in a longitudinal study of the same subjects. In the future, it would be desirable to conduct a longitudinal survey for more rigorous analysis. There are important considerations for future research.

References

Bailey, R. (2006). Physical education and sport in schools: A review of benefits and outcomes. *Journal of School Health,* 76(8), 397-401.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. USA: Routledge.

Fujimura, K., Goda, D., Fukuda, K. & Abe, N. (2025). Development and Verification of a Lesson Model for the Promotion of Sports Integrity Education: Focusing on the “Cultural Characteristics of Sports and the Development of Modern Sports” Unit in the “Physical Education Theory” Area in High Schools. *Research Minutes on Secondary Education: Hiroshima University High School Fukuyama*, 65, 116-130. (in Japanese)

Fukuda, K., Hashimoto, S. & Shibayama, K. (2024). A Case Study on the Sense of Motor Competence Retained by KOSEN Students: Focusing on Grade Differences and Gender Differences. *Journal of Japan Association for College of Technology*, 29(3), 17-22. (in Japanese)

Kato, K., Kimura, M., Tanaka, S. & Nakahara, J. (2023). Leadership Behavior and Leader Identity among College Students. *Journal of the Japanese Society for Educational Technology*, 47(2), 207-216. (in Japanese)

Kobayashi, Y., Shimoda, S. & Otsuka, T. (2023). Revision of Model Core Curriculum for KOSEN: Toward upgrading the quality assurance system of education in KOSEN. *Lecture Notes of the Engineering Education Research Seminar*, 258-259. (in Japanese)

Merrium, S.B.: Hori, S., Kubo, M. & Narushima, M. (translation) (2004). *Qualitative Research and Case Study Applications*. Minerva Shobo: Japan. (in Japanese)

MEXT (2019). *Higher Education Learning Guidelines E xplanatory Notes (Heisei 30 Years Notices) Explanatory Notes Health and Physical Education, Physical Educati on and Sports*. Higashiyama Shobo: Japan. (in Japanese)

Michael, S.L., Li, J., Sliwa, S., Cornett, K. & Hertz, M. (2023). Association Between Adolescent Self-Reported Physical Activity Behaviors and Feeling Close to People at School During the COVID-19 Pandemic. *American Journal of Lifestyle Medicine*, 18(3), 364-375.

Nishimura, Y. & Nagata, M. (2023). Health Promotion Through Sports: Physical and Mental Effects of Sports Activities on Children. *Bulletin of Toyooka Junior College*, (20), 161-170. (in Japanese)

Organization of National Institute of Technology (2017 a). *Web Syllabus for KOSEN: Hiroshima College of Mar itime Technology.* Retrieved from https://syllabus.kosen-k.go.jp/Pages/SyllabusPDF?school_id=33&department_id=11&subject_id=&year=2022&lang=ja&subject_code=1941008&preview=False&type=start&attachment=false. (in Japanese)

Organization of National Institute of Technology (2017b). *Model core curriculum: Guidelines*. Retrieved from https://www.kosen-k.go.jp/wp/wp-content/uploads/2024/04/2017_Model-Core-Curriculum-Guidelines.pdf. (in Japanese)

Otani, T. (2019). *Paradigm and Design of Qualitative Study: From Research Methodology to SCAT*. Nagoya University Press: Japan. (in Japanese)

Shibayama, K., Sagano, T. & Saito, K. (2022). Teachers' Attitudes toward the Current Status and Issues of Physical Education Lessons in Technical Colleges. *Journal of Japan Society for Subject Teaching*, 44(4), 55-68. (in Japanese)

Shibayama, K., Tomioka, H., Hamanaka, R. & Ogawa, H. (2024). What is Kosen students learning in physical e ducation classes?: Based on a survey. *International Sym posium on Advances in Technology Education 2024 Pro ceedings*, 376-380.

Shimizu, Y. & Yamamoto, K. (2022). *Introduction to Statistical Analysis Starting Now with JASP*. Kodansha: Japan. (in Japanese)

Smith, A. L. (2003). Peer relationships in physical activity contexts: A road less traveled in youth sport and exercise psychology research. *Psychology of Sport and Exercise*, 4(1), 25-39.

Sugita, F. (2023). A Study of ethical value of Sport. *Tama University journal of management and information science*, (27), 149-154. (in Japanese)

Tadano, S. (2019). Technical college education leading future learning (2) Quality assurance of technical college education: Guaranteeing the power of students. *Journal of Information Processing*, 60(7), 596-599. (in Japanese)

Tamura, Y., Horiyasu, T., Kobayashi, T., Chonan, K., Isozaki, M., Yabuki, H., Izawa, K., Sano, Y., Muramatsu, S. & Kataoka, Y. (1994). Effect of Monthly Sea Training on Students' Physique and Physical Fitness. *Chiba Journal of Physical Education*, 18, 25-32. (in Japanese)