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The Contents Design of Technology Enhanced Co-Curricular Learning in the Collegiate Environment

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Abstract: *The objective of this study was to design contents of Technology Enhanced Learning (TEL) with emphasis on a co-curricular program to promote effective operation of an online-based curriculum. The program with TEL emphasis enhanced operations and strengthened core-competencies in higher education. To achieve this goal, we examined literature reviews and case studies of the co-curricular program with a focus on the theoretical foundation of the digital instructional design model. Our cases derived from T University located in Busan, South Korea were used to understand how the co-curricular program was operated and a template of an online-based class model was designed to perform in both online and offline classrooms. Results of this study are expected to further the exploration of co-curricular learning model as well as cement the embellishment of institutional strategies for technology-enhanced digital teaching and learning methods.*

Keywords: Technology-Enhanced Learning; Co-Curricular Program; Rotational Contents Design; Team Learning

1. Introduction

Recently, a key word has emerged in various universities' curriculum, that is, "innovation through competency." Although the imperatives to cultivate core-competencies has been continuously magnified, it is impossible to cultivate various competencies that the society expects for college students to be prepared only with their core-curriculum. Thus, the significance of the competency-based curriculum continues to ceaselessly augment itself through non-curricular activities with more flexible and autonomous functions. Most of the non-curricular program operated by the universities that we studied relate to acquisition of appropriate social skills, emotional stabilization, and vocational programs, are comparatively diverse programs that satisfy the students' needs. In addition, certain institutions prepare reports of performance indicators on extra-curricular activities regularly as the requirements and importance of such have been increasingly emphasized. The educational objectives and goals pursued by the major/general education curriculum, evaluated as systematic and specialized, lacks flexibility and less autonomous in operation compared to extra-curricular programs.

On the other hand, the extra-curricular curriculum responds suitably to the needs of learners and has been equipped with flexible and autonomous decision-making in its design and execution. The extra-curricular curriculum, though individual opinions in survey results vary, is most effective in improving the aspect of subject-matters such as learners' achievement and confidence, in enhancing the sense of affiliation with their school or department, and in improving their grade point average(GPA) scores. However, despite this the recognition of the effectiveness and resulting expansion, extra-curricular programs has not yet overcome problems such as low student awareness and participation rate, lack of program diversity, and poor systematic management at an administrative level. The classification criteria, performance measurement and methods are other challenges that impede the improvement of non-curricular programs.

Until now, extra-curricular educational activities have been operated in a fragmented, sporadic, and onetime fashion, mostly in omnifarious areas of foreign languages, community service, acquisition of employment skills and relate certificates, and thus the tight link with regular curriculum of specialized subject-matters, and general education, and extra-curricular activities. The growing body of literature reported that

based upon its research, core-competency may be acquired solely through the cooperation and amalgamation with the areas of subject-matters, general education and extra-curricular programs [1]-[6]. As a result, co-curricular focused extra-curriculum activities is gradually being implemented in the purpose and spirit to supplement the subject-matters that offered by the majoring department, deepening the content comprehension and effectively attracting students' interest and motivation to their area of study [1], [3]-[6]. Co-curricular classes reported positive learning experience and effects such as improving students' learning competencies, but certain limitations exist due to the fact that studies have been mainly conducted in in-class setting with face-to-face teaching and learning. As the importance of online learning has been soaring in high demand due to the prolonged COVID-19 pandemic, digital learning, that is, learning methods based on the use of new digital tools to enable learners in a different way from face-to-face learning environment, should also be considered by educators.

Blended learning can be a learning method that combines the advantages of face-to-face class and online learning environment, overcoming the shortcomings of online classes by promoting active learning creatively. Blended learning is widely encouraged in the higher education in the era of un-tact in which how and when to deliver educative service may be altered at any given time owing to the pandemic. In addition to the social condition, universities have been embraced blended learning methods for exploring the effectiveness of learner-centered teaching and learning to compensate for the shortcomings of traditional classroom-centered class. Thus, blended learning-based class design model can serve as a guideline for the promotion of co-curricular extra-curriculum program in university education. Therefore, it is requisite to inspect online class situations carefully, both hypothetical and actual, in the consideration of exploring co-curricular program that has been successfully operated to yield the meaningful learning outcomes. The previous studies that examine the learning effects of non-curriculum programs are focused on co-curricular to other miscellaneous subject matters and reveal the effectiveness therof, but otherwise do not comment upon blended learning frameworks. Currently, there is a severe lack of instructive studies on the methodology of unconventional teaching design stages that culminate in learning outcomes. As most of the studies under discussion center upon the face-to-face classes co-curricular programs, cumulative results of on a co-curricular blended model that properly mixed with on- and offline learning situation are hardly reported.

Thus, we intend to promulgate in this study a basic configuration of an instructional design contents that facilitates a digital learning in a co-curricular, extra-curriculum program that diversifies its applications in higher education by enhancing subject-matter comprehension with technological implementation. We expect to contribute in the analysis of the extra-curriculum instructional teaching model in link to the core subject-matters and in the establishment of novel contents for a digital-based educative praxis.

2. Theoretical Exploration for Instructional Contents Design

2.1. Co-curricular Extra-curriculum Activity

In present context, the term 'Extra-curriculum with Co -curricular Subject matters' refers to a program structure that organize with the link between regular curriculum such as majoring subject matters and general education classes. The main distinction between regular curriculum and the extra-curricular curriculum rests primarily in the conferral of credits. The extra-curricular program is a type of educational program that guides students' self-development efforts that classified as extraneous in the regular curriculum. Notwithstanding the superiority of major and general education courses at universities that are generally systematic and specialized, the merit of extra-curricular curriculum lies in the fact that the programs are implemented with flexibility and autonomy [3]. It is in this fact that is the pursuit of autonomy and diversity in that extra-curricular activities do not grant graduation credits but allow learners to exert their own volition in voluntary and selective activities.

The extra-curricular curriculum is very diverse and covers almost all activities outside regular curriculum. Through the extra-curricular curriculum, students can develop various competencies that will become in high-demand by employers and other social institutions. The relevancy of extra-curricular education is on a credending track [4]. The malleability of the extra-curricular curriculum is that it can establish educational goals and select activities by reflecting competencies in accordance with the changes required by society. To understand the background of this phenomenon in the extra-curricular curriculum courses, regular curriculum cannot satisfy the increasingly stringent requirement for diverse and broad learning experiences and learning environments. Thus, in the extra-curricular curriculum, the hypothesis that self-directed learning is accelerated

by students' leading choices/areas of learning activities, educational effects such as learners' collaboration ability, leadership competency, social engagement, and college life satisfaction were confirmed by the data [5].

In general, universities nowadays administer extra-curricular programs with the purpose of improving the basic academic abilities in addendum, conducting experiments for researchers, and compensating with skill-driven, participatory programs for the impracticality of theory-focused, abstract class of their major. However, they only provide minimal information about these co-curricular programs and the enrollment is also based on students' voluntary participation. As extra-curricular education supplements and expands the scope of the regular curriculum in-depth development of co-curricular program, it needs to induce students' active participation and competencies by bridging abstract learning contents that learners acquired in their regular curriculum with active and lived educational experiences that ultimately reward individuals with an encouraging sense of learning satisfaction [3]. Unlike the regular curriculum courses, extra-curricular educational activities necessitate students' voluntary participation, but often the programs suffer from low participation rates due to no credit penalties and low awareness. In the rare cases that co-curricular has been linked with the regular curriculum, general education such as liberal arts classes have been dominant rather than co-curricular with core-competency subject matters.

According to studies examining cases of co-curricular programs in dual context of general education classes and majoring subject matter [1], [3-8], most of co-curricular extra-curriculum programs have been constructed in the view of supplementing and enhancing the understanding of contents. It was found that project-based extra-curricular pursuits accommodated students to accomplish more in their subject matters by fostering discipline of their studying as well as improving core-competency as the programs provides ample opportunities to the utilization of the knowledge previously learned inside of the class structure. It was also found that the progress of the learner-led performance executed effectively in cultivating core-competencies such as self-directed competency, interpersonal competency, communication competency, creative thinking competency, and problem-solving competency.

2.2. Online Class and Blended Learning

To give a proper definition, online classes are conducted both in real-time running or video-recorded in a non-face-to-fact online situation where students, teachers and classrooms are discrete. Here, we will look into the components of online class design.

The main factor in online class design is learner-centered education [9]. If we intend to realize the learner-centered teaching and learning design of online education, the direction will be centered upon the promotion of self-directed learning and nurturing inter active learning environment. First, in order to encourage learners' self-directed learning in online classes, existing self-regulated learning strategies are used to support learning based on students' individual characteristics and learning data via an education system such as PIES(Personalized Integrated Educational System). which preserves individuals' learning history. In addition, the entire process of instructional planning, design, and evaluation is supported by technology-assisted learning platform. Second, in order to promote the interactive learning of online education, active interactions between learners and instructors, learners and learners, and learners and contents should be encouraged by utilizing various online tools. Through the functional interaction with these tools, online class can be the field of a high-quality educational experience than that of actual classroom. This perhaps solve the predicament of online education which mainly consists in the absence of a sense of presence in students' learning performance. Third, from the constructivistic viewpoint, which places a great emphasis on the learners' lived educational experience or "practicum", online educational success can be students' connection with optimal functionality in technology with which they be able to performance as self-assisted, self-directed, and self-regulated learners. Potentially, if a transformation in online learning setting achieves realization, then online learners' enthusiasm for their learning about the class contents may be deftly cultivated, creating greater promise to expedite more educational effects than that in the traditional teaching methodology of class learning.

The effective interaction with learners and instructors via the learning platform can be more onerous than initially expected. Even in the platform learning, students often expected the teacher's performance just like they are in the classroom which may cause some confusion. Thus, teachers in online platform do more instructional preparation than they were in the classroom performance. Also, it has been reported that teachers' dexterity dealing with technology tools is a decisive factor in the success of the online class [9]. The learner evaluated that the quality of online classes can be relied upon the method of online content delivery, the competency of the instructor, the composition of the lecture screen, and the structure and operation of the lecture

[9]. It can be denoted that a good online class contains factors such as content design, proper demonstration, and screen design and image quality should be considered critically from a holistic viewpoint.

A blended learning incorporates online and offline learning depending on the type of online class operation. Blended learning alleviates the problems occurred face-to-face classes with the advantage of e-learning. As in the implementing the blended learning class, online learning is compelling in terms of effective interaction such as the expanding, equalizing, and informal interactive communication. Yet concomitantly, there is a lack of qualitative interaction can be occurred if not properly handle the pedagogical practice. Flipped learning is defined as a method in which students study prepared video lessons in advance through online learning and participate lessons in the classroom. Blended learning and flipped learning can be more regulated as pre-knowledge acquisition through video learning after which post-discussion through which enhanced learning is processed. In this case, the instructor must consider the online portion as prior learning and the actual class conducted in the classroom. Investigating international case studies [10]-[14], an in-depth approach for online learning and adopting technology in the design stage of a blended learning course signifies recognition of the pedagogical aspect in online lessons. The participants have acknowledged the effectualness of the sophisticated course design, and that their academic achievement has been improved than their previous results in offline classes. On the other hand, the blended instructional approach with cursory design and lax implementation resulted in markedly disproportionate amounts of online learning instruction, disconnection between face-to-fact learning and online courses, which is in accordance the probable result of low academic achievement in students' outcomes and lessened functionality of online learning technical tools. When designing blended model, it is necessary to understand the advantages and limitations of on- and offline classes, to be able to reorganize the class according to the learning situation, and to combine the advantages of in-class activities and online learning situation with ease.

The blended learning model utilizing in the educational settings is as follows [15]-[17],. First, the 'Flex Model' refers to a model that grounds online learning, but flexible enough to meet the teacher face-to-face so the learner's may satiate his or her educational needs. In this model, a teacher meets students on-site to enhance approachability between students and the instructor. In South Korean context, the case of "Korean Cyber High School" is an exemplary case of using the flex model. The 'Enriched Virtual Model' refers to a process in which the required face-to-face interaction is required on Tuesdays and Thursdays, but online self-study is permitted on Mondays, Wednesdays, and Fridays, In the 'A La Carte Model', students attend school participation in classes, but some elective subject matters are offered online, as well as teacher-students conferencing occurs on regular basis throughout the semester. The 'Rotation Model' refers to a rotation of a certain learning model according to a set schedule during the semester in which learning methods such as 'online learning',' small group instruction',' assignment' are circulated. Overall, it is considered well adaptable model for a novice instructor, who having conducted face-to-face classes for long, has just embarked upon online teaching and learning. Sub-categories of the Circular Model include 'Station Rotation','Lab Rotation','Flipped Classroom' and 'Individual Rotation'. 'Station Rotation' is a form of learning by circulating fixed stations (online, teacher-led classes, collaborative activities) within the learning field to which the learner belongs. At the beginning and end of the class, the instructor leads the class until in the middle of the class, after which the students cycle through the three stations in small group activities. 'Lab Rotation' is a form of online learning that takes place within the time of classroom instruction, commonly inside of a computer lab for online learning elements to prevent disconnection between online and offline learning. 'Flipped Classroom' same as flipped learning, has a structure in the form of online learning that reverses the order of traditional classroom learning, face-to-face discussion learning or online learning, and face-to-face task solving. 'Individual Rotation' is a form in which students rotate to learn according to a schedule tailored to each individual through a computer algorithm or personally by a teacher. Individual rotation learning has similarities to station rotation learning in that it revolves within groups of the classroom, but individual rotation learning differs in that it switches stations according to their own customized schedule.

3. Materials and Methods

3.1. Case Study

To explore the direction of designing the blended-based instructional model with co-curricular extra-curricular program, we select T University located in Busan, South Korea. T-University has been operating this

program from the 2020 academic year in which school curriculum has been restructured into a competency-based, co-curricular, and integrated disciplinary perspectives. As the university has accumulated empirical data on the operation of the components of class management linked to this co-curricular program. Thus, the program was analyzed as an optimal example in achieving the goal of this study in designing blended learning co-curricular class.

As we delved into the above mentioned case, the prerequisite learning ability of students was inspected beforehand and their competency level in discipline was strengthened by either engaging with team-based learning activities or attentively monitored instruction through co-curricular program. Though learner-centered active learning methods such as team learning, the focus upon strengthening collaboration capabilities such as cooperative learning competency, collaborative learning capability, and peer and group leading capability. The instructor conductors diagnostic evaluation (both before and after co-curricular program), manages team learning by the participants, and then selects a team leader who behaves as a mediator between the teacher and team members. For each team activity, the team leader writes a learning log and all the participants write a reflective team journal, team learning typically lasts more than 5 times for about 2 hours at a time. At the end of the program, a post test is conducted to perform pre- and post- comparative analysis on the effectiveness of learning. Upon reviewing the general trend of program activities, we concluded that the comprehension of the subject matters of their discipline and learning efficiency of the participating students were improved overall. Among the lasses participated co-curricular program in the second semester of the 2021 academic year, two subject matters in which learner-centered educational activities including team learning activities were performed competency and in which learner satisfaction was satisfactorily high were selected as the sample case for this study.

The learning process of a specific subject matter was analyzed in a case-by-case analysis with a learning analysis method that corresponds to the most preliminary analysis [18] [19]. The learning activities and contents were examined, and information about which factors and environments influence learning and ways to improve it was extracted. As for the accumulating data, both structured data and unstructured text data were analyzed. Among the qualitative research methods, by using the consensual Qualitative Research(CQR) method [20], the data for the program operation plan, student activity log and testimonials, satisfaction survey narrative types, and result reports were coded to create domain-categories was developed, and finally resulting in the core-concept that was cross-analyzed by researchers who executed the proofreading.

3.2. Case Analysis Results

First, the goal of the co-curricular of <Language Development> class is to facilitate for students to properly apply linguistic terms when explaining the overall aspect of language development in applying Korean grammatical knowledge to the latter task of analyzing children's actual speech pathology. Based on the basic linguistic terminology of the Korean grammatical knowledge learned in this course, it benefits students by effectively exercising practical knowledge in applying it to gathered speech data through team activities and analysis.

For the operation of the co-curricular as the extra-curricular program of the <Language Development>, a diagnostic evaluation is conducted to evaluate the basic knowledge and skills related to linguistics of Korean gramma pre-semester starts or at the beginning of the semester for students to monitor their own prerequisite learning ability and understand general competency level of their discipline through the 'Major Conduct of the Competency Survey'. This particular class is a required course for all first-year students, and in the supposition that students who engage in co-curricular activities may not yet have a substantial sense of initiative as regard to choice of major, the trajectory of the operation is set to increase departmental awareness and academic initiative through team learning. In the general framework, about 5 teams or so, 3-4 team members perform team learning from which a leader is selected for each team.

A short video lecture and group activities are conducted using Zoom instrument under the professor's supervision, and a learning log is cataloged, the results of which the team leader reports to the professor. In these regular team learning activities, all students prepared at least one oral assignment per week, analyzed the contents of various genres of written and spoken material, completed the same learning goal every week, and performed a post-learning diagnostic evaluation and survey in the final week of the course. At the end of the semester, a diagnostic evaluation was repeated to check the review of Linguistics and Korean grammar to confirm the advanced learning ability of the participating students.

According to the standards followed by co-curricular programs, basic concepts related to language development that frequently appear in exams were reviewed and academic achievement and adaptability to the department improved through peer-to-peer learning, fostering greater motivation. To assist task performance and increase the learning adaptability of the subject in question, review of the oral material and the continuous reiteration of Korean grammar knowledge of high school textbooks constituted the main teaching content. As a result, basic vocabulary knowledge was strengthened, and particularly by applying the same knowledge with a peer and analyzing the phonetic meaning of the statement in a pair or group, the resulting learning was intensified by mutual cooperation.

Table 1. Student-led Learning Activities

Week	Team Activities	Tech-based method
1	Diagnostic evaluation(Pre-) Team Organization/ Core-competency aptitude test/ Survey Content analysis(word and sentence level)	Online survey Online Zoom
2	Morpheme analysis	Online Zoom
3	Sentence structure, syntax	Online Zoom
4	Verb conjugation and endings	Online Zoom
5	Diagnostic evaluation(Post-) Speech analysis(Utterance) /Program satisfaction survey	Online Zoom Online submission (reflection, activity log) Online diagnostic test

As a result of the subject matter's learning evaluation, the score increased by 6.66 points from 52.67 points in the pre-evaluation to 59.33 points in the post-diagnosis. In the 'Program Participation Satisfaction Survey', participants' interest in their discipline has been increased. As a result of comparing the pre- and post-test results, the students reported that they studied Korean grammar and linguistics on their own, and the average score of the entire dictionary questionnaire improved from 3.15 to 3.58. The response that 'I can explain the grammatical knowledge to other students' also received scores of 3 or higher in the range of 'mostly yes' compare to the 2 point of 'not so' response in the beginning of the program. In addition, interest in studies on discipline has increased slightly.

Table 2. Pre- & Post- Analysis of Learning Activities

	Team		Type	Pre-diagnostic Test		Post-diagnostic Test		Achievment
	Leader	Member						
Language Development	4 team		During	52.7		59.3		+6.66
	4	8		80	33.3	86.6	33.3	

As a result of qualitative analysis of the data of <Language Development>, 125 codings were generated. This was "consultation and coordination with peers" (23) as the maximum number of codings summarized in semantic units in a list of eight domains. In an example of this coding, the students participating in the program were first-year students and understood the contents of the class by "sharing thoughts and opinions with fellow team members" through extra-curricular activities in the midst of COVID-19 crisis, and "communicating with the team members for difficult parts." One participant also stated, "I gradually decided the direction of the class by talking and exchanging my opinions with others." In addition to this, the effect of "Professor's feedback" (17), which secured the second largest number of coding among eight domain lists, appears to have played an important role in inducing meaningful learning of subject-cross-curricular activities. Because, in the linguistic part, the professor in charge of the instruction of technical terminology and grammatical understanding commented, "At the end of the group study, she summarized the part that were confusing as a whole, and it was helpful for learning", and the professor's explanation of advanced grammatical content as "By using the song as an example sentence, she explained the grammar content so it could be easily understood." Through the co-curricular activities, students felt that their major competency in the requirement of linguistic skill improved,

reporting that, "Participating in the extra-curricular activities has increased their grammatical knowledge." I conclusion, it may be that the major-linked extra-curricular activities improved the problem-solving ability of the participating students by performing small group tasks to apprehend grammar knowledge.

On the students' reflective group reflection journals, the content of learning was perceived as uninteresting as most of the grammar examples are taken out of context with exhaustive rote-memorization, but morphological analysis, which gave most of the students barely grasped, was rendered effective by cooperative learning with the team members. Especially, in an instance from the qualitative data, when the learning material that they struggle the most with emerged from various journals, they adapted to the learning structure harmoniously in a group fashion. In particular, the instructor's immediate feedback and pre-learned mini-lecture videos were invaluable in group activities, one of the methods which was recognized by the participants that the program was beneficial because they were able to demonstrate the oral phrases that they had acquired in their regular class.

Table 3. <Language Development> Co-curricular Analysis

Core-concept	Domain-Category	Coding #
Task-based Problem Solving skill	Team unity	14
	Feedback from Instructor	17
	Consultation and coordination with peers	23
	Team task-based performance	15
	Individual competency demonstration	11
	Sense of accomplishment	15
	Team learning awareness	14
	Problem-solving with collaboration	16
8 Domains		125

Second, a case analysis of <Medical-Surgical Nursing>. Adult nursing practice is a required that deals with in-depth knowledge of the circulatory system, which is the vital in professional practice. Accordingly, through the diagnostic evaluation of prerequisite subjects, the co-curricular program was developed and put into operation to identify the characteristics of learners, such as minimal degree of prerequisite learning and the basic level of achievement for the instructor to set the learning goals for the program, and to establish a class strategy applicable to them. An extra opportunity to be able to get familiar with the structure and function of the circulatory system was warmly welcomed as a learning goal for co-curricular activities. In addition, a constructive change to enhance core-competency related to the discipline and collective rewards for the improved groups was promised, which attracted students' interest in this extra-curricular activity.

Through the diagnostic evaluation, as mentioned above, the co-curricular program was practiced in accordance with the appropriate instructional strategy by identifying the characteristics of the learner such as the level of pre-learning stage and the level of achievement for the goal of the program. In the extra-curricular program, especially in the cycle, "Anatomy and Physiology" part is composed of four study subjects in which the teams conducted group learning activities. Each member is in charge of one sub-topic, and after intensive individual learning, team learning is carried out in a small group session. Through individual student evaluation and team evaluation, teams with excellent learning scores were rewarded for their academic achievement. By adding inducements for excellent teamwork as well as improving individual academic achievement, this gesture indicated that the successes of individual team members can lead to team success and prizes, thereby enhancing collaboration capability among members.

In order to examine the effectiveness of the program, pre-evaluation and post-questions, the professor analyzed the results with a total score of 80 points for the pre-test and 120 points for the post-test. As a result of team learning, the evaluation after learning in groups 1, 3, and 4 was dropped, but the group 2, the post-evaluation results proved the effectiveness of the program. However, the "Major Learning Ability Survey"

demonstrated that students' learning abilities had improved. Learning satisfaction was analyzed as 4.73(Likert 5) in terms of operation of the extra-curricular class.

Table 4. Pre-Post Analysis of Learning Activities

Evaluation	Result				Note
Pre-Diagnostics	1team	2team	3team	4team	G2 Awarded Proficiency ↓
	87.6	79.3	72.7	56.7	
Post-Diagnostics	1team	2team	3team	4team	
	67.4	82.1	66.9	52.2	
Survey : Core-competencies	Pre-: 2.94±0.43		Post-: 4.14±0.50		Proficiency ↑
Program Satisfaction	4.73±0.43				range 1~5

The main course is especially demanding for students in the nursing department. As a result of inferring and analyzing the core-concept after developing domain-categories by coding the data, the general conclusion was that the participating students in the upper grades dealt well with the "online cooperative learning situation with division of workloads among the team members". As evidenced by their positive interaction in sharing new perceptions of team learning, collaboration and problems with peers, and in helpfully acknowledging the inadequacies of individual learning capabilities accompanied by problem resolution. From the pre- and post-study performance analysis, the learning results were reported as lower than when the extra-curricular activities were started, but based on the data on program satisfaction and group learning reflection, the results of qualitative analysis confirms collaboration and information sharing strategy among team members, the team leader's learning situation and responsibility for the team members, and recognition of the team members' hard work each other. Thus, it was confirmed that meaningful learning experiences for students should be analyzed in contemplation of far more factors than test scores.

Table 5. <Medical-Surgical Nursing> Co-curricular Analysis

Core-concept	Domain-Category	Coding #
Online Collaboration & Information Sharing Strategy	Team dynamics	3
	Evaluation/Feedback from Prof.	5
	Collaboration and sharing strategy	17
	Team problem solving skill	15
	Understanding shortcomings	12
	Effective strategy of team learning	15
	Team learning awareness	20
	Sharing strategy and knowledge	11
	8 Domains	98

3.3. Discussion and Implications

The case analysis confirmed that the co-curricular program linked to the extra-curricular activity indeed strengthened core-competencies of their discipline, and it increased the synergy of learning through problem-solving learning through online team activities and cooperation and collaborative learning among team members.

T-University regards the university students' extra-curricular activities as having a positive effect on active and cooperative learning development, which is expected to bring a ripple effect of teaching methodology in the university [21]. In order for participants to become active and cooperative in learning, it is necessary to invest extra time and effort rather than unthinkingly proceeding with regular course contents. Collaborative learning with fellow students is important in co-curricular program of extra-curricular activities, and by asking questions or by discussing with other students, they receive timely help in understanding the class materials. In addition, they will be able to prepare for major-related exams and certification exams together while studying in tandem. These active and cooperative learning activities facilitate class preparation and eventually ignite to deep learning. Moreover, to motivate students to participate and learn proactively scholarships that derive from the mileage of extra-curricular system are provided and the participating students can collaborate with each other less inhibitively. It was confirmed that these practices are regarded as an effective educational methods that can generate a synergistic effect of learning in step with the curriculum. The nature of the activity linked to the extra-curriculum program in which the class management shifts by the application of a multi-dimensional/modal educational method in which the extra-curricular activity that fulfills the needs of the participants. The factors that might affect the selection of the instructor among multitudinous options typically include the experience of the practice the field of studying directly connected with the job preparation, practice and implementation. Students participating in the co-curricular program usually report that they acquire the ability to emphasize quickly with the teaching habits of the instructor, accurately evaluate their own requirements and learning level, and familiarize themselves with the nature of the subject.

Hyun's study, which analyzed the same program of this study, also found that learner's program satisfaction and team learning satisfaction lead to program recommendation to their peers [6]. In particular, in the COVID-19 situation, there was a lack of interaction between peers by implementing social distancing. Due to such a program, participating students were able to exercise tasks through online team activities (mainly problem-solving learning practice) and division of workloads among team members (collaborative and cooperative learning) with which limited but flexible learning environment has been practiced via the digital educational technology. The customized and personalized online based team learning received positive evaluations and identified learners' needs and demands for team acclivities within the context of learner centered education. If an accurate diagnosis of team learning through cooperation is the basis of reinforcement of learners' self-directed and problem-solving abilities in the co-curricular program, participants in the extra-curricular activity will have a meaningful learning effect through team learning appears to be verifiable.

To enhance students' competency, co-curricular problem linked with extra-curricular activity implements in the regular school curriculum. The degree and method of participation differ depending on the departmental and/or instructional level, however, the participation performance of co-curricular program need to be thoughtfully considered before the implementation.

4. Designing a blended learning-based Co-Curriculum Contents

4.1. Co-curriculum Learning Direction

Based on the results of case studies and previous reports [14]- [20], the design direction of the instructional contents was derived.

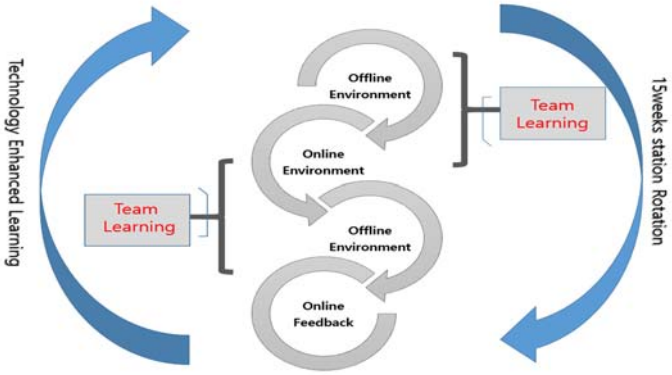

Figure 1. Station rotation model based blended class

First, co-curricular classes induce active participation in learning and form social relationships through the process of solving problems by linking abstracted and formalized subject contents with concrete and practical learning experiences in informal situations such as extra-curricular activities with the purpose of designing to enhance their learning abilities. By allowing an opportunity to actually apply and utilize the knowledge learned in their regular education course, the participants engage the co-curricular activities to improve the content knowledge and skill, as well as to enhance core-competency abilities. In the teaching and learning method with digitally driven multi-mode learning strategy, core competencies such as self-directed skill, interpersonal skill, communication skill, creative thinking skill, and problem-solving skill are cultivated through the learner-led project execution process. The participants endowed to take an active role to construct knowledge or new concepts by connecting between the content presentation of subject matters and extra-curricular activity learning format. To the end, they become more aware of adaptive learning, individualized instruction, and customized learning. Instructors who manage co-curricular program are expected to deliver the content knowledge as well as managing to orchestrate the entire process of the extra-curricular program. To design co-curricular instruction ahead, instructor as well as curriculum designer with collaborative efforts to embed the co-curricular program within course design. By doing so one can easily understand the entire process of lecture planning, execution, and evaluation to establish an education system for the operation of curriculum–extra -curricular linkages. With the course syllabus as their blueprint for the course management, instructor and students together construct educational technology based learning environment. Information and communication technologies such as LMS (Learning Management System), video conferencing tools such as Zoom, are indispensable for realizing the interactive co-learning.

Second, blended learning class with emphasis on the realization of learner-centered, require to prepare resources with careful discretion as class contents and materials can be easily obtained on the internet, but appropriate and systematic instructional strategies are needed. The suggested blended learning class model is designed based on the ‘Station Rotation Model’. Based on the cycle of each learning station, the learning station from the teacher's knowledge transfer to the interactive activities between learners can be multifaceted and continuous, and each form of learning is suitable for linking successively. In this study, the cycle of 'offline-online-offline-online(evaluation)' is circulated for one semester in accordance with the current situation of university lectures for 15 weeks. Since online feedback, the last link of the learning model, cannot afford to circulate in the station of on- and offline learning, online learning is divided into a station of learning executed in extra-class hours (in alliance with co-curricular program). With this in mind, we envisioned the form of station rotation models that circulate three points: 'offline learning', 'team learning', and 'online learning', but include team learning within offline and online learning (see Fig1). Therefore, blended learning-based classes are organized to strategically operate online learning activities and face-to-face learning activities.

Third, in offline environment, face-to-face learning activities introduce the basic concepts and principles for the team learning via online learning environment. For team learning, design what group activities will lead to achieving the class goals as well as establish strategies to increase collective cooperation. Then, in online learning activities, basic concepts and principles that acquired in the face-to-face class are re-learned by customized and/or individualized learning. After that, offline environment recur to ensure learners’ understanding of the contents.

Forth, as for the online feedback, we suggest to utilize AI technology and operate various digital-based learning platforms. AI technology is used in LMS to help them constantly recognized goals, provide them constructive feedback, and continuously monitor students’ progress to evaluate on-going proficiency. In addition, the AI technology adaptive learning systems are recorded unremittingly that brings about active interaction and students’ learning outcomes as the feedback from the machine is possible.

4.2. Designing Learning Contents

Based on the blended learning-based instructional model of co-curricular program, the teaching and learning strategy was constructed as follows.

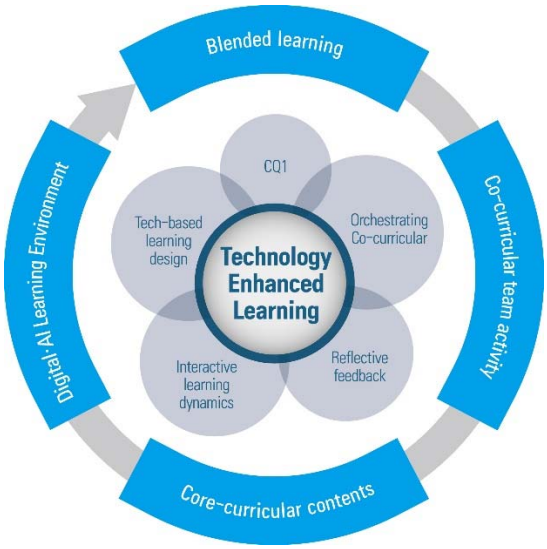

Figure 2. Technology enhanced learning contents design

4.2.1. Technology Enhanced Learning

Blended learning based instruction helps students to accomplish a meaningful learning process by each student's individual differences, needs, characteristics, interests, and academic mastery. To realize the customized and personalized learning, the learning experience must provide a proper learning platform designed that operate to execute the effective and systematical perform for Technology enhanced learning. With the adapting educational technology, and by checking and controlling their learning process without being an obstacle of ubiquity in the access and delivery of resources and service, learners become more interactive, collaborative, and personalized. Thus, a learning platform is designed and operated to meet such learning management can be systematically performed. In particular, in the context of cooperative learning, it is necessary to have the ability to get familiar with the functionality in educational technology as well as to refine self-regulated learning capabilities in a group with team members.

In order to induce smooth interactive online classes, the technology enhanced learning infrastructure and learning platform, which are the basis of digital learning, must be designed and operated in a user-driven manner. For example, to efficiently manage and share materials so that group learning or individual learning can be possible by replaying the learning content at any time, or detailed instructions for instructors, professional managers, and learners in each area to efficiently operate the online learning environment.

The problem with online learning is that students may not have real sense of learning awareness even if they take video lectures or participate real-time classes [9]. Therefore, a learning platform should be designed and operated to enhance the learning presence, and through this, active learning experiences and individual learning intentions can be achieved via online. In the online classroom situation, learners should be provided with opportunities to reflect on their own learning process and results and to develop meta-cognitive learning ability and competency that can constantly identify and improve their level of achievement. The instructor helps learners understand their learning situation by providing information related to the learning status through the online platform. In the instructor's guide for the design of online learning for motivation, it is possible to stimulate learners' interest in learning and to strategically manage their own learning motivation. In the course of the learning process, the instructor performs analysis based on various evaluation materials conducted using the learning platform, accumulates and manages the collected data, and uses big data for the successful class activities of students and the quality of the instructor's class for online classes.

4.2.2. Interactive Learning Dynamics

Dynamic learner-centered interaction can take place between instructor and students, team leader and team members. it is essential to create a learning atmosphere that can increase academic efficacy, a step-by-step scaffolding strategy that allows learners to focus on learning content and check the progress by themselves. If the dynamics function properly, then, timely responses to students' question-and-answer will occur. To aggrandize the effect, student preference evaluation method for academic achievement can bring about promising results. It is very difficult to derive dynamic interactions for successful classes in a non-face-to-face

situation where students, professors, and classrooms are separated. However, applying sophisticated design and teaching methods in consideration of the online educational environment and technical characteristics can increase the interaction of teaching and learning. In online classes, education on appropriate behavioral guidelines is required when conducting real-time classes. In this class etiquette, students should learn a new online class culture to maintain smooth non-face-to-face classes, such as how to understand the appropriate situation and convey their opinions when participating in real-time classes, technical difficulties, and appropriate expressions. In addition, when collaborating in online classes, it is necessary to provide a rubric for peer evaluation when performing team activities and joint projects in order to proceed more effectively than in the classroom situation. In order for legitimate criticism to be shared among learners, it is necessary to prepare in advance by instructors. For example, it provides an evaluation rubric for peer evaluation, or prepares students for presentation before peer evaluation so as to promote confidence through practice. It also provides guidance to fellow students participating in the evaluation to become a valid evaluation in advance. In this way, it induces activation of peer-to-peer interactions. Since online class guidelines on communication with students and peers conduct classes under non-face-to-face situations, it is necessary to create an online non-face-to-face class atmosphere where students express their thoughts online and listen to their peers' opinions.

4.2.3. Technology-based Learning Design

In order to allow learners to continue to focus on the class in online classes, instructors need to reorganize the contents of the class according to the online class. The module should be appropriately set according to the student level in consideration of the learning topic, difficulty, and connection between contents. In the case of classes conducted online, the contents of the class should be divided into shorter time units than face-to-face classes in consideration of the concentration. For this reason, it is essential to reorganize online classes in consideration of the connection between the topics, difficulties, and contents described above. In order to facilitate the interaction between learners and class contents, the core parts that learners must know when organizing class contents are selected and organized. In addition, in order to increase the mutual relationship between students and learning contents, it is recommended that learning tasks should be appropriate for learners' interests and needs, and that these tasks can be related to meaningful learning experiences in actual situations. At the time of online class design, instructors must conduct a preliminary survey on students' interest, motivation, needs, and satisfaction to grasp them. Before the learning task, students' preferred methods of performing and submission are investigated through surveys, interviews, and meetings, and after performing the learning task, instructors and learners jointly evaluate the learning task to derive improvement measures. When applying the principle of learner-participating online instructional design, interaction between students and learning contents occurs through task performance, and eventually, the learner's learning effect can be maximized and the quality of the instructor's teaching content can be improved.

To make extra-curricular courses efficient via AI-based learning and assessment technologies for implementation to embedded LMS, they are required to operate and manage as conversation-based learning, and e-Portfolio tools. These AI tools to monitor student progress can provide guided feedback, and cumulative student assessment. Conversation-based learning is a system that uses AI technology to simulate voice tutorial conversations between teachers and students. It has mainly been used to perform step-by-step online writing in Computer Science, but as recently been used in less structured subjects as well. The learning system develops a conversation that leads students to find an appropriate solution to a problem on their own, and learns through questions generated by machine. It leads students’ in-depth understanding of their learning objectives as they participate the learning process actively to respond positive feedback. The AI-based e-portfolio can also be used to accumulate students’ online activities of subject matters and extra-curricular education. Records on the e-portfolio will be created and authenticated by block chain technology to yield an intelligent, dynamic learning inventory. By doing this, students will have a much more palpable record of their learning experiences and achievements.

4.2.4. Reflective Feedback

Activate learners' reflective activities through collective journal writing is an important factor in achieving student self-directedness through instructional design. It is necessary to provide learners with an opportunity to reflect on their own learning processes and outcomes and to develop meta-cognitive learning ability and competency that can consistently identify and improve their achievement levels. The collective reflection

writing is recognized as an effective tool that enables learners to systematically reflect. Learners can develop a critical thinking process by systematically looking back on their learning content itself at a certain point in the learning process. A learning activity report and a reflection log are prepared so that reflective feedback activities can be carried out. Through the learning activity report, it identifies whether there are difficulties in using the skills necessary for students' online classes, and closely analyzes whether students increase their understanding through student reflection journals. In the case of online classes, cooperative knowledge composition and cooperative self-regulation strategies are also established through group reflection of students. In particular, in task-oriented or team-based classes, co-reflection of online class activities can enhance students' sense of belonging to the learning community and instill a sense that producing and developing common knowledge as a "knowledge-building learning community that promotes collaborative knowledge production" [22]. It helps to improve pedagogical strategies of instructors.

4.2.5. CQI

Learning analytics is collecting data that generated through online and offline learning and they will be students' grades and academic achievements, LMS activity history, credits, etc. can be found on the online platform. Using the data accumulated through these online platforms, it is configured to track students' academic stages and predict future academic performance. This learning analysis analyzes various data generated in the student's learning process in real time and builds an optimized learning model for each student. In addition to analyzing the learning process of a specific subject, it is possible to predict the academic performance or activities of the subject to be taken in the future by analyzing the student's social relationship or data such as demographic characteristics, past learning outcomes, online logins, and discussion participation. Predictive results help to efficiently proceed with self-directed learning, and help professors to efficiently intervene in the learning process and give guides. Based on the student's learning activities or achievements, it provides optimized learning content, that is, intelligent or adaptive educational content, to the student. The last step is adaptive learning that provides learning information, methods, and feedback according to the student's level and learning style.

Table 6. Co-Curricular blended class design & contents development

Principle	Element	Item
Technology Enhanced Learning	Network learning	· Manage smooth interactive online class
		· Secured an efficient digital learning infrastructure
	Learning platform	· Learning platform designed to promote learning presence
		· Learning platform designed for team or personalized learning
		· Learning platform designed to systematically manage the learning history
Interactive Learning Dynamics	Instructor v. Students	· Provide a checklist for team activities
		· Provide adequate personal and team feedback
	Team leader v. Team member	· Provide a guide to an appropriate online learning culture
		· Provide online rubric for peer evaluation
Technology-based Learning Design	Learner-centered ; Task-based contents	· Reorganize the contents to fit the online class
		· Task appropriate to the interests and needs of the learners
		· Design participatory online task performance that engages learners
Reflective Feedback	Collective reflective journal/Log	· Investigate any difficulties In using the skills required for online class
		· Improve students understanding by carefully analyzing the student reflective log
CQI	Continuous Learning Improvement evaluation	· Learning Analytics
		· Optimize learning for each student in the on/off learning process via the analysis

5. Conclusions

In order for various efforts to achieve results through innovation and quality improvement of university education, it is necessary to provide students with a wide range of experience by developing and implementing a systematic comparison program and various education for each student's characteristics. Through these learning activities, socially-friendly talent can be produced, and it can be recognized as a place where universities provide high-quality curriculum as educational activities that learners take the lead.

First, the instructional design linked to subject comparison derived three directions: the connection between subject and comparison, a blended learning-based cyclical instructional model, and learner-centered education. In this study, the station rotation model was presented to design a blended instructional model linked to the subject comparison that circulates the cycle of offline-online-offline-online (evaluation) within 15 weeks of a semester. This instructional model design will allow learners to check the learning process on their own, thereby improving learning understanding, and ultimately encouraging academic achievement by recognizing learning as a meaningful activity. Instructors and curriculum designers will be able to develop a CQI system that allows them to design, operate, manage, and evaluate data-based classes by promoting pedagogical improvement of linked programs with professional comparison and program management personnel rather than burdening them.

Second, blended instructional design strategies linked to subject comparison were presented as meaningful learning, dynamic interaction, flexible instructional organization, reflective reflection, and CQI evaluation. If the instructional design is based on the station rotation model, the instructional design strategy can be seen as a cross-sectional model of the learning situation in each subject-linked comparison and class activity. Based on this model, the blended instructional design strategy linked to subject comparison is expected to increase the amount of meaningful learning of students by the number of times if it is operated for a semester from as short as 5 weeks to as long as one semester.

Third, for the operation of subject-linked comparison classes, individualized learning intervention should be operated by category or major. In order to induce gradual academic development by overcoming the sluggish basic learning ability, we propose a plan to resolve the predicament by using a mobile adaptive learning system. Individualized learning procedures are operated online and appropriate coaching is needed. It is expected that if such a program is modularized and completed in the lower grades, it will be possible to facilitate students' virtuous cycle of academic performance in major-related classes.

6. Recommendations

Recommendations for follow-up research based on the results of this study are as follows.

First, it is necessary to expand the operation of co-curricular program in extra-curricula curriculum. Universities need to select areas or topics that are likely to succeed in co-curricular programs with the examples of several preceding universities, and then gradually expand the pilot operation of the programs. In order to strengthen student competency and establish a systematic plan through co-curricular program, it is necessary to develop the extra-curricular curriculum with personalized and customized learning orientation which ultimately improve learners’ academic achievement.

Second, it is necessary to prepare a systematic learning analytics. Overseas universities that use educational data well have already shown great results in academic performance, retention rate, and graduation rate. Interest in learning analysis is low in the nation’s universities. Since the use of LMS (Learning Management System) also does not utilize other functions other than delivering class data, it is necessary to seek ways to more proactively utilize the learning platform. Various analysis techniques for predicting students' academic performance should be used, and reliable prediction algorithm development is required. The data analysis results are intended to improve the learning and educational environment of students in a specific institution, and algorithm or model development should also be designed to reflect the characteristics of the educational institution.

Third, a ground breaking online learning support system should be established. In an online learning environment, it is necessary to maximize the use of technology in online class design by checking technical support and learning support system when designing classes. Due to the nature of online classes, it is necessary to be able to predict technical problems that may occur during class operation, and to prepare countermeasures. To this end, it is necessary to be familiar with the school's technical support policies and plans. In the case of

online classes, students' individual learning results should be systematically managed and an online learning environment should be established so that students can read them when necessary. In the case of universities, there are many differences in the technical support system, operating budget, manpower, and program quality for each school. Improving online classes requires individual efforts by instructors, but a support system is more urgent.

Conflicts of Interest: The authors declare no conflict of interest.

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