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A Social Computing Based Analysis on Team Efficacy and Outcome of Real-time Online Sports Capstone Design Class

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Abstract. Recently, non-face-to-face classes are increasing in university education, and classes including practical classes and team activities as well as theory classes are often conducted non-face-to-face due to COVID-19. In particular, recently, capstone design classes at universities are being conducted not only in the engineering field but also in other majors. In the case of these capstone design classes, there are many professors who show difficulty in conducting non-face-to-face classes. This study investigates team efficacy and team activity-related performance in an online capstone design class. The subjects of this study were 30 sports major students who took a sports capstone design class. The real-time video class was conducted through Webex, and a Padlet was used as a tool for more active interaction. Analysis was performed using SPSS statistical analysis. The results of a questionnaire survey on team effectiveness and learning performance among participants are as follows. The average of team effectiveness was high, which means that team activities, which were considered difficult as non-face-to-face activities, were performed effectively. There were many items that had a significant correlation with team efficacy and learning performance when conducting a team project in capstone design learning. In other words, to achieve positive results, it will be necessary to increase the sense of team efficacy, as well as to actively utilize technology to increase the sense of team efficacy. The results and analysis of this study are expected to be helpful not only for non-face-to-face capstone design classes, but also for non-face-to-face classes centered on team activities.

Keywords: Team efficacy, outcome, capstone design, education technology, real-time online education

1. Introduction

Recently, in the society as a whole, education for so-called digital natives is required, and universities are also recommending classes or online classes using these digital devices, while education on how to use them is also provided (Na, Jang, 2016; Na, Song, 2014). In particular, the use of digital devices and online classes have become more active due to COVID-19, and these classes are expected to increase with the emphasis on the need for educational technology to respond to changes in future education after pandemic. Even in the past, the need and demands for the vitalization of online lectures have been constantly raised in education. Online classes are being actively conducted mainly at cyber universities, and some general university courses were operated in an online format. Nevertheless, the proportion of online classes at four-year universities before COVID-19 was only about 1% of the class (Do, 2020). However, it is predicted that the frequency of these online classes will not return to the pre-coronavirus level even after the coronavirus is over. Universities should also strive to improve their competencies through these classes and interactive online activities that will be actively used in a future society (Brown et al., 2020). In this case, even the capstone design class, which until now had been considered to have halved the effectiveness of online classes, would be able to be effectively performed.

Recently, interest in capstone design in universities is increasing (Lee et al., 2009; Kim, Lee, 2017; Lee et al., 2010). In the past, 'capstone design' was mainly performed in engineering-related departments, but since capstone design is effective in nurturing the capabilities necessary for the future, it has recently been carried out in humanities and social sciences and arts and physical education subjects as well (Kim, 2019). In the capstone design class, the sense of team efficacy among team members is very important because it is mainly conducted by performing a team project based on the theory learned in the department or through experience. However, due to the COVID-19 pandemic, most university classes have been switched to online, and there are studies that show less interaction compared to face-to-face situations, and team efficacy is also predicted to decrease (Jung, Brady, 2020). Recently, real-time online classes using Zoom and Webex are conducted where professors and students gather in online environment. In addition, by using the small group function, team activities are possible, and the professor can observe the students and give feedback on them to activate the interaction (Kleinman, 2005). On the other hand, there is also an argument that college students who participate in online-based team learning have a different sense of burden than the face-to-face situation (An, 2021). However, this can also be supplemented by the use of smart technology. Smart technology in the learning environment is sometimes used synonymously with smart tools (Kim, 2015). Despite the fact that online capstone design can be activated as described above, it is difficult to find studies using interaction or communication tools in capstone design classes. Moreover, recently, many studies related to smart tools have been conducted, but most of these studies are for teachers (Lee, Hwang, 2017).

There are few studies that actually used it for college students and looked at its effectiveness, but it is difficult to find a case where it was used in capstone design, which is getting a lot of interest in recent years.

Therefore, the purpose of this study is to investigate team efficacy and team activity-related performance in an online capstone design class using Webex's small group function and a Padlet, a tool that can help in interaction and communication among sports majoring college students. Also, based on this, we would like to suggest directions and implications for effective strategy establishment of online capstone design classes. This study focused on sharing and communication support tools. The sharing and communication support tool refers to a tool that helps small groups to share ideas to help interaction and improve teamwork (Kang, 2018).

2. Literature review

Ryu and Kang (2020) investigated the use of smart tools that support sharing and communication among pre-primary teachers through the analysis of the science lesson plan. This showed a high percentage and was found that elementary school pre-service teachers used smart tools in 22 of the 33 lesson plans they developed, and used devices that support the mirroring function or the user's screen sharing method. In the case of using sharing and communication tools, most of the presentations of experiment and activity data were reflected in the students' expressions of various opinions or corrections through exchange. What this study is particularly meaningful is that this study is not only about knowing the functions of sharing and communication tools and selecting smart tools, but also developing and demonstrating classes directly. It was emphasized that it is necessary to examine the possibility of various uses of the tool.

Chang and Young (2017) investigated the perceptions of 12 elementary school teachers to find out the changes that occur using smart technology. The survey used questionnaires, group discussions, classroom discussions, and participant interviews, and it was thought that the use of smart devices would bring about the following changes in scientific research activities. Teachers thought that they could observe phenomena that were difficult to observe directly through smart devices. This is being used a lot in education that requires observation recently. In addition to this, teachers thought that digital measurement would allow for accurate and quantitative inquiry results, and that data could be accumulated in a variety of ways. Furthermore, teachers also considered sharing, which can be said to be the biggest advantage of using smart devices, as an advantage of utilization. Han and Na (2019) tried to examine their experiences of how and why teachers apply smart technology in STEAM classes, identify difficulties, and find out what kind of support they need. Their research showed that the study participants were using various types of smart technology in the STEAM class. In addition, they stimulate students' interest, active participation, and indirect experience.

This smart technology was used to provide opportunities for students and to attract students' attention. In addition to this, it was also used to provide classes suitable for the future society. In the case of difficulties, it was difficult to find and secure suitable smart technology when applying smart technology in STEAM classes. Some participants had difficulties in conducting classes because the smart technology suddenly stopped working. In this study, in order to activate the use of smart technology, guidelines for applying smart technology, development and dissemination of educational materials, training, and securing smart technology devices were presented. Although more support is being provided now than at the time of conducting this study, it will be necessary to consider these aspects.

Lee (2013) conducted a study for designing a model for team-based learning using smart technology, that is, the Smart technology-enhanced Team-Based Learning (S-TBL). Based on the existing Team-Based Learning model, this is a meaningful model because it designed a learning model that combines not only mobile technology, but also cooperative learning, problem solving learning, and various evaluation models. This model is designed to cultivate various competencies such as problem-solving and critical thinking as well as conceptual learning. Specifically, when designing a learning model applicable in a smart technology environment based on the existing Team-Based Learning model, it provides a holistic learning environment that integrates learning resources, evaluation tools, problem-solving situations, and problem-solving processes. It will increase communication among team members.

3. Methods

Participants, class methods and analysis methods are as follows.

3.1. Participants

The participants of this study were learners taking the ‘Sports Capstone Design Course, which is a sports health management major. There were 18 male students and 12 female students, 25 students in third grade and 5 in fourth grade. All students had enough sports-related knowledge to carry out capstone design by grade three or higher.

3.2. Process

This class was opened for third graders, and the first third session was conducted as a theory class to help students understand the capstone design class, and after that, it was conducted as a real-time video class. The real-time video class was conducted through Webex, and a Padlet was used as a tool for more active interaction. Classes are designed to use these technologies to achieve cooperative learning, creativity, and problem-solving skills. Based on the contents and experiences learned at the undergraduate level, the team project was focused on recognizing and solving problems related to sports. Students form teams of three to five people, and each team

autonomously selects a topic. The instructor used the small group function of Webex to allow the students to work in each team, and the instructor went into each small group, observed the students, and gave feedback. Participants worked on the project in collaboration with the team members and submitted the project report as the final product. In each class, the whole group explained the task for the day and presented the results of the last class. After that, they were divided into small groups so that they could design the capstone as a group activity. The group activities consisted mainly of discussion, and the results of the discussion were uploaded to a Padlet so that other team members could see it, and the professor in charge gave feedback on the content. Topic selection, overview, surroundings, adding creativity, composition and content, and the final report were uploaded to the Padlet. For harmony among team members, the team name was decided, team rules were set, and this was also uploaded.

3.3. Questionnaire

To check the team activity performance after the online capstone design class, the questionnaire of Shin (2018) was modified and used for this study. In the case of the team efficacy lecture, the questions of Marshall (2003) were modified by Shin Su-min (2018). For the team efficacy questionnaire, a questionnaire was given before mid-term exam, and the questionnaire for learning outcomes was given after the completion of this class. All items were rated on a five-point scale (1=strongly disagree, 5=strongly agree). In addition, the students responded in the descriptive form about team effectiveness and learning performance.

3.4. Analysis

Data related to team efficacy and learning performance were analyzed at a significance level of .05 using SPSS 18.0. A descriptive statistical analysis was performed. In addition, to see whether team efficacy can predict learning outcomes, correlation analysis between team efficacy and learning outcomes was also performed.

4. Results and discussion

Team efficacy, learning outcomes, and correlation between team effectiveness and learning outcomes shown in this study are as follows, respectively.

4.1. Team efficacy in technology utilization class

[Table 1] and [Table 2] show the results of perception of team effectiveness. Only the average of the questions 'I think our team has the necessary skills to perform capstone design' was below four and the average of all other items was above four. Since this survey was conducted after several classes using Webex and Padlet, it is believed that the participants recognized that there was no problem in team activities when using

these technologies. On the other hand, even in the case of items with a score of four or less, it was found that learners' perceptions changed when they saw the learning outcomes. Usually, professors think that team effectiveness will decrease if it is not a face-to-face class. Contrary to concerns, these results mean that there is no problem in team effectiveness when smart technologies such as Padlet is used in classes using online platforms.

Table 1. Perceptions of team effectiveness (frequency)

	not at all	disagree	neutral	agree	strongly agree
a1. I believe that our team members will contribute to the 'team task.	0	0	5(16.7%)	10(33.3%)	15(50.0%)
a2. I am sure our team has the knowledge of 'how to work as a team.	0	2(6.7)	5(16.7%)	10(33.3%)	13(43.3%)
a3. I believe our team has basic teamwork skills.	0	0	6(20.0%)	8(26.7%)	16(53.3%)
a4. I believe that our team can work together well and do team activities.	0	1(3.3%)	5(16.7%)	9(30.0%)	15(50.0%)
a5. I expect our team to do the 'team task' well.	0	1(3.3%)	4(13.3%)	9(30.0%)	16(53.3%)
a6. I believe that our team has the 'skills needed to perform team tasks.	0	1(3.3%)	7(23.3%)	14(46.7%)	8(26.7%)
a7. I expect our team to do well on 'team assignments and team exams.	0	0	5(16.7%)	9(30.0%)	16(53.3%)
a8. I believe our team will do well on team assignments and exams.	0	0	4(13.3%)	13(43.3%	13(43.3%)

4.2. Learning outcomes in technology utilization classes

[Table 3] and [Tabel 4] show the learning outcomes in the capstone class using technology. Looking at the results, except for the question of whether the ability to recognize problems and solve them has improved, the average score exceeded four in all items. In particular, the average of the item asking whether the ability to communicate effectively was cultivated and the item asking whether the necessity and content of the outcome could be understood by others was the highest. These results mean that sufficient communication is possible even in non-face-to-face classes if the technology that can activate team activities is used.

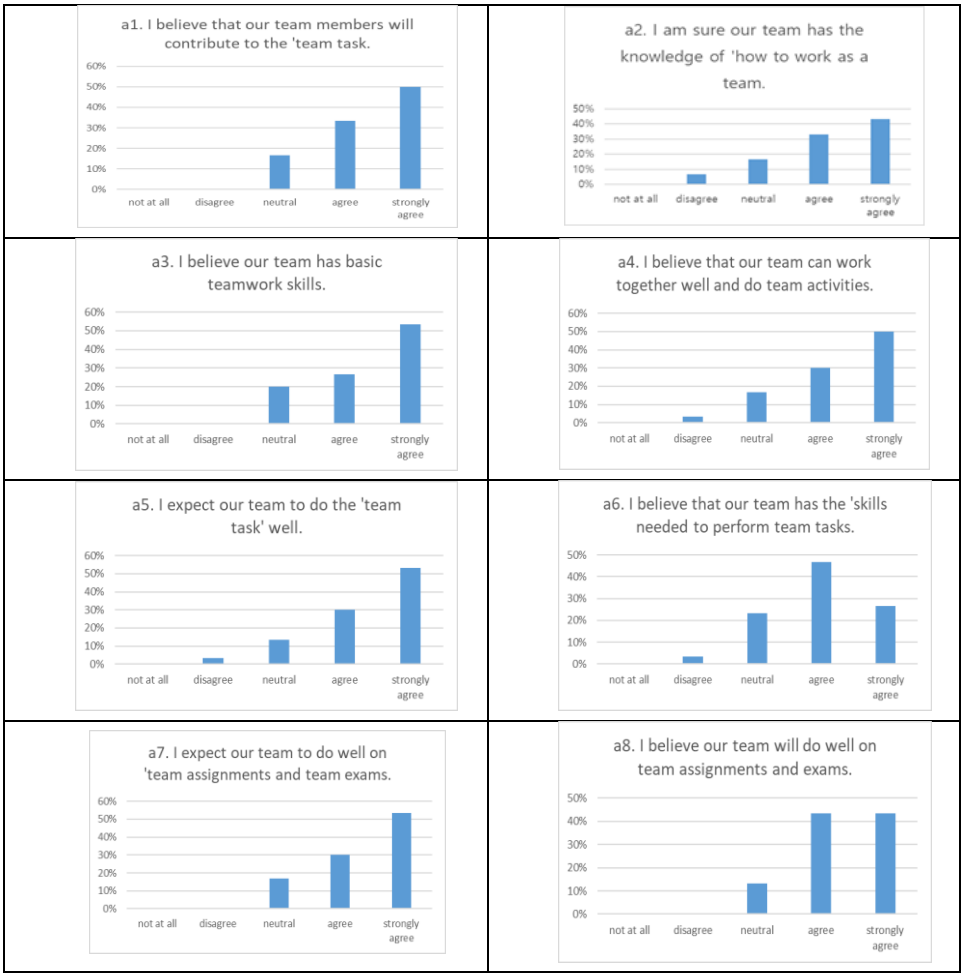


Fig. 1: Perceptions of team effectiveness(frequency)

Table 2: Perceptions of team effectiveness (mean, s.d.)

	mean	s.d
a1. I believe that our team members will contribute to the 'team task.	4.33	.758
a2. I am sure our team has the knowledge of 'how to work as a team.	4.13	.937
a3. I believe our team has basic teamwork skills.	4.33	.802
a4. I believe that our team can work together well and do team activities.	4.27	.868
a5. I expect our team to do the 'team task' well.	4.33	.844
a6. I believe that our team has the 'skills needed to perform team tasks.	3.97	.809
a7. I expect our team to do well on 'team assignments and team exams.	4.37	.765
a8. I believe our team will do well on team assignments and exams.	4.30	.702

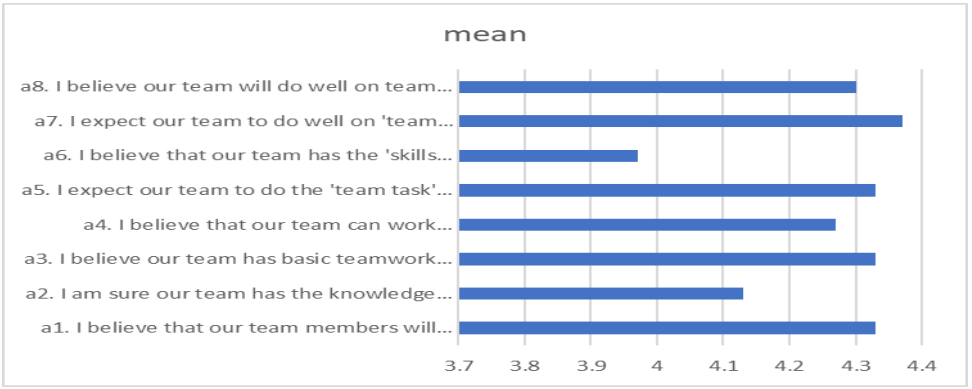
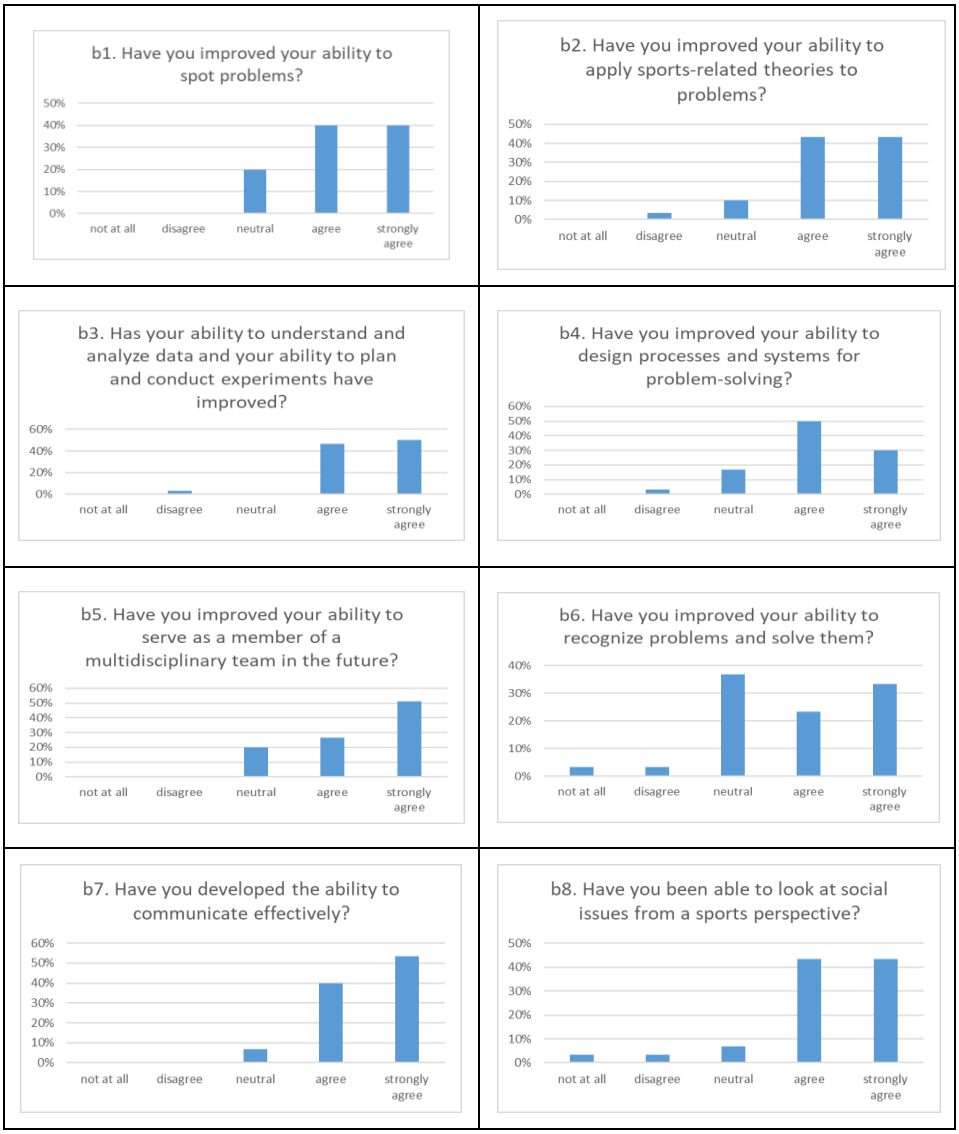


Fig. 2: Perceptions of team effectiveness(mean)

Table 3: Perception of learning outcomes (frequency)

	not at all	disagree	neutral	agree	strongly agree
b1. Have you improved your ability to spot problems?	0	0	6(20.0%)	12(40.0%)	12(40.0%)
b2. Have you improved your ability to apply sports-related theories to problems?	0	1(3.3%)	3(10.0%)	13(43.3%)	13(43.3%)
b3. Has your ability to understand and analyze data and your ability to plan and conduct experiments have improved?	0	1(3.3%)	0	14(46.7%)	15(50.0%)
b4. Have you improved your ability to design processes and systems for problem-solving?	0	1(3.3%)	5(16.7%)	15(50.0%)	9(30.0%)
b5. Have you improved your ability to serve as a member of a multidisciplinary team in the future?	0	0	6(20.0%)	8(26.7%)	16(51.3%)
b6. Have you improved your ability to recognize problems and solve them?	1(3.3%)	1(3.3%)	11(36.7%)	7(23.3%)	10(33.3%)
b7. Have you developed the ability to communicate effectively?	0	0	2(6.7%)	12(40.0%)	16(53.3%)
b8. Have you been able to look at social issues from a sports perspective?	1(3.3%)	1(3.3%)	2(6.7%)	13(43.3%)	13(43.3%)
b9. Are you familiar with the use of various tools to solve problems?	0	0	7(23.3%)	10(33.3%)	13(43.3%)

b10. Do you understand the difference between theory and practice?	0	0	3(10.0%)	14(46.7%)	13(43.3%)
b11. Have you been able to make others understand the need and content of your achievements?	0	0	2(6.7%)	12(40.0%)	16(53.3%)
b12. Have your time management and risk management skills improved during the project?	0	0	3(10.7%)	9(32.1%)	16(57.1%)



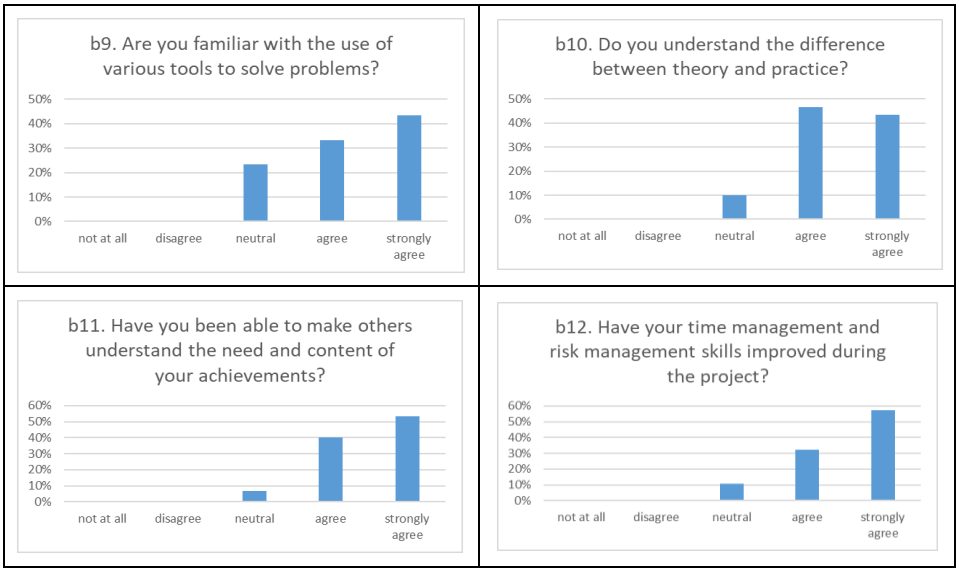


Fig. 3: Perception of learning outcomes (frequency)

Tabel 4: Perception of learning outcomes (mean, s.d.)

Question	mean	s.d.
b1. Have you improved your ability to spot problems?	4.20	.761
b2. Have you improved your ability to apply sports-related theories to problems?	4.27	.785
b3. Has your ability to understand and analyze data and your ability to plan and conduct experiments have improved?	4.43	.679
b4. Have you improved your ability to design processes and systems for problem-solving?	4.07	.785
b5. Have you improved your ability to serve as a member of a multidisciplinary team in the future?	4.33	.802
b6. Have you improved your ability to recognize problems and solve them?	3.80	1.064
b7. Have you developed the ability to communicate effectively?	4.47	.629
b8. Have you been able to look at social issues from a sports perspective?	4.20	.961
b9. Are you familiar with the use of various tools to solve problems?	4.20	.805
b10. Do you understand the difference between theory and practice?	4.33	.661
b11. Have you been able to make others understand the need and content of your achievements?	4.47	.629

b12. Have your time management and risk management skills improved during the project?	4.46	.693

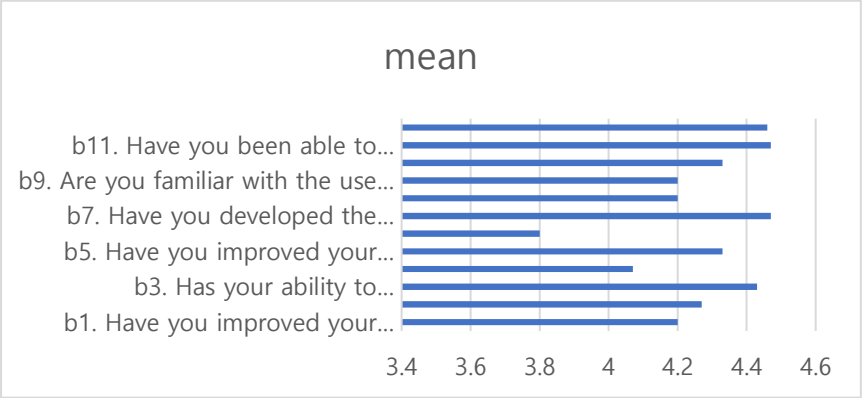


Fig. 4: Perception of learning outcomes(mean)

The descriptive answers about team effectiveness and learning performance in this class were as follows. In the descriptive questions, it was found that the students recognized that there was no difficulty in team activities and that they were able to develop various competencies.

Tabel 5: Main descriptive answers

Descriptive answers
- It was very meaningful to learn a new class method, and it was a good time to work together with other students and carry out assignments in a very efficient and creative way in the current situation of COVID-19.
- It was more helpful to take classes using the online class environment and real-time video lecture platform that was better than the previous Capstone non-face-to-face lectures.
-It was online, but it was very helpful to use the technology that allows you to do group activities. -Even though it was online, it became a class to develop the ability to speak out in front of people.
- At first, team activities didn't feel very welcome, but in class, I found creative ideas through various opinions and learned how to draw positive and rational conclusions through amicable compromises.
- It was good to be able to develop my competencies for various roles evenly through the experience of taking on different roles every week.
- The ability to understand and solve problems given weekly has improved, and the ability to understand and analyze data has also improved through data research. Also, it seems that the conversational ability to convey

my thoughts through the presentation, the problem of the current sport, the acquisition of various theories by looking at the tasks of other groups, and the thinking ability to think in various aspects through feedback have improved.

- Through this class, the problem-solving process, team leadership, communication skills, presentation skills, and project management skills were further strengthened. And autonomous responsibility and creativity were further developed.

-Although we were not able to meet in person, learning about action learning through online classes increased participation in learning and it was nice to be able to share ideas freely with each other.

-I was able to think in many ways, including a new way to communicate with team members, a new way to conduct a class, a new way to discuss. We were able to communicate more smoothly with our team members through diverse participation, that is, submitting various materials and presenting opinions. Originally, I couldn't participate much due to my personality, but I was able to participate a lot through this class.

-It was my first time taking a capstone design class as an online class, so I was concerned and worried about the relationship with the team members. However, as time passed, the awkwardness disappeared, and teamwork was good despite being online.

4.3. Correlation between team effectiveness and learning outcomes

[Table 6] shows the relationship between team effectiveness and learning outcomes in the capstone design class. Looking at the results, 'Have you improved your ability to spot problems?' and ' Has your ability to understand and analyze data and your ability to plan and conduct experiments have improved?' and 'Have you developed the ability to communicate effectively?' were strongly affected by the sense of team efficacy.

In particular, 'have you improved your ability to spot problems?' questions and the response 'I believe that our team has the 'skills needed to perform team tasks', 'have you improved your ability to apply sports-related theories to problems?' and the response 'I am sure our team knows 'how to work', has your ability to understand and analyze data and your ability to plan and conduct experiments have improved?' and the response 'I am sure our team has the knowledge of how to work as a team,' show strong correlations.

These results suggest that it is important to improve team effectiveness to improve the ability to apply to problems in the capstone design class, improve the ability to understand and analyze data, and develop the ability to communicate effectively.

Tabel 6: Correlation between team effectiveness and learning outcomes

		a1	a2	a3	a4	a5	a6	a7	a8
b1	Pearson r	.598**	.590**	.508**	.490**	.483**	.627**	.462*	.529**
	sig.	.000	.001	.004	.006	.007	.000	.010	.003
b2	Pearson r	.541**	.606**	.456*	.347	.278	.503**	.348	.475**
	sig.	.002	.000	.011	.060	.138	.005	.059	.008
b3	Pearson r	.380*	.665**	.422*	.441*	.281	.530**	.480**	.441*
	sig.	.039	.000	.020	.015	.133	.003	.007	.015
b4.	Pearson r	.309	.550**	.292	.226	.173	.330	.245	.338
	sig.	.097	.002	.117	.230	.359	.075	.192	.068
b5.	Pearson r	.378*	.489**	.464**	.264	.238	.230	.300	.367*
	sig.	.039	.006	.010	.159	.206	.221	.108	.046
b6.	Pearson r	.470**	.512**	.364*	.396*	.269	.393*	.432*	.360
	sig.	.009	.004	.048	.030	.151	.032	.017	.051
b7.	Pearson r	.458*	.476**	.296	.396*	.411*	.506**	.421*	.375*
	sig.	.011	.008	.112	.030	.024	.004	.021	.041
b8.	Pearson r	.142	.429*	.179	.099	.085	.275	.178	.163
	sig.	.454	.018	.344	.602	.655	.141	.346	.388
b9.	Pearson r	.282	.512**	.320	.217	.254	.275	.269	.317
	sig.	.130	.004	.084	.249	.176	.141	.151	.088
b10.	Pearson r	.321	.260	.173	.140	.103	.151	.091	.297
	sig.	.084	.166	.359	.460	.588	.427	.633	.111
b11.	Pearson r	.386*	.476**	.228	.269	.346	.438*	.349	.375*
	sig.	.035	.008	.226	.150	.061	.015	.059	.041
b12.	Pearson r	.436*	.483*	.380	.377	.199	.396*	.397*	.391*
	sig.	.023	.011	.050	.053	.320	.041	.040	.044

[Table 7] and [Table 8] show the correlation between the items of team efficacy and the correlation between the items of learning performance, respectively. In the case of team effectiveness, it was found that there was a significantly high correlation between all items. Also, in the case of learning outcomes, except for 'have you developed the ability to communicate effectively?', 'are you familiar with the use of various tools to solve problems?'', 'have you been able to look at social issues from a sports perspective?' and 'do you understand the difference between theory and practice?', the relationship between the items show significant correlation.

Tabel 7: Correlation between team effectiveness questions

		a1	a2	a3	a4	a5	a6	a7	a8
a1	Pearson r	1	.663**	.832**	.803**	.683**	.694**	.733**	.777**
	sig.		.000	.000	.000	.000	.000	.000	.000

a2	Pearson r	.663**	1	.764**	.760**	.683**	.825**	.795**	.776**
	sig.	.000		.000	.000	.000	.000	.000	.000
a3	Pearson r	.832**	.764**	1	.907**	.798**	.655**	.862**	.796**
	sig.	.000	.000		.000	.000	.000	.000	.000
a4.	Pearson r	.803**	.760**	.907**	1	.862**	.701**	.938**	.769**
	sig.	.000	.000	.000		.000	.000	.000	.000
a5.	Pearson r	.683**	.683**	.798**	.862**	1	.673**	.872**	.698**
	sig.	.000	.000	.000	.000		.000	.000	.000
a6.	Pearson r	.694**	.825**	.655**	.701**	.673**	1	.689**	.747**
	sig.	.000	.000	.000	.000	.000		.000	.000
a7.	Pearson r	.733**	.795**	.862**	.938**	.872**	.689**	1	.751**
	sig.	.000	.000	.000	.000	.000	.000		.000
a8.	Pearson r	.777**	.776**	.796**	.769**	.698**	.747**	.751**	1
	sig.	.000	.000	.000	.000	.000	.000	.000	

Table 8: Correlation between learning outcomes questions

		b1	b2	b3	b4	b5	b6	b7	b8	b9	b10	b11	b12
b1	Pearson r	1	.831**	.627**	.554**	.621**	.605**	.519**	.509**	.608**	.480**	.519**	.557**
	sig.		.000	.000	.001	.000	.000	.003	.004	.000	.007	.003	.003
b2	Pearson r	.831**	1	.682**	.642**	.730**	.768**	.508**	.612**	.567**	.554**	.508**	.544**
	sig.	.000		.000	.000	.000	.000	.004	.000	.001	.001	.004	.003
b3	Pearson r	.627**	.682**	1	.720**	.485**	.745**	.641**	.761**	.404*	.435*	.641**	.843**
	sig.	.000	.000		.000	.007	.000	.000	.000	.027	.016	.000	.000
b4.	Pearson r	.554**	.642**	.720**	1	.730**	.677**	.564**	.622**	.742**	.753**	.703**	.732**
	sig.	.001	.000	.000		.000	.000	.001	.000	.000	.000	.000	.000
b5.	Pearson r	.621**	.730**	.485**	.730**	1	.525**	.365*	.492**	.854**	.629**	.501**	.583**
	sig.	.000	.000	.007	.000		.003	.048	.006	.000	.000	.005	.001
b6.	Pearson r	.605**	.768**	.745**	.677**	.525**	1	.608**	.648**	.411*	.638**	.608**	.630**
	sig.	.000	.000	.000	.000	.003		.000	.000	.024	.000	.000	.000
b7.	Pearson r	.519**	.508**	.641**	.564**	.365*	.608**	1	.468**	.354	.526**	.913**	.792**
	sig.	.003	.004	.000	.001	.048	.000		.009	.055	.003	.000	.000
b8.	Pearso	.509*	.612*	.761*	.622*	.492*	.648*	.468*	1	.481*	.326	.525*	.603*

	n r	*	*	*	*	*	*	*		*		*	*
	sig.	.004	.000	.000	.000	.006	.000	.009		.007	.079	.003	.001
b9.	Pearson r	.608**	.567**	.404*	.742**	.854**	.411*	.354	.481**	1	.518**	.490**	.518**
	sig.	.000	.001	.027	.000	.000	.024	.055	.007		.003	.006	.006
b10.	Pearson r	.480**	.554**	.435*	.753**	.629**	.638**	.526**	.326	.518**	1	.691**	.574**
	sig.	.007	.001	.016	.000	.000	.000	.003	.079	.003		.000	.002
b11.	Pearson r	.519**	.508**	.641**	.703**	.501**	.608**	.913**	.525**	.490**	.691**	1	.792**
	sig.	.003	.004	.000	.000	.005	.000	.000	.003	.006	.000		.000
b12.	Pearson r	.557**	.544**	.843**	.732**	.583**	.630**	.792**	.603**	.518**	.574**	.792**	1
	sig.	.003	.003	.000	.000	.001	.000	.000	.001	.006	.002	.000	

5. Conclusion

The purpose of this study is to investigate team efficacy and team activity-related performance in an online capstone design class using Webex's small group function and a Padlet a tool that can help in interaction and communication among sports majoring college students. The results of the questionnaire survey on team effectiveness and learning performance among participants show that the average of team effectiveness was high, which means that team activities, which were considered difficult as non-face-to-face activities, were performed effectively. There were many items that had a significant correlation with team efficacy and learning performance when conducting a team project in capstone design learning. In other words, to achieve positive results, it will be necessary to increase the sense of team efficacy and to actively utilize technology to increase the sense of team efficacy.

The summary of the results and the implications of this study are as follows. First, although many studies related to capstone design learning have been conducted recently, there are not many studies on non-face-to-face capstone design classes. However, this study showed positive results in team efficacy and learning performance when technology that facilitates team activity and helps communication is used. This means that non-face-to-face capstone design can be performed effectively if appropriate technology is used, helping to set the direction of future lesson plans.

Second, there were many items that had a significant correlation with team efficacy and learning performance when conducting a team project in capstone design learning. In other words, to achieve positive results, it will be necessary to increase

the sense of team efficacy, and it will be necessary to actively utilize technology to increase the sense of team efficacy.

Third, in the results of this study, the average of the items asking whether participants have the necessary skills to perform capstone design or whether their problem-solving ability has improved was relatively low compared to other items. When the learners evaluated the results produced, it was found that they had sufficient skills and developed problem-solving skills. Nevertheless, such a result is a lack of confidence. Therefore, it will be necessary to inform learners in detail how much skill is required in this class and what the goal of problem-solving competency is. Also, if this has been achieved, it will be necessary to ensure that students have confidence in themselves.

This study has a limitation because it only targeted students from one university. However, it can be said that it is meaningful because it examines the relationship between classes using smart technology and team effectiveness and performance in online classes.

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