Analysis of Changes in University Students' Awareness of Online Classes from 2020 to 2022 during the COVID-19 Pandemic*

Eunmo SUNG
Andong National University
Korea

Sumi KANG**
KAIST
Korea

The purpose of this study was to examine changes in students' awareness of online classes in university education over the three years from 2020 to 2022 during the COVID-19 pandemic. To achieve this, various aspects of online classes, including self-directed learning, interaction (between instructors and learners, and among learners), evaluation of the learning process and outcomes, and the learning environment and control of learning, were analyzed for changes from 2020 to 2022. The study included 534 university students enrolled in University A who participated in online classes in both 2020 and 2021. The results indicated that there was no significant difference in the awareness of self-directed learning, but significant differences were found in the awareness of interaction, evaluation of the learning process and outcomes, and the challenge related to learning environment and control of learning in online classes, which were higher in 2021 and 2022 than in 2020. Additionally, detailed changes in awareness of online classes showed significant differences in specific aspects of awareness in university online classes. In summary, students' awareness of online classes improved in 2021 and 2022 compared to 2020, as learners adapted to online classes due to the COVID-19 pandemic. Moreover, it was observed that difficulties in the challenge related to learning environment and control of learning were overcome in 2021. Based on these research findings, several implications for improving the design and operating strategies of effective online classes in future university education were proposed.

Keywords : Online Class, Awareness, Self-directed learning, Interaction, Control of learning

Introduction

The spread of COVID-19 in 2020 had a significant impact not only on the world but also in Korea society. This impact was particularly pronounced in the field of education, where traditional face-to-face interactions between instructors and learners were taken for granted. With the emergence of the pandemic, university education was compelled to transition to online classes, marking the introduction of 'non-face-to-face classes' which had never been experienced before

During the forced transition to online classes, elementary, middle, and high schools were able to receive assistance from education policies supported at the national level. However, university education, which had to manage all online classes independently, encountered numerous challenges in the early days of the COVID-19 pandemic in 2020 when the switch to online classes became mandatory. This was primarily because universities did not have enough time to establish their own information and communication technology infrastructure for online classes or to develop the teaching capabilities of instructors. Due to the lack of infrastructure for online classes at universities and the insufficient preparation for teaching and learning methods, students had to face many difficulties in adapting (Almendingen et al., 2021; Kang & Park, 2022; Lee et al., 2020; Lee & Kim, 2020; Lee & Shin, 2020; Sung & Kang, 2024).

For instance, in situations where preparation for online classes is lacking, the focus of education shifts towards assignments or external video content, resulting in complaints about the decline in content quality. Additionally, when there is a lack of interaction between instructors and students, as well as among students themselves, coupled with insufficient self-directed learning capabilities for online classes, the irregular and substantial increase in learning volume imposes a burden on students, leading to the proliferation of negative awareness about online education (Lee & Kim, 2020; Lee et al., 2022; Sung & Kang, 2022; Sung et al., 2021).

However, as the COVID-19 pandemic persisted, efforts were made to enhance

the quality of online classes at universities. Administrators, who were initially unprepared for online classes, endeavored to establish online systems and infrastructure. Instructors worked on developing various teaching and evaluation methods, as well as educational content tailored for online classes. Meanwhile, learners utilized diverse online learning strategies within the virtual learning environment, adapting through trial and error. Consequently, improvements in online class-related infrastructure and platform development were achieved. Academic schedule management for online classes became more streamlined compared to face-to-face classes. Instructors, initially skeptical about the educational effectiveness of online classes, not only enhanced the effectiveness of education but also developed a positive awareness regarding operational efficiency (Kim et al., 2021; Lee & Shin, 2020; Choi et al., 2020; Seo & Lee, 2020).

In addition, learners also hold positive awareness of online classes, such as the high usefulness of learning convenience like repetitive learning and the freedom of time and space (Sung & Kang, 2022; Sung et al., 2022). Initially, during the early days of online classes, learners' awareness were negative. However, as online classes stabilized, learners began to develop positive awareness, and research results indicated their willingness to continue taking online classes even after the coronavirus pandemic ends (Kim et al., 2021; Lee, 2021; Lee & Shin, 2020; Jeong, 2021; Sung & Kang, 2022; Sung et al., 2022) emerged one after another. In other words, both instructors and learners have experienced both positive and negative aspects during the initial introduction and adaptation process of fully online classes at the university level.

However, existing research on online classes at universities has two main limitations. Firstly, most previous studies have focused on comparative research aimed at examining the current status of online classes and deriving improvement strategies, rather than investigating changes in students' awareness of online classes (Kwon, 2022). To achieve substantial improvement in online classes, it is necessary to understand how students' awareness have changed over time, leading to the

derivation of more student-centered improvement directions. However, previous studies have mainly analyzed the types of online classes conducted at universities, the use of media, preferred teaching methods, and focused on analyzing students' satisfaction, disadvantages, advantages, and problems with online classes to propose improvement measures, thus lacking in exploring changes in students' awareness.

Another limitation is that research during the COVID-19 period has compared and analyzed the results from 2020, 2021, and 2022 at specific points in time. This horizontal research approach allows for the analysis of results at specific points in time, but it is inadequate for analyzing and interpreting changes in awareness over time. Understanding the evolving nature of changes in awareness of online classes among university students requires analyzing the changes over time rather than just at specific time points. In other words, there is a need to examine the changes in awareness of online classes among university students from 2020 to 2022 from a longitudinal research perspective. Additionally, most comparative analyses of online classes have focused on 2020 and 2021, which is another limitation.

Based on the limitations of these previous researches, analyzing the changes in students' awareness of online classes in university education from 2020, when the COVID-19 pandemic began, to 2022, when it continued, can provide valuable insights into the evolution of online learning during the pandemic. By examining how learners' awareness have shifted over this period, we can uncover important strategies for operating online classes in the post-COVID era. This analysis can help identify areas of improvement, understand which aspects of online learning are most valued by students, and inform the development of effective online teaching methodologies and support systems. Ultimately, gaining a comprehensive understanding of the changing awareness of online classes among university students throughout the pandemic can contribute to the enhancement of online education both during and after the COVID-19 era.

Accordingly, this study sought to examine changes in students' awareness of online classes in university education over the three years from 2020 to 2022 during the COVID-19 period. To achieve this, the awareness of online classes includes self-

directed learning, interaction (between instructor and learner, and among learners), evaluation of the learning process and outcomes, and the challenges related to learning environment and the control of learning, which were frequently mentioned in previous studies as success factors for online classes. The research questions for this study are as follows:

1) How has university students' awareness of self-directed learning in online classes changed during the COVID-19 period from 2020 to 2022?

2) How has university students' awareness of interaction (between instructors and learners, among learners) in online classes changed during the COVID-19 period from 2020 to 2022?

3) How has university students' awareness of the evaluation of the learning process and outcomes in online classes changed during the COVID-19 period from 2020 to 2022?

4) How has university students' awareness of the challenges related to the learning environment and the control of learning in online classes changed during the COVID-19 period from 2020 to 2022?

Literature Review

Concept and characteristics of online classes at universities

Traditionally, classes at universities have involved instructors and students meeting and interacting simultaneously in a physical space. Online classes, on the other hand, were initially used as supplementary sessions when face-to-face classes were impractical. However, with the onset of the COVID-19 pandemic, universities adapted by incorporating online classes as a primary educational method, eliminating the need for face-to-face interaction between instructors and students (Sung & Kang, 2024).

An online class refers to a class that takes place in real-time or non-real-time in another space, without the instructor and learner physically meeting (Sung & Kang, 2024). The general concept and form of these online classes can be examined in the context of distance education. Although the meaning of distance education is defined differently by each scholar, according to Moore (1973), a representative distance education scholar: 'Distance education is described as an educational system in which learners are separated in time and space from the instructor, learn autonomously, and interact through media.'

Online classes at universities can also be understood as a form of distance education, where instructors and learners are physically separated in time and space. The medium plays a crucial role in bridging this physical separation, making media an essential resource for online classes to take place.

In online classes, the characteristics of the medium determine the type of interaction between instructors and learners, learner-to-learner interaction, and interaction between learners and educational content (content) (Moore & Kearsley, 1996; Jung & Rha, 2004). As various media for interaction have become more diverse in recent years, Sung and Kang (2024) have presented the following methods for interaction. In terms of interaction between instructors and learners, 1:1, 1: multiple, and 1: multiple group interactions can occur in real-time or non-real-time through text and conversation. Similarly, learner-to-learner interaction can take various forms, such as 1:1, 1: many, and many: many, in real-time or non-real-time through text and conversation. Interaction between learners and educational content (content) encompasses various materials, including digital textbooks (pdf, ppt, etc.), lecture audio and video materials, general video materials (YouTube, etc.), educational software materials, digital bulletin board materials, SNS materials, and ChatGPT. These interactions can occur in real-time or non-real-time. In actual online classes, a combination of these interaction types is often employed, making effective class design of online classes an important consideration.

The university students' awareness regarding online classes in Higher education

Due to COVID-19, online class methods were implemented in universities starting from the first semester of 2020, and online classes were actively conducted in Korea. Various studies on the actual situation and awareness of online classes in university education have been conducted (Almendingen et al., 2021; Kang, 2021; Kwon, 2022; Lee & Kim, 2020; Lee & Shin, 2020; Jeon, 2020; Jung, 2020; Jung & Yoon, 2020; Sung & Kang, 2024). The results of the previous research on the awareness of online classes in university education are as follows:

Initially, in the early days of 2020 when COVID-19 began, the awareness of online classes in university was predominantly negative. According to Almendingen et al. (2021), Lee and Kim (2020), Lee and Shin (2020), and Jung and Yoon (2020), university members who universities operators, instructors, and learners were ill-prepared for online classes during this period. For universities, major issues included the lack of necessary infrastructure and unstable network systems for online education, as well as a deficiency in proficiency in online academic operations. Furthermore, instructors' limited online teaching skills, such as interactions between instructor and students, led to concerns about the declining quality of education, as online classes primarily relied on simple videos and assignments, thereby increasing the learning workload. Additionally, inadequate student awareness of the importance of communication and interaction further hindered the effective delivery of online classes.

On the other hand, there were also positive awareness of online classes. This included autonomy to participate in online classes at their desired time and location, independence to learn without worrying about professors or other students, and convenience in being able to repeat professors' lectures multiple times or learn at their own pace (Kwon, 2022; Lee & Kim, 2020; Lee & Shin, 2020; Jung, 2020; Sung

& Kang, 2024).

In 2021, despite the escalating spread of COVID-19 and deepening societal crises, online classes at universities were analyzed to have been operated more stably based on the lessons learned from 2020's trial and error(Sung & Kang, 2024). However, according to the previous research findings(Jang et al., 2021; Kang & Park, 2022; Lee et al., 2022; Moon & Kim, 2023), students' awareness of online classes at universities still showed a mixture of positive and negative awareness similar to those in 2020. Positive awareness of online classes included the ability for repetitive learning, the freedom to attend classes in any location, and the flexibility to attend classes at one's own convenience. On the other hand, negative awareness of online classes included decreased concentration compared to face-to-face classes, inadequate communication with professors, and perceived inadequacy of course content compared to face-to-face classes.

In March 2022, as COVID-19 began to wane, most schools resumed face-to-face classes. However, depending on the level of COVID-19 spread, classes transitioned to online format. Over the past two years, students have become accustomed to online learning due to COVID-19, and there has even been a awareness that online classes are preferable to face-to-face classes (Kang, 2023; Sung & Kang, 2024). Still, the positive awareness of online classes includes the time-saving aspect of not having to commute to school and the ability to attend classes from any desired location, which are seen as important factors. However, negative awareness of online classes include the tendency towards laziness due to the comfort of online learning and a preference for online classes based on convenience rather than effectiveness in learning (Kang, 2023; Oh, 2022). This phenomenon may be attributed to becoming accustomed to online classes over the past two years since 2020, leading to a pursuit of convenience over effectiveness.

Method

Participants

The participants in this study were 534 university students enrolled in University A that participated in online classes from 2020 to 2022 during COVID-19. The average age of the participants was 22.78 years (SD=3.25) for undergraduate students. Gender of participants were 333 male students (62.4%) and 201 female students (36.6%).

In 2020, 141 students (34.5%) participated in this study. These students were enrolled in 2020 when the COVID-19 pandemic began, comprising 78 first-year students (14.6%), 9 second-year students (1.7%), 18 third-year students (3.4%), and 36 fourth-year students (6.7%). In the early days of the COVID-19 pandemic in 2020, due to the lack of infrastructure for online classes at universities and insufficient preparation for teaching and learning methods, students had to face many difficulties in adapting. The types of online classes during this period were mainly task-based and video-based, with some real-time classes being conducted. Regarding online classes, controversy over their quality intensified (Sung & Kang, 2024).

In 2021, 207 students (38.8%) participated in this study. These were students who had experienced the COVID-19 pandemic for more than a year and were enrolled in school in 2021, including 36 first-year students (6.7%), 64 second-year students (12.0%), 69 third-year students (12.9%), and 38 fourth-year students (7.1%). For first-year students, it was their initial experience with online classes at a university, while for second-, third-, and fourth-year students, it marked their second year of such experience. In 2021, based on the trial and error of 2020, infrastructure for online classes was improved, and various types of online classes were developed. It was reported that attitudes toward online classes significantly improved as most task-oriented classes disappeared, video-based and real-time classes were implemented, and efforts were made to foster various interactions in the online class environment (Sung & Kang, 2024).

In 2022, 186 students (34.8%) participated in this study. These were students who had experienced the COVID-19 pandemic for more than two years. For them, 2022 marked their first, second, third, and fourth years of online classes at university, respectively. They consisted of 70 first-year students (13.1%), 53 second-year students (9.9%), 41 third-year students (7.7%), and 22 fourth-year students (4.1%). By 2022, with accumulated know-how from two years of online class experience, the quality of online classes had further improved, and they were partially conducted alongside offline classes. Online class types included video and real-time classes based on online interaction, as well as hybrid classes operating in parallel with both online and offline formats.

Table 1 presents the distribution of participants in this study by year and grade from 2020 to 2022.

Table.1
Participant information by year and grade from 2020 to 2022

Year \ Grade	1st	2nd	3rd	4th	Total
2020	78	9	18	36	141
	14.6%	1.7%	3.4%	6.7%	26.4%
2021	36	64	69	38	207
	6.7%	12.0%	12.9%	7.1%	38.8%
2022	70	53	41	22	186
	13.1%	9.9%	7.7%	4.1%	34.8%
Total	184	126	128	96	534
	34.5%	23.6%	24.0%	18.0%	100.0%

Materials

The instruments for this study were consisted of 2 parts such as awareness questionnaires of online classes and participants' demographic information

questionnaires.

Awareness questionnaires of online classes were consisted of 4 parts such as self-directed learning in online classes 5 items, interaction in online classes 5 items, evaluation of learning process and outcome in online classes 4 items, challenge related to learning environment and control of learning in online classes 3 items. Awareness items of self-directed learning in online classes were referred to the study by Sung and Choi (2016)(i.e. *learning that can be repeated many times)*. Awareness items of interaction in online classes were referred to study by Joung (2009) and Jung (2020)(i.e. *convenience of interaction with instructors (question-and-answer, discussion, comments, etc*.)). Awareness items of evaluation of learning process and outcome in online classes were referred to study by Choi (2008), and Eom et al. (2020)(i.e. *monitoring your own learning process*). Awareness items of challenge related to learning environment and control of learning in online classes were referred to study Lee and Kim (2020)(i.e. *deficiencies and errors in the online education infrastructure environment*). 14 items for each scale were asked to rate their level of agreement with each statement by using 4-point Likert scale (*with 1 = very little and 4 = very much*). The reliability coefficient of the questionnaire obtained by Cronbach's alpha was .89, indicating suitable reliability.

Participants' demographic information questionnaires consisted of three items: age, gender, and grade status.

Data collection and analysis

The survey for this study was conducted with the aim of improving online classes in Higher education. Data collection for this study targeted students at University A who had experience participating in online classes for three years from 2020 to 2022.

The 2020 survey was conducted over 9 days, from June 25 to July 3, and data from 141 individuals were collected. The 2021 survey was conducted over 10 days, from October 6 to 15, and data from 207 individuals were collected. The 2022 survey was conducted over 10 days, from June 8 to 17, and data from 186 individuals were

collected. Collected data were analyzed by descriptive statistics and ANOVA techniques.

During the initial phase of the analysis, descriptive statistics were used to identify the reliability of each instrument. To examine changes in university students' awareness of online classes, ANOVA was conducted using data from 2020 to 2022. SPSS 27.0 was employed for data analysis.

Result

Changes of awareness on online classes from 2020 to 2022 during COVID-19

In this study, we analyzed changes in university students' awareness of online education conducted by universities from 2020 to 2022 during the COVID-19 pandemic. For this purpose, the analysis focused on areas such as self-directed learning, interaction, evaluation of learning process and results, and difficulties in learning environment and control perceived by university students in online classes. Table 2 and Figure 1 show the analyzed results.

The results of descriptive statistical analysis of changes in students' awareness of online classes conducted by universities during the COVID-19 pandemic are as follows. As Table 2 shows, in the self-directed learning, M = 3.54 (SD = 0.50) in 2020, M = 3.53 (SD = 0.54) in 2021, and M = 3.59 (SD = 0.49) in 2022. In the interaction, M = 2.42 (SD = 0.76), M = 2.89 (SD = 0.70) in 2021, and M = 2.98 (SD = 0.79) in 2022. In the evaluation of learning process and outcome, M = 2.97 (SD = 0.79), M = 3.20 (SD = 0.68) in 2021, and M = 3.20 (SD = 0.79) in 2022. In the d challenge related to learning environment and control of learning, M = 2.26 (SD = 0.80), M = 2.04 (SD = 0.76) in 2021, and M = 2.22 (SD = 0.86) in 2022. These changes are visualized and presented in a graph as shown in Figure 1.

Table.2
Analysis of differences in changes in awareness regarding the online classes from 2020 to 2022

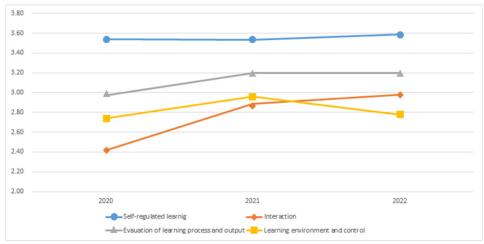| Domain of Awareness on Online class	year	N	Mean	S.D	F	Post-Hoc
Self-directed learning	2020	141	3.54	0.50	.674	NS
	2021	207	3.53	0.54		
	2022	186	3.59	0.49		
	Total	534	3.55	0.51		
Interaction	2020	141	2.42	0.76	25.089**	22, 21>20
	2021	207	2.89	0.70		
	2022	186	2.98	0.79		
	Total	534	2.80	0.78		
Evaluation of learning process and outcome	2020	141	2.97	0.79	5.054**	22, 21>20
	2021	207	3.20	0.68		
	2022	186	3.20	0.79		
	Total	534	3.14	0.75		
Challenge related to learning environment and control of learning	2020	141	2.26	0.80	3.997*	20>21
	2021	207	2.04	0.76		
	2022	186	2.22	0.86		
	Total	534	2.84	0.81		

*: $p<.05$, **: $p<.01$, NS: Not Significant

Figure 1. Changes of awareness on online classes from 2020 to 2022 during COVID-19

In order to determine whether there were differences in descriptive statistics by year (from 2020 to 2022) in the awareness area of online classes, an ANOVA analysis including post hoc analysis was conducted. As a result, there was no significant difference in the awareness of self-directed learning, F = 0.674, $p>$ 0.05. In the interaction, there was significant difference by year at the F=25.089, $p <$.01 level. As a result of post-hoc analysis, it was found that the interaction scores in 2021 and 2022 were significantly higher than those in 2020. In the evaluation of learning process and outcome, there was a significant difference by year at the F=5.054, $p <$.01 level. As a result of post-hoc analysis, it was found that the evaluation scores in 2021 and 2022 were significantly higher than those in 2020. In the challenge related to learning environment and control of learning, there was a significant difference by year at the F=3.997, $p <$.05 level. As a result of post-hoc analysis, it was found that the evaluation scores in 2020 were significantly higher than those in 2021.

In summary, there was no significant difference in the awareness of self-directed learning in online classes of university across COVID-19 years. However, interaction and evaluation were higher in 2021 compared to 2020, while challenge was higher in 2020 than in 2021. This suggests that when online classes began in 2020 due to the COVID-19 outbreak, there were deficiencies in interaction and evaluation in online classes, along with inadequate learning environments and difficulties in learning control. Nevertheless, efforts to enhance the teaching and learning process and expand infrastructure in online education have led to a positive increase in awareness of online classes.

Detailed changes in awareness of online classes in university students during COVID-19 from 2020 to 2022

To further examine the results of changes in university students' awareness of online classes analyzed earlier, detailed changes in awareness were analyzed, focusing on the areas of self-directed learning, interaction, evaluation of learning process and

results, and challenge related to learning environment and control of learning.

Detailed Changes in awareness of self-directed learning in online classes.
Detailed changes in awareness of self-directed learning in online classes were
analyzed by 4 items. The results are shown in Table 3.

Tabel 3 shows the results of descriptive statistical analysis of detailed changes in
students' awareness of self-directed learning in online classes conducted by university
during the COVID-19 pandemic. In '1. Learning that can be repeated many times',

Table. 3
*Analysis of differences in changes in awareness regarding the self-directed
learning in online classes from 2020 to 2022*

Awareness on self-directed learning	year	N	Mean	S.D	F	Post-Hoc
1. Learning that can be repeated many times	2020	141	3.77	0.49	4.542**	20>21
	2021	207	3.56	0.72		
	2022	186	3.66	0.61		
	Total	534	3.65	0.63		
2. The comfort of studying alone without other students	2020	141	3.42	0.79	1.292	N.S.
	2021	207	3.53	0.67		
	2022	186	3.53	0.71		
	Total	534	3.50	0.72		
3. Learning according to your own time plan	2020	141	3.43	0.92	.503	N.S.
	2021	207	3.49	0.70		
	2022	186	3.51	0.74		
	Total	534	3.48	0.78		
4. Learning according to your own learning speed	2020	141	3.45	0.78	.461	N.S.
	2021	207	3.44	0.76		
	2022	186	3.51	0.71		
	Total	534	3.47	0.75		
5. Learning at the place (space) you want	2020	141	3.65	0.71	1.416	N.S.
	2021	207	3.61	0.67		
	2022	186	3.72	0.54		
	Total	534	3.66	0.64		

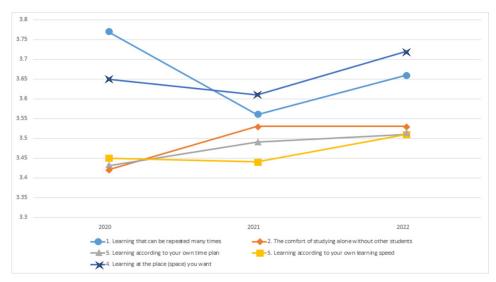**: $p<.01$, NS: Not Significant

Figure 2. Detailed Changes of awareness on self-directed learning in online classes from 2020 to 2022 during COVID-19

M = 3.77 (SD = 0.49) in 2020, M = 3.56 (SD = 0.72) in 2021, and M = 3.66 (SD = 0.61) in 2022. In '2. The comfort of studying alone without other students', M = 3.42 (SD = 0.79), M = 3.53 (SD = 0.67) in 2021, and M = 3.53 (SD = 0.71) in 2022. In '3. Learning according to your own time plan', M = 3.43 (SD = 0.92), M = 3.49 (SD = 0.70) in 2021, and M = 3.51 (SD = 0.74) in 2022. In '4. Learning according to your own learning speed', M = 3.45 (SD = 0.78), M = 3.44 (SD = 0.76) in 2021, and M = 3.51 (SD = 0.71) in 2022. In '5. Learning at the place (space) you want', M = 3.65 (SD = 0.71), M = 3.61 (SD = 0.67) in 2021, and M = 3.72 (SD = 0.54) in 2022. These changes are visualized and presented in a graph as shown in Figure 2.

In order to determine whether there were differences in descriptive statistics for the detailed awareness of self-directed learning in online classes by year (from 2020 to 2022), an ANOVA analysis including post hoc analysis was conducted. As a result, only in the item '1. Learning that can be repeated many times,' a significant difference was found at the F = 4.542, $p <.01$ level, and no significant difference was found in other items. A post-hoc analysis on item 1, where a significant difference appeared, found that the scores in 2021 were significantly higher than those in 2020.

In summary, there was a strong awareness that self-directed learning in online

classes could be achieved through repeated practice at the onset of the COVID-19. Meanwhile, the reason why there has been no change in the awareness of self-directed learning in online classes is that the awareness has remained consistently high since the beginning of the pandemic in 2020. This is interpreted to be because this awareness was consistently recognized as important even afterward

Detailed Changes in awareness of the interaction in line classes. Detailed changes in awareness of the interaction in online classes were analyzed by 5 items. The results are shown in Table 4.

Table. 4
Analysis of differences in changes in awareness regarding the interaction in online classes from 2020 to 2022

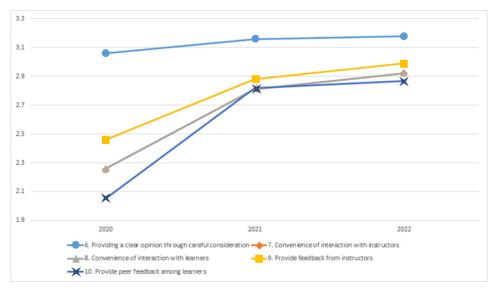| Awareness on interaction	year	N	Mean	S.D	F	Post-Hoc
6. Providing a clear opinion through careful consideration	2020	141	3.06	0.85	.819	N.S.
	2021	207	3.16	0.85		
	2022	186	3.18	0.91		
	Total	534	3.14	0.87		
7. Convenience of interaction with instructors (question-and-answer, discussion, comments, etc.)	2020	141	2.26	1.02	20.914**	22,21>20
	2021	207	2.81	0.92		
	2022	186	2.92	0.99		
	Total	534	2.70	1.01		
8. Convenience of interaction with learners (question-and-answer, discussion, comments, etc.)	2020	141	2.26	1.02	20.149**	22,21>20
	2021	207	2.81	0.91		
	2022	186	2.92	1.03		
	Total	534	2.70	1.02		
9. Provide feedback from instructors	2020	141	2.46	1.04	14.588**	22,21>20
	2021	207	2.88	0.84		
	2022	186	2.99	0.90		
	Total	534	2.81	0.94		
10. Provide peer feedback among learners	2020	141	2.05	1.01	36.009**	22,21>20
	2021	207	2.82	0.90		
	2022	186	2.87	0.96		
	Total	534	2.63	1.01		

**: $p<.01$, NS: Not Significant

Figure 3. Detailed Changes in awareness of the interaction in online classes from 2020 to 2022 during COVID-19

Tabel 4 shows the results of descriptive statistical analysis of detailed changes in students' awareness of interaction in online classes conducted by university during the COVID-19 pandemic. In '6. Providing a clear opinion through careful consideration', M = 3.06 (SD = 0.85) in 2020, M = 3.16 (SD = 0.85) in 2021, and M = 3.18 (SD = 0.91) in 2022. In '7. Convenience of interaction with instructors (question-and-answer, discussion, comments, etc.)', M = 2.26 (SD = 1.02), M = 2.81 (SD = 0.92) in 2021, and M = 2.92 (SD = 0.99) in 2022. In '8. Convenience of interaction with learners (question-and-answer, discussion, comments, etc.)', M = 2.26 (SD = 1.02), M = 2.81 (SD = 0.91) in 2021, and M = 2.92 (SD = 1.03) in 2022. In '9. Provide feedback from instructors', M = 2.46 (SD = 1.04), M = 2.88 (SD = 0.84) in 2021, and M = 2.99 (SD = 0.90) in 2022. In '10. Provide peer feedback among learners', M = 2.05 (SD = 1.01), M = 2.82 (SD = 0.90) in 2021, and M = 2.87 (SD = 0.96) in 2022. These changes are visualized and presented in a graph as shown in Figure 3.

In order to determine whether there were differences in descriptive statistics by year (from 2020 to 2022) in the detailed awareness of interaction in online classes, an

ANOVA analysis including post hoc analysis was conducted. As a result, there was no significant difference in the awareness of '6. Providing a clear opinion through careful consideration', F = 0.819, p> 0.05 level. However, significant differences were found at the p <.01 level in all other items; '7. Convenience of interaction with instructors (question-and-answer, discussion, comments, etc.) at F=20.914, p <.01 level, '8. Convenience of interaction with learners (question-and-answer, discussion, comments, etc.)' at F=20.149, p <.01 level, '9. Provide feedback from instructors' at F=14.599, p <.01 level, '10. Provide peer feedback among learners' at F=36.009, p <.01 level. As a result of post-hoc analysis with significant items. it was found that the scores in 2021 and 2022 were significantly higher than those in 2020 for all items.

In summary, the interaction and feedback among instructor and learners, as well as among learners, were very low in online classes when COVID-19 in 2020 However, it is interpreted that educational efforts to enhance feedback and interaction among instructor and learners, as well as among learners themselves, have improved since then in online classes.

Detailed Changes in awareness of the evaluation of learning process and outcome in line classes

Detailed changes in awareness of the evaluation of learning process and outcome in online classes were analyzed by 4 items. The results are shown in Table 5.

Tabel 5 shows the results of descriptive statistical analysis of detailed changes in students' awareness of *the evaluation of learning process and its outcome* in online classes conducted by university during the COVID-19 pandemic. In '11. Focus on lecture content', M = 2.84 (SD = 1.08) in 2020, M = 3.15 (SD = 0.90) in 2021, and M = 3.03 (SD = 1.03) in 2022. In '12. Monitoring your own learning process', M = 2.95 (SD = 0.89), M = 3.20 (SD = 0.81) in 2021, and M = 3.28 (SD = 0.84) in 2022. In '13. Reflection and evaluation of one's own learning results', M = 2.91 (SD = 0.91), M = 3.20 (SD = 0.75) in 2021, and M = 3.24 (SD = 0.94) in 2022. In '14. Formation of

Table. 5

*Analysis of differences in changes in awareness regarding the evaluation of
learning process and its outcome from 2020 to 2022*

Awareness on Evaluation of learning process and outcome	year	N	Mean	S.D	F	Post-Hoc
11. Focus on lecture content	2020	141	2.84	1.08	3.941*	21>20
	2021	207	3.15	0.90		
	2022	186	3.03	1.03		
	Total	534	3.03	1.00		
12. Monitoring your own learning process	2020	141	2.95	0.89	6.448**	22,21>20
	2021	207	3.20	0.81		
	2022	186	3.28	0.84		
	Total	534	3.16	0.85		
13. Reflection and evaluation of one's own learning results	2020	141	2.91	0.91	6.587**	22,21>20
	2021	207	3.20	0.75		
	2022	186	3.24	0.94		
	Total	534	3.14	0.87		
14. Formation of self-directed learning habits	2020	141	3.16	0.97	.578	N.S.
	2021	207	3.26	0.84		
	2022	186	3.26	0.88		
	Total	534	3.23	0.89		

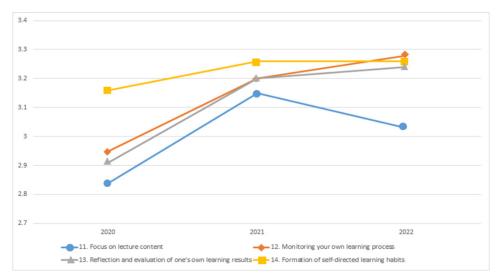*: $p<.05$, **: $p<.01$, NS: Noti Significant

Figure 4. Detailed Changes in awareness of the evaluation of learning process
and its outcome in online classes from 2020 to 2022 during COVID-19

self-directed learning habits', M = 3.16 (SD = 0.97), M = 3.26 (SD = 0.84) in 2021, and M = 3.26 (SD = 0.88) in 2022. These changes are visualized and presented in a graph as shown in Figure 4.

In order to determine whether there were differences in descriptive statistics by year (from 2020 to 2022) in the detailed awareness of the evaluation of learning process and its outcome in online classes, an ANOVA analysis including post hoc analysis was conducted. As a result, there was significant difference in the awareness of '11. Focus on lecture content' at F = 3.941, $p<0.05$ level, '12. Monitoring your own learning process' at F = 6.448, $p<0.01$ level, '13. Reflection and evaluation of one's own learning results' at F = 6.587, $p<0.01$ level. However, there was no significant difference in the awareness of '14. Formation of self-directed learning habits'. As a result of post-hoc analysis with significant items. it was found that the scores in 2021 with all items (as well as 2022 with item 12, 13 only) were significantly higher than those in 2020.

In summary, the interpretation that learners' concentration in lectures, monitoring of the learning process, and reflection and evaluation of learning results improved in 2021 compared to 2020, as learners adapted to online classes due to the COVID-19 pandemic.

Detailed Changes in awareness of challenge related to learning environment and control of learning in line classes

Detailed changes in awareness of *challenge related to learning environment and control of learning* in online classes were analyzed by 3 items. The results are shown in Table 6.

Tabel 6 shows the results of descriptive statistical analysis of detailed changes in students' awareness of the challenge related to learning environment and control of learning in online classes conducted by university during the COVID-19 pandemic. '15) Deficiencies and errors in the online education infrastructure environment', M = 2.47 (SD = 0.99) in 2020, M = 2.18 (SD = 0.96) in 2021, and M = 2.40 (SD = 1.11) in 2022. In '16) Challenge related to controlling learning environments that interfere

Table. 6
Analysis of differences in changes in awareness regarding the challenge related to learning environment and control of learning from 2020 to 2022

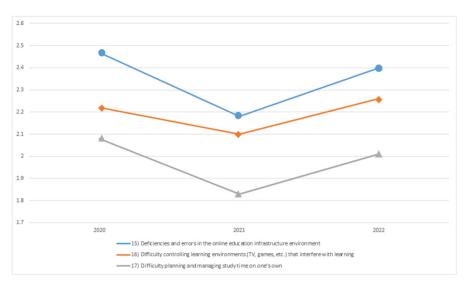| Awareness on challenge related to learning environment and control of learning	year	N	Mean	S.D	F	Post-Hoc
15. Deficiencies and errors in the online education infrastructure environment	2020	141	2.47	0.99	4.017*	20 > 21
	2021	207	2.18	0.96		
	2022	186	2.40	1.11		
	Total	534	2.33	1.03		
16. Challenge related to controlling learning environments (TV, games, etc.) that interfere with learning	2020	141	2.22	1.08	1.148	N.S.
	2021	207	2.10	1.02		
	2022	186	2.26	1.10		
	Total	534	2.19	1.07		
17. Challenge related to planning and managing study time on one's own	2020	141	2.08	1.05	3.047*	20 > 21
	2021	207	1.83	0.93		
	2022	186	2.01	1.02		
	Total	534	1.96	1.00		

*: $p<.05$, NS: Noti Significant

Figure 5. Detailed Changes of awareness in the challenge related to learning environment and control of learning in online classes from 2020 to 2022 during COVID-19

with learning', M = 2.22 (SD = 1.08), M = 2.10 (SD = 1.02) in 2021, and M = 2.26 (SD = 1.10) in 2022. In '17) Challenge related to planning and managing study time on one's own', M = 2.08 (SD = 1.05), M = 1.83 (SD = 0.93) in 2021, and M = 2.01 (SD = 1.02) in 2022. These changes are visualized and presented in a graph as shown in Figure 5.

In order to determine whether there were differences in descriptive statistics by year (from 2020 to 2022) in the detailed awareness of the challenge related to learning environment and control of learning in online classes, an ANOVA analysis including post hoc analysis was conducted. As a result, there was significant difference in the awareness of '15) Deficiencies and errors in the online education infrastructure environment' at F = 4.017, $p<0.05$ level, '17) Challenge related to planning and managing study time on one's own' at F = 3.047, $p<0.05$ level, However, there was no significant difference in the awareness of '16) Challenge related to controlling learning environments that interfere with learning'. As a result of post-hoc analysis with significant items. It was found that the scores in 2020 with all items were significantly higher than those in 2021.

In summary, the difficulties in the learning environment and its control in online classes were most pronounced in 2020, which started without preparation due to the outbreak of COVID-19. However, it can be interpreted that these difficulties were overcome in 2021.

Discussion and Conclusion

The purpose of this study was to examine changes in students' awareness of online classes in university education over the three years from 2020 to 2022 during the COVID-19 pandemic. To achieve this, the awareness of online classes includes aspects such as self-directed learning, interaction (between instructor and learner, and among learners), evaluation of the learning process and its outcomes, and the

challenge related to learning environment and control of learning, were attempted to analyze changes from 2020 to 2022, which were frequently mentioned in previous studies as success factors for online classes. As a result, there was no significant difference in the awareness of self-directed learning in online classes of university across COVID-19 period. However, interaction and evaluation of learning process and its outcome were higher in 2021 compared to 2020, while challenge related to learning environment and control of learning was higher in 2020 than in 2021.

Based on the findings of this research, the following discussion points can be presented. First, the lack of change in perceptions of self-directed learning during the COVID-19 period in online classes may be attributed to students' prior experiences with online learning. Even though online classes were initiated forcefully due to the COVID-19 pandemic, students may have already recognized the importance and effectiveness of self-directed learning through previous experiences with e-learning or internet-based courses. Despite the lack of tangibility compared to face-to-face classes, the experience of online learning, where repetitive learning is possible, students can learn at their own pace, and they have the flexibility to study at their preferred time and location, may have contributed to the unchanged perceptions of self-directed learning in online classes. This interpretation is supported by the fact that the percentage of e-learning experiences among individuals in their 20s was 83.7% in 2019 and 89.7% in 2020(Software Policy & Research Institute, 2020).

Second, the lowest level of interaction observed in online classes in 2020 can be attributed to the significantly low preparedness of universities for online teaching. When online classes began due to the COVID-19 pandemic, primary and secondary schools were able to provide online classes through national educational institutions such as EBS educational broadcasts or the Korean Education & Research Information Service. However, universities were in a situation where online classes accounted for less than 1% of all lectures (Korean Association of Private University Presidents, 2020; Sung & Kang, 2024). This aligns with previous research findings indicating that the low level of infrastructure for online classes and the significantly

low online teaching abilities of instructors were contributing factors (Almendingen, et al., 2021; Hwang & Kim, 2021; Jang et al., 2021; Kang & Park, 2022; Lee & Kim, 2020; Lee & Shin, 2020). However, online classes at university in 2021 and 2022 were interpreted to have been operated more stably based on the lessons learned from 2020's trial and error (Sung & Kang, 2024).

Third, reflective abilities regarding learning processes and outcomes have positively improved in online classes. In the initial stages of online classes in 2020, students tended to be lethargic due to the convenience of online learning. However, as online classes extended into 2021 and 2022, the duration of online classes increased, leading to higher levels of concentration and engagement in learning. Consequently, it can be observed that students' abilities to reflect on and evaluate learning processes and outcomes have improved (Oh, 2022)

Lastly, there has been a positive improvement in the learning environment and self-regulation abilities for online classes. At the onset of online classes, both the learning environment and self-regulation for online learning were challenging. However, as online classes persisted over time, significant changes were made to improve personal learning environments and self-regulation. Nonetheless, there was a decline in learning environment and self-regulation in 2022. If the online classes in 2020 were considerably challenging tasks, the adaptation to these challenges in 2021 led to significantly higher adaptability. However, as reported in study of Oh (2022), as individuals become more accustomed to online classes, there is a possibility that complacency towards online learning may affect both the learning environment and self-regulation, leading to a decline once again.

Based on the discussion of these research findings, the following implications for future research can be suggested, focusing on the limitations of this study:

First, this study has mainly focused on quantitative analysis, future research could benefit from incorporating qualitative methods such as interviews or focus groups to gain deeper insights into students' awareness of online classes. Qualitative data can provide richer contextual information and help uncover nuanced aspects of students'

awareness.

Second, future research should investigate whether there are variations in learners' awareness based on the type of online class in university education. Learners' perceived factors may vary depending on the specific type of online class they experience. Identifying these factors can facilitate the development of tailored teaching strategies for different online learning environments.

Third, this study was unable to control for demographic variables other than gender and grade. Given the multitude of factors that can influence university students' perceptions of online classes, it is imperative to identify the primary influencers and conduct robust statistical analyses while controlling for these factors.

Finally, as this study exclusively focused on students at University A, there are limitations to the generalizability of the findings. Internal dynamics unique to University A, such as institutional policies, faculty support, and technical infrastructure like Learning Management System (LMS) functionalities, may have influenced students' perceptions. Therefore, to generalize changes in university students' perceptions of online classes, future research should examine whether similar outcomes are observed across various universities.

References

Almendingen, K., Morseth, M. S., Gjølstad, E., Brevik, A., & Tørris, C. (2021). Student's experiences with online teaching following COVID-19 lockdown: A mixed methods explorative study. *PLoS ONE, 16*(8), 1-16.

Choi, K. A. (2008). Relationships of different interpersonal interactions and learners' perceptions about learning strategy growth and distance learning effectiveness in e-Learning. *Journal of Educational Technology, 24*(4), 167-191.

Choi, J. S., Kwon, M. K., & Choi, E. K. (2020). A study on the instructor perceptions and satisfaction levels of real-time online classes: Focusing on the case of Korean language program at D University. *Journal of Dong-ak Language and Literature, 8*(3), 159-179.

Eom, M. R., Lee, H. J., Choi, K. U., Jeon, M. H., & Hyun, M. Y. (2020). Exploring the ways to support online class operations through analysis of the perceptions of instructors and students. *Journal of Higher Educational Research, 3*(2), 1-26.

Hwang, Y. H., & Kim, C. S. (2021). Perceptions toward non-face-to-face online class operations during the COVID-19 pandemic: Focusing on university students' satisfaction and anxiety. *The Linguistic Association of Korea Journal, 29*(1), 71-91.

Jang, H. C., Roh, M. R., & Jeon, B. D. (2021). Satisfaction analysis of online non-face-to-face classes in the COVID-19. *Journal of the Korean Society of Radiology, 15*(4), 519-524.

Jeon, B. R. (2020). A phenomenological study on the online learning experience of university students who participated in learning consulting. *The Journal of Humanities and Social science, 11*(3), 1375-1386.

Jeong, S. M. (2021). Analysis of differences in satisfaction with remote learning between two-year college students and four-year university students after the outbreak of COVID-19. *Journal of the Korea Contents Association, 21*(5), 276-284.

Joung, Y. R. (2009). A study of the effect factors' influence on course satisfaction in cyber university. *Journal of Educational Technology, 25*(1), 61-94.

Jung, I. S., & Rha, I. J. (2004). *Understanding distance education.* Seoul: Kyoyook Book.

Jung, H. K. (2020). College students' satisfaction with the overall implementation of online classes and testing during the corona 19 pandemic. *Multimedia-Assisted Language Learning, 23*(3), 392-412.

Jung, H. Y., & Yoon, J. W. (2020). A survey research of student's perception of Korean language online video lecture. *The Journal of Curriculum and Evaluation, 11*(3), 1305-1318.

Kang, Y. H., & Park, C. W. (2022). A study on satisfaction with online classes of radiology students due to COVID-19. *Journal of the Korean Society of Radiology, 16*(1), 35-43.

Kang, H. D. (2021). University students' perceptions of the effects of online lecture types and its media types. *English Teaching, 76*(1), 59-86.

Kang, H. D. (2023). A study on university students' perceptions of the effects of online and face-to-face English class types during post-COVID-19. *The Journal of Modern British & American Language & Literature, 41*(4), 181-202.

Kim, J. W., Park, Y. S., Kim, K. Y., & Yang, K. S. (2021). An analysis of college professors' and students' perceptions and experiences of online classes under the COVID-19 situation. *Educational Research, 80,* 33-58.

Korean Association of Private University Presidents (2020). *Academic operations status after university opening due to COVID-19.* Retrieved from August 17, 2023, http://kapup.org/sub/sub02_02.php?boardid=notice&mode=view&idx=28&sk=&sw=&offset=10&category=&goPage=

Kwon, S. Y. (2022). A study on instructors and learners' perception of excellent online class in university after COVID-19. *Journal of Educational Technology, 38*(4), 1095-1131.

Lee, D. J., & Kim, M. S. (2020). University students' perceptions on the practices of online learning in the COVID-19 situation and future directions. *Multimedia-Assisted Language Learning, 23*(3), 359-377.

Lee, S. D., Kim, G. Y., & Jeon, H. J. (2022). A study on the satisfaction and

perception of professors and learners in online classes. *The Journal of Humanities and Social science, 13*(1), 1113-1128.

Lee, J. Y., Sung, E. M., Lee, J. E., Lim, K. Y., & Han, S. Y. (2020). Challenges and tasks facing online classes during the COVID-19 pandemic. *Journal of Educational Technology, 36*(3), 671-692.

Lee, Y. H. (2021). Explorations for the effective implementation based on the students' satisfaction survey for the online class in the university for the COVID-19 response. *Cultural Exchange and Multicultural Education, 10*(1), 270-306.

Lee, Y. S., & Shin, D. K. (2020). An investigation of the implementation of online classes in the untact era caused by the COVID-19 pandemic. *Journal of Curriculum and Evaluation, 23*(4), 39-57.

Moon, M. Y., & Kim, H. S. (2023). Factors afecting of online lecture on online class satisfaction of health science students taking online classes according to COVID-19. *Asia-pacific Journal of Convergent Research Interchange, 9*(1), 327-339.

Moore, M., & Kearsley, G. (1996). *Distance education: A systems view.* Belmont, CA: Wadsworth.

Moore, M. (1973). Toward a theory of independent learning and teaching. *Journal of Higher Education, 44*(9), 661–680.

Oh, S. T. (2022). A comparative study on COVID-19 and online classes perception of freshman of culinary arts major in 2020 and 2022. *Culinary Science & Hospitality Research, 28*(10), 52-61.

Seo, J. W., & Lee, C. (2020). Action-items for training and development designers to reinforce the learners' presence in the online-based higher education environment. *Journal of Learner-Centered Curriculum and Instruction, 20*(8), 695-718.

Software Policy & Research Institute (2020). *2020 Survey of Korean e-Learning industry.* Gyeonggi-do: Software Policy & Research Institute.

Sung, E, M., & Kang, S. M. (2022*). Exploring changes in perception of positive and negative characteristics according to learners' preference for online classes in higher education* [Paper

presentation]. Korean Association for Educational Information and Media Spring Conference 2022. Metaverse Platform, Republic of Korea.

Sung, E. M., & Kang, S. M. (2024). Analysis of university students' perception factors and changes regarding online class in the COVID-19 Pandemic era: Focused on data from 2020 to 2022 using the semantic differential scaling method. The *Journal of Korean Association of Computer Education, 27*(1), 157-169.

Sung, E. M., Kang, S. M., & Lee, S. H. (2022). *Exploring changes of influence in self-directed learning competency on university students' perception of learning effectiveness in online learning* [Paper presentation]. Korea Academia-Industrial cooperation Society Spring Conference 2022, Jeju, Republic of Korea. https://www.kais99.org/jkais/springNfall/spring2022/oral/2022_spring_074 .pdf

Sung, E. M., Choi, J. E., & Baek, M. J. (2021). A study on development for teaching and learning model of online project-based learning in untact context. *The Korean Journal of Educational Methodology Studies, 33(*1), 227-270.

Sung, E. M., & Choi, H. S. (2016). Exploring the factors of self-directed learning competency of the highest academic-achievement learners in higher education. *Journal of Educational Technology, 32*(2), 427-452.

Eunmo SUNG

Associate Professor, Dept. of Educational Technology, Andong National University.

Interests: Instructional Design, Learning Technology Design, Self-directed Learning, Learning Analytics, Competency Modeling

E-mail: emsung@anu.ac.kr

Sumi KANG

Assistant Research Professor, Global Institute for Talented Education, Korea Advanced Institute of Science and Technology (KAIST).

Interests: Instructional Design, Learning Analytics, EduTech.

E-mail: edudom@hanmail.net