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Effects of learning flow, learning interaction, and academic self-efficacy on learning satisfaction of college students who experienced HyFlex lecture

Sun-Ju Kim[1*]
[1]Department of Dental Hygiene, College of Health &Medical Sciences, Cheongju University, South Korea, sjkim@cju.ac.kr (S.J.K.).

Abstract: This study aims to examine the levels of learning flow, learning interaction, academic self-efficacy, and learning satisfaction among students who have experienced HyFlex lectures, as well as to investigate the correlations between these variables and the factors affecting learning satisfaction. The subjects of this study were 198 students taking HyFlex lectures offered in the first semester of 2024 who agreed to participate in the research among those attending a university located in Chungbuk. Data were collected through self-administered questionnaires from June 3 to June 10, 2024, using SPSS Statistics 22.0. The results of analyzing the differences according to general characteristics showed that learning satisfaction varied by type of class (F=4.728, p=.040) and was higher for theory classes compared to practical classes. It was also high when academic performance (F=11.089, p=.003) was 'above average.' The factors affecting learning satisfaction were academic performance (β =.322, p<.01), learning flow (β =.377, p<.001), learning interaction (β =.395, p<.001), and academic self-efficacy (β =.297, p<.01). Learning interaction was the variable with the most significant positive effect on learning satisfaction. The results of this study can be used as foundational data for establishing improvement measures to enhance the quality of HyFlex lectures and the learning outcomes of learners.

Keywords: *Academic self-efficacy, Hyflex learning, Learning flow, Learning interaction, Learning satisfaction.*

1. Introduction

1.1. Research Background and Necessity

College courses in the post-COVID-19 era are evolving into formats that integrate online classes into traditional classes. Many colleges have adopted online education systems in their academic systems after the pandemic, and active discussions have been made on various teaching methods using remote learning systems as well as their educational effectiveness [1]. However, several issues have been identified, including the limitations of online classes, lack of student participation and communication, declining academic performance, and deteriorating class quality. As a remedial action for these limitations, education that combines online and offline learning is being applied as a new teaching-learning method in higher education. In particular, there is a growing interest in HyFlex, which is a teaching method that combines online and offline learning. HyFlex is a compound for 'hybrid' and 'flexible', referring to an instructional approach in which some learners attend classes in person inside physical classrooms, while others participate in physical classroom activities online via video conferencing platforms. HyFlex lectures resolve issues incurred by the spatial constraints of face-to-face learning contexts, expand learning spaces, and offer various teaching-learning methods, which is why many colleges have created HyFlex learning environments and are actively adopting these courses [2].

The main feature of HyFlex lectures is that they give learners the right to choose how they will participate in class, enabling them to engage in learning activities suitable for their situations in diverse

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* Correspondence: sjkim@cju.ac.kr

learning environments, such as face-to-face or online learning, or asynchronous online lectures. HyFlex lectures are receiving attention as a new instructional model amid the rapidly changing social and teaching-learning environments, but for successful and effective implementation of HyFlex lectures, there is a need for a thorough analysis of the effects of learning or learning satisfaction from the perspective of learners actually taking the courses.

Learning satisfaction can be defined as the degree of satisfaction obtained when a learner achieves their intended goals in learning or when their personal expectations are met. Learning satisfaction is the learner's subjective response to the teaching-learning process and reflects their overall reaction to the learning experience. Learning satisfaction of learners in online lectures is the result obtained when the learner's expected needs and goals for the online courses are met, and it serves as a crucial element in knowledge acquisition [3]. Therefore, learning satisfaction can be considered a typical and important factor in measuring the effects of learning [4].

Learning flow is an optimal psychological state that appears when one is concentrated on specific learning activities or classes, indicating a state where one is absorbed in their learning activities or classes, displaying their best functions to make academic achievement [5]. Concentrating on classes in the learning process helps achieve more satisfaction and accomplishment from the classes, which may have a positive impact on the learning process and outcomes [6]. In other words, learning flow stimulates interest in learning that leads to active participation in learning activities, thereby increasing learning satisfaction. Particularly in online classes, if learners cannot be immersed in class, there may be disparities in learning among learners, which may affect learning achievement and satisfaction. Therefore, learning flow is essential for sustained learning, making it necessary to analyze the relationship between learning flow and learning satisfaction [Fig. 1].

Interaction in learning is crucial not only for improving the effect of education but also for learners to gain recognition and realize their identity within society represented by school. When learners recognize interaction with their instructors and fellow learners, they become more immersed in learning activities, which can enhance learning outcomes [7]. Among the many limitations of online learning is the lack of interaction, such as insufficient participation and communication among students. Learning interaction in HyFlex lectures is an important factor that can overcome the physical limitations of face-to-face and online classes and improve the quality of learning as well as learning satisfaction.

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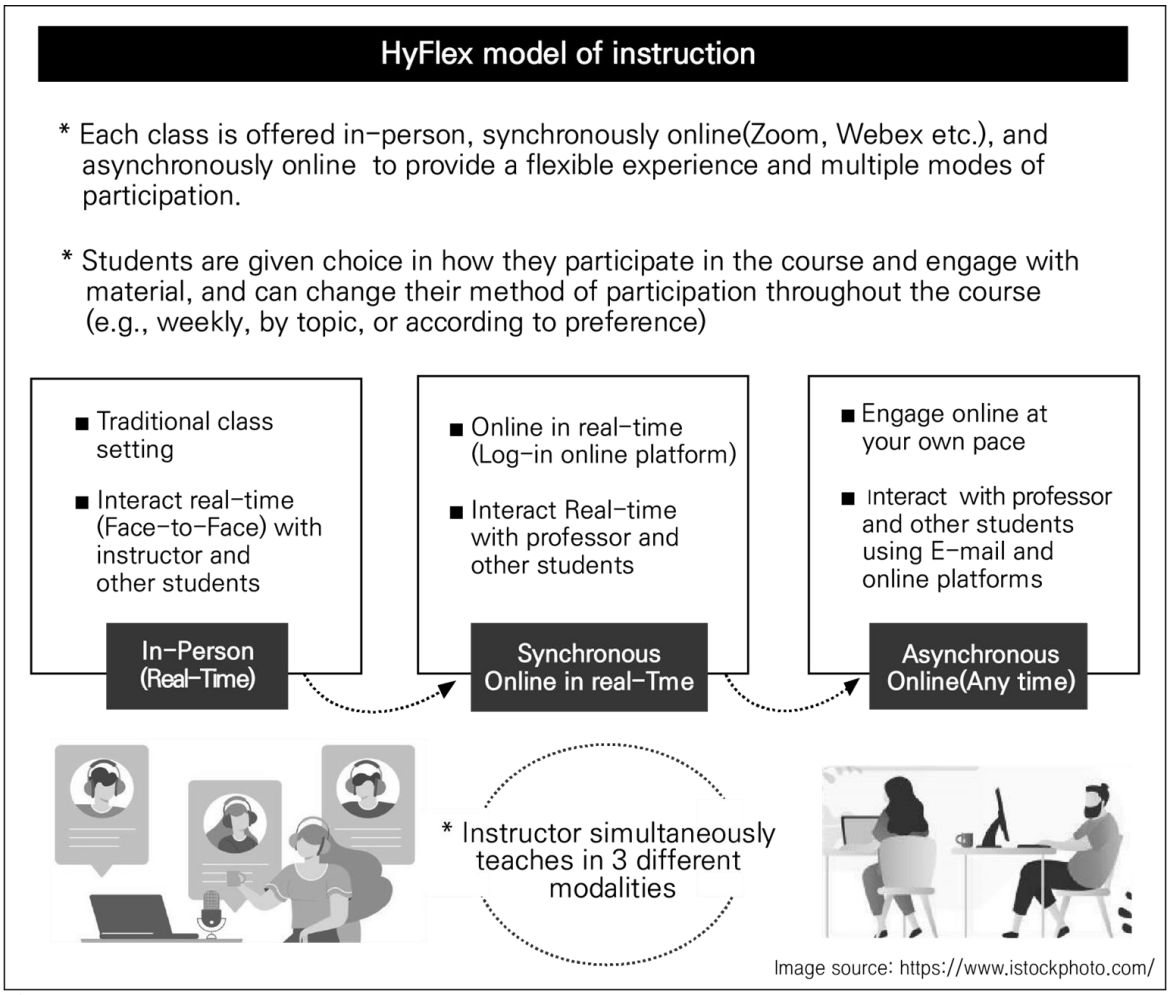

Figure 1.
HyFlex model of instruction.

Academic self-efficacy refers to a learner's subjective belief that they can understand, analyze, and remember the content necessary to successfully acquire new knowledge and skills [8]. Academic self-efficacy is closely related to learning satisfaction, and it is a driving force that motivates learners to acquire and perform new knowledge and skills, as well as a key variable that mediates knowledge acquisition and performance among learners [9]. Thud, it is likely that improving interactions between learners and instructors as well as learning flow and academic self-efficacy of students have a significant relationship with learning satisfaction even in HyFlex classes, which raises the need for further research on this topic.

A review of prior research on HyFlex lectures in Korea shows that research has been limited to case studies of HyFlex lectures, surveys on the perceptions of instructors and learners regarding HyFlex lectures, and research on instructional design models and strategies for effective HyFlex lectures [2, 10-12]. However, these studies were mostly conducted in cyber universities or were conducted in online classes recently implemented at general colleges due to COVID-19, while there is insufficient research on the learning effectiveness or learning satisfaction from the perspective of learners who have experienced HyFlex lectures.

Accordingly, this study seeks to analyze the current state of learning satisfaction among students who

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have taken HyFlex lectures and the factors affecting learning satisfaction, and to provide improvement measures to improve the quality of HyFlex lectures as well as the learning outcomes of learners.

1.2. Research Objectives

The specific research objectives are as follows.

1) To identify the levels of learning flow, learning interaction, academic self-efficacy, and learning satisfaction among the subjects.

2) To identify the differences in learning flow, learning interaction, academic self-efficacy, and learning satisfaction based on the sociodemographic characteristics of the subjects.

3) To examine the relationships between learning flow, learning interaction, academic self-efficacy, and learning satisfaction.

4) To examine the factors affecting learning satisfaction.

2. Research Methods

2.1. Research Participants

This study employed convenience sampling of students taking HyFlex courses offered in the first semester of 2024 at C University located in Chungbuk. The courses were conducted in a uniform HyFlex classroom setting, where both offline and online learning environments were equally applied. The classroom was equipped with audio facilities (wireless microphone system, beamforming microphones), a speaker tracking camera, an electronic podium system, and an 86-inch electronic whiteboard, while the online class platform adopted Cisco Webex.

2.2. Ethical Considerations

Ethical considerations were taken into account by distributing explanatory notes and consent forms about research to the participants who agreed to voluntarily participate, explaining the purpose and content of the study. The participants were informed that collected data were anonymized and not used for purposes other than research, and that they could withdraw from the survey at any time without any impact on their academic evaluations, after which the research was conducted with their consent. The survey was designed to take about 5 minutes considering participant fatigue, and a small token of appreciation was offered to respondents after completion.

2.3. Research Method

The researcher visited the classrooms from June 3 to 10, 2024 and explained the intent of research to the students. Only those who agreed to participate were asked to complete a structured self-administered questionnaire. G*power 3.1.9.2 software was used to determine the appropriate sample size. To calculate the required number of participants for multiple regression analysis, the study used a significance level of 0.05, a statistical power of 0.95, a medium effect size of 0.15, and 10 predictor variables (general characteristics, learning flow, learning interaction, academic self-efficacy, learning satisfaction), based on which the required sample size was calculated as 172 participants. A total of 201 students responded to the survey, but survey results from 198 participants were used in the final analysis excluding 3 incomplete responses, indicating that the number of participants has power as an adequate sample size.

2.4. Research Tool

The survey tool used in this study consisted of 6 items on general characteristics (gender, academic year, type of class, major satisfaction, academic performance, commute time, online learning experience, HyFlex learning experience), 22 items on learning flow, 14 items on learning interaction, 10 items on academic self-efficacy, and 8 items on learning satisfaction (Table 1).

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Table 1.
Research tool.

Variables	Item	Range	Cronbach's α
Learning flow	22	1~5	0.901
Learning interaction	14	1~5	0.887
Academic self-efficacy	10	1~7	0.928
Learning satisfaction	8	1~5	0.933

2.4.1. Learning Flow

To measure the level of learning flow, this study used a questionnaire that was originally developed by Seok [13] and later modified and supplemented by Yoon [14] to be suitable for college students. The questionnaire consists of a total 22 items rated on a 5-point Likert scale, consisting of "Strongly disagree" (1 point), "Disagree" (2 points), "Neutral" (3 points), "Agree" (4 points), and "Strongly agree" (5 points), with higher scores indicating higher levels of learning flow. The reliability coefficient (Cronbach's α) for this tool was 0.868 in the study by Yoon [14] and 0.901 in this study.

2.4.2. Learning Interaction

To identify the learning interaction perceived by learners in an online lecture platform environment, this study used a tool developed by Williams and Deci [15] and later modified and supplemented by Lee [7]. The learning interaction questionnaire consists of a total 14 items rated on a 5-point Likert scale, consisting of "Strongly disagree" (1 point), "Disagree" (2 points), "Neutral" (3 points), "Agree" (4 points), and "Strongly agree" (5 points), with higher scores indicating higher levels of perceived learner interaction. The Cronbach's α was 0.927 in the study by Lee [7] and 0.887 in this study.

2.4.3. Academic Self-Efficacy

This study used a tool originally developed by Ayres [16] and later adapted, modified, and supplemented by Park and Kwon [17] to measure academic self-efficacy among college students. This tool consists of total 10 items rated on a 7-point Likert scale, consisting of "Strongly disagree" (1 point), "Generally disagree" (2 points), "Slightly disagree" (3 points), "Neutral" (4 points), "Slightly agree" (5 points), "Generally agree" (6 points), and "Strongly agree" (7 points), with higher scores indicating higher levels of academic self-efficacy. The Cronbach's α was 0.950 in the study by Park & Kwon (2012), and 0.928 in this study.

2.4.4. Learning Satisfaction

To measure the online learning satisfaction of college students, this study used a tool developed by Wang [18] and later modified and supplemented by Park [19] for cyber university students. The tool consists of a total 8 items rated on a 5-point Likert scale, consisting of "Strongly disagree" (1 point), "Disagree" (2 points), "Neutral" (3 points), "Agree" (4 points), and "Strongly agree" (5 points), with higher scores indicating higher levels of learning satisfaction. The Cronbach's α was 0.90 in the study by Park [19] and 0.933 in this study.

2.5. Research Analysis

The collected data was analyzed using SPSS Statistics 22.0 Version (IBM Co., Armonk, NY, USA), and the specific analysis methods were as follows. Frequency analysis was conducted on the demographic characteristics of the subjects. Differences in learning flow, learning interaction, academic self-efficacy, and learning satisfaction according to the demographic characteristics of the subjects were calculated using t-tests and one-way ANOVA, with post hoc tests conducted using Scheffé's test. The correlations among learning flow, learning interaction, academic self-efficacy, and learning satisfaction were analyzed using Pearson's correlation coefficients, and factors affecting learning satisfaction were

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analyzed through multiple regression (Figure 2).

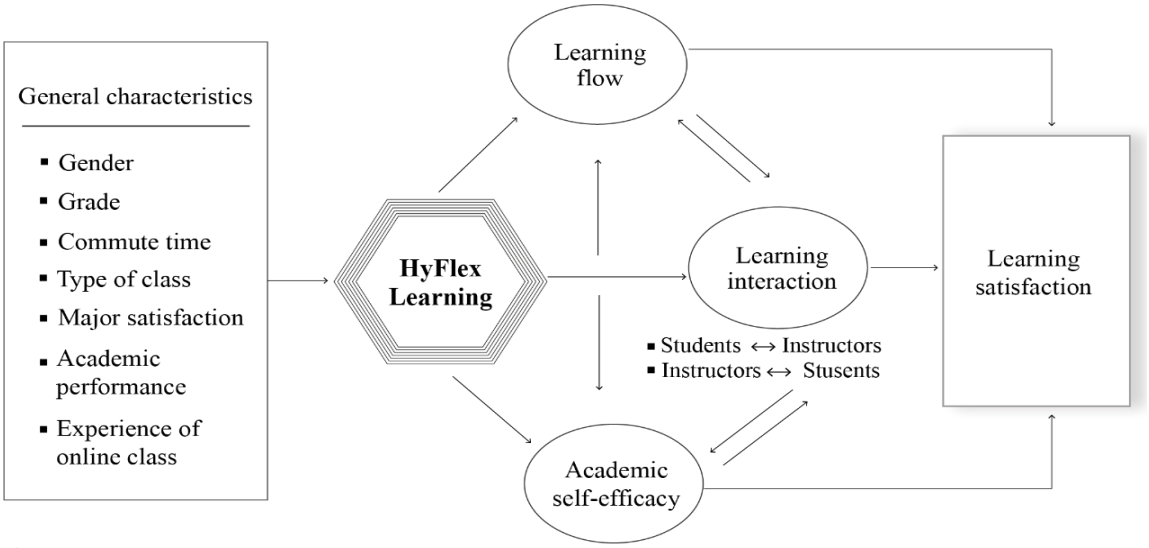

Figure 2.
Study model.

2.6. Limitations

This study was conducted with students from a single university, selected by convenience sampling, and the findings are based on the subjective judgments of the participants regarding the variables and thus there are limitations in generalizing the results to a broader population.

3. Results

3.1. General Characteristics of Subjects

Frequency analysis was conducted to examine the general characteristics, and the results are shown in (Table 2). There were 114 male (57.6%) and 84 female students (42.4%); and 96 subjects (48.5%) were juniors and 102 (51.5%) were seniors. For the type of HyFlex class, 142 subjects (71.7%) took theory classes and 56 (27.3%) took combined (theory and practical) classes. Commute times were distributed as follows: 47 subjects (23.7%) spent less than 30 minutes, 67 subjects (33.9%) spent 30 minutes to 1 hour, and 84 subjects (42.4%) spent more than 1 hour. For academic performance, 4 subjects (27.4%) were above average, 109 (55.0%) were average, and 35 (17.7%) were below average. For major satisfaction, 131 (66.2%) were satisfied, while 67 (33.8%) were not. 100% of the subjects responded they have experience taking an online class, whereas 100% responded they do not have experience taking a HyFlex class.

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Table 2.
General characteristics of the subjects.
N=198

Variables		N	%
Gender	Male	114	57.6
	Female	84	42.4
Grade	Junior	96	48.5
	Senior	102	51.5
Type of Class	Theory	142	71.7
	Theory + Practice	56	28.3
Commute time	≤ 30min	47	23.7
	30mi n~ 1hr	67	33.9
	> 1hr	84	42.4
Major satisfaction	Satisfied	131	66.2
	Unsatisfied	67	33.8
Academic performance	Above average	54	27.3
	Average	109	55.0
	Lower than average	35	17.7
Experience of online class	Yes	198	100.0
	No	0	0.0
Experience of HyFlex class	Yes	0	0.0
	No	198	100.0

3.2. Levels of Learning Flow, Learning Interaction, Academic Self-Efficacy, and Learning Satisfaction of Subjects

The levels of learning flow, learning interaction, academic self-efficacy, and learning satisfaction of subjects are shown in (Table 3). Learning flow scored an average of 3.78±0.51 out of 5 points, learning interaction 3.91±0.71 out of 5 points, academic self-efficacy 5.89±0.81 out of 7 points, and learning satisfaction 3.88±0.57 out of 5 points.

Table 3.
Learning flow, learning interaction, academic self-efficacy, learning satisfaction.
N=198

Variables	M±SD†	Min	Max	Range
Learning flow	3.78±0.51	2.89	4.32	1~5
Learning interaction	3.91±0.71	2.25	4.42	1~5
Academic self-efficacy	5.89±0.81	2.37	6.80	1~7
Learning satisfaction	3.88±0.57	2.14	5.00	1~5

Note: †M±SD: mean±standard deviation.

3.3. Differences In Learning Flow, Learning Interaction, Academic Self-Efficacy, and Learning Satisfaction According to General Characteristics

The results of analyzing learning flow, learning interaction, academic self-efficacy, and learning satisfaction according to general characteristics are shown in (Table 4). Learning flow showed a significant difference depending on academic performance (F=12.661, p=.003). The results of the post-hoc analysis showed that learning flow was higher for students whose academic performance was 'above average' compared to 'average' or 'below average.' learning interaction also showed a significant difference depending on academic performance (F=8.621, p=.023), with post-hoc analysis revealing

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higher learning flow for those whose academic performance was 'above average.' Academic self-efficacy showed a significant difference depending on the type of class (F=11.775, p=0.003), with higher academic self-efficacy found in theory classes compared to practical classes. Learning satisfaction varied by type of class (F=4.728, p=.040) and was higher for theory classes compared to practical classes, and it was also high when academic performance (F=11.089, p=.003) was 'above average.' There were no statistically significant differences in learning flow, learning interaction, academic self-efficacy, and learning satisfaction depending on gender, academic year, commute time, or major satisfaction.

Table 4.
Differences of learning flow, learning interaction, academic self-efficacy & learning satisfaction to general characteristics.

Variables		Learning flow		Learning interaction		Academic self-efficacy		Learning satisfaction	
		M±SD†	t/F(*p*)	M±SD	t/F(*p*)	M±SD	t/F(*p*)	M±SD	t/F(*p*)
Gender	Male	3.74±0.56	-1.113 (.102)	3.84±0.81	2.963 (.330)	5.98±0.88	2.848 (.095)	3.82±0.66	-0.848 (.185)
	Female	3.81±0.46		3.98±0.61		5.79±0.74		3.93±0.48	
Grade	Junior	3.77± 0.33	1.601 (.246)	3.95±0.54	0.354 (.378)	5.78±0.73	1.115 (.266)	3.80±0.51	0.915 (.266)
	Senior	3.79±0.68		3.86±0.88		5.99±0.89		3.95±0.63	
Type of class	Theory	3.82±0.48	0.899 (.289)	3.93±0.75	3.487 (.491)	6.17±0.75	11.775 (.003)	4.03±0.60	4.728 (.040)
	Theory +Practice	3.74±0.53		3.88±0.67		5.61±0.87		3.73±0.54	
Commute time	< 30 min	3.82±0.40	1.320 (.088)	3.94±0.51	2.648 (.719)	5.95±0.70	1.208 (.490)	3.93±0.43	1.017 (.210)
	30 min ~1 hr	3.77±0.54		3.88±0.81		5.83±0.88		3.83±0.68	
	1 hr <	3.75±0.48		3.90±0.60		5.89±0.74		3.86±0.46	
Academic performance	Above average[a]	4.03±0.44	12.661 (.003) (c,b<a)	4.12±0.84	8.621 (.023) (b,c<a)	5.84±0.93	0.625 (.670)	4.01±0.69	11.089 (.003) (c,b<a)
	Average[b]	3.69±0.47		3.79±0.69		5.97±0.84		3.88±0.48	
	Lower than average[c]	3.61±0.55		3.81±0.72		5.87±0.78		3.76±0.65	
Major satisfaction	Satisfied	3.75±0.42	1.641 (.169)	3.97±0.55	1.780 (.277)	5.95±0.91	-2.641 (.109)	3.92 ±0.41	0.941 (.210)
	Unsatisfied	3.81±0.59		3.85±0.87		5.82±0.71		3.84±0.57	

Note: †M±SD: mean±standard deviation, p-value obtained from t-test or one-way ANOVA.
[a, b, c]: Different letters represent significant differences in Scheffe's method comparison at a 0.05 significance level.

3.4. Correlations among Learning Flow, Learning Interaction, Academic Self-Efficacy, and Learning Satisfaction

Pearson's correlation coefficients were used for analysis to determine the correlations between learning flow, learning interaction, academic self-efficacy, and learning satisfaction, and the results are shown in (Table 5). The correlation coefficients between the variables ranged from 0.341 to 0.563, and all correlation coefficients were statistically significant at the <0.01 level. Learning satisfaction had significant positive correlations with learning flow (r=0.512, p<.001) learning interaction (r=0.418, p<.001), and academic self-efficacy (r=0.479, p<.001).

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Table 5.
Correlations among learning flow, learning interaction, academic self-efficacy, learning satisfaction.

Variables	Learning flow	Learning interaction	Academic self-efficacy	Learning satisfaction
Learning flow	1			
Learning interaction	0.563(<.001)	1		
Academic self-efficacy	0.442(<.001)	0.341(<.001)	1	
Learning satisfaction	0.512(<.001)	0.418(<.001)	0.479(<.001)	1

Note: *p-value obtained from Pearson's correlation coefficient.

3.5. Factors Affecting Learning Satisfaction

To identify the factors affecting learning satisfaction, this study conducted a multiple regression analysis with learning flow, learning interaction, and academic self-efficacy as independent variables and learning satisfaction as the dependent variable. The Durbin Watson statistic was 1.920, which is close to 2, satisfying the independence of residuals; and the variance inflation factor (VIF) ranged from 1.923 to 2.339, which is below the threshold of 10, indicating no multi-collinearity issues among the independent variables. The factors affecting learning satisfaction were learning flow (β=0.377, p<.001), learning interaction (β=0.405, p<.001), and academic self-efficacy (β=0.297, p<.01), with learning interaction (β=0.405, p<.001) having the greatest impact. The explanatory power of the model was 37% (adjusted R^2=.370), and the F-value was 77.801 (p<0.001), indicating that the regression model was statistically significant (Table 6).

Table 6.
The factors that influenced learning satisfaction.

Variables	B	SE	β	t	*p*
(Constant)	4.522	0.925		7.455	<0.001
Learning flow	0.377	0.033	0.062	2.455	<0.001
Learning interaction	0.405	0.068	0.566	3.990	<0.001
Academic self-efficacy	0.297	0.075	0.089	0.920	<0.05
R^2=.398, Adjusted R^2=.370, F=77.801, p<.001, VIF=1.923~2.339, Durbin-Watson=1.920					

Note: SE: standard error
*p-value obtained from multiple regression analysis.

4. Discussions

The HyFlex model is gaining increasing attention among colleges in South Korea as it overcomes the limitations of learning spaces in face-to-face learning contexts, expands learning space, and offers various teaching-learning methods. This study aimed to identify the levels of learning flow, learning interaction, academic self-efficacy, and learning satisfaction among students taking HyFlex courses, and to determine factors affecting learning satisfaction. The conclusions and discussions derived from this study are as follows.

First, the mean scores of the factors were as follows: learning flow was 3.78, learning interaction was 3.91, academic self-efficacy was 5.89, and learning satisfaction was 3.88. Since there is no prior research on learning satisfaction in HyFlex courses for direct comparison, the results were comparatively analyzed with studies that explored learning satisfaction in online courses. In the study by Yang [20] which surveyed online learning satisfaction among college students, learning flow scored 3.39, academic self-efficacy 5.73, and learning satisfaction 3.48. Moreover, online learning satisfaction scored 3.20 in the study by Kim [21] on college students, while it scored 3.31 in the study by Park and Shin [22] indicating that learning flow, academic self-efficacy, and learning satisfaction were higher in HyFlex courses compared to online courses. Traditional online courses, where students watch pre-recorded lecture videos, face significant limitations in terms of the learning flow of students or learning

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interaction between instructors and learners, which may lead to lower satisfaction with the course. Choi, et al. [23] stated that it is necessary to address issues such as low learning flow and insufficient interaction with instructors and fellow learners in online remote education. The HyFlex model, which integrates offline face-to-face classes with real-time online classes, can enhance the learning flow and interaction among students more effectively than courses conducted only online. Han and Lee [2] examined the responses of college students to HyFlex classes before and after the course and found that students had very low expectations for HyFlex classes before the course, but they showed very high satisfaction in the survey after the course. HyFlex courses allow learners to choose between face-to-face and online class participation and enable real-time interaction and two-way communication with instructors and fellow learners in person, leading to higher learning satisfaction among learners compared to traditional online course methods. In this regard, HyFlex courses can be an alternative that addresses the issues associated with traditional online courses.

Second, as a result of analyzing learning flow, learning interaction, academic self-efficacy, and learning satisfaction according to general characteristics, there were significant differences in learning flow, learning interaction, and learning satisfaction depending on the academic performance of the subjects. In other words, students with above-average academic performance showed higher levels of learning flow, learning interaction, and learning satisfaction. This finding is consistent with Yang [20] who reported that college students with higher academic performance also showed greater learning flow, and Kim [24] who found that higher self-efficacy led to higher online learning satisfaction. However, in terms of major satisfaction, while Yang [20] and Park and Shin [22] found that higher major satisfaction led to higher online lecture satisfaction, this study showed different results as there were no significant differences in learning satisfaction based on major satisfaction. This discrepancy might be due to the fact that Yang [20] and Park and Shin [22] focused on nursing students, suggesting that there may be differences in major satisfaction depending on the field or major. Thus, further research should be conducted with more detailed subdivisions by major. In terms of learning satisfaction, theory classes showed higher learning satisfaction compared to practical classes. This result aligns with Yu [25] who reported that students taking theory classes had higher learning satisfaction compared to those taking combined theory and practical classes. Practical classes, due to their nature of having to be conducted face-to-face, have limitations when conducted via video or online formats, which could result in lower satisfaction compared to theory classes. If practical classes are conducted in a HyFlex model, it will be necessary to design well-structured courses and create a systematic lecture environment to further enhance the learning presence.

Third, as a result of analyzing the correlations among learning flow, learning interaction, academic self-efficacy, and learning satisfaction, it was found that learning satisfaction had positive correlations with learning flow, learning interaction, and academic self-efficacy. Several previous studies have also revealed that self-efficacy and learning satisfaction have a statistically significant correlation [21, 23-25]. Moreover, Jeong and Joo [26] stated that self-efficacy has a significant positive effect on the learning satisfaction of college students through the mediation of learning participation. These results suggest that learning flow is enhanced through interaction and improves academic self-efficacy, thereby increasing learning satisfaction.

Fourth, the factors affecting learning satisfaction were academic performance, learning flow, learning interaction, and academic self-efficacy, with learning interaction being the variable that has the greatest positive impact on learning satisfaction. Moore and Kearsley [27] stated that the learning outcomes of learners vary depending on the quality of interaction between instructors and learners, as well as among learners themselves. Han [28] claimed that interaction is a critical factor to consider in online education, and Lee [7] emphasized that instructional design with enhanced interaction elements is key to achieving high satisfaction among learners participating in online remote education. Learners want to feel the presence of instructors in remote video lectures and require communication with instructors and fellow learners. One of the major disadvantages of online learning is the difficulty in communication and interaction between students and instructors. Online interaction often relies on

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subjective perceptions or emotional interpretations of individuals due to the lack of face-to-face contact, which can limit communication [29]. HyFlex courses are clearly differentiated from general online courses by addressing the potential lack of interaction through the integration with offline face-to-face classes. A HyFlex model involves both learners attending online and learners participating in offline classrooms, so despite the different learning environments, courses must be designed and operated in a way that allows all learners to receive the same education and interact with each other in order to improve learning effectiveness and satisfaction.

In conclusion, HyFlex courses offer higher learning satisfaction compared to traditional online courses, and learning interaction was the factor that had the greatest impact on learning satisfaction in conducting HyFlex classes. By enhancing learning interaction through integrated management of online and offline classes, HyFlex courses can serve as an effective alternative to address the issues of traditional online courses. However, since HyFlex courses utilize online systems for non-face-to-face classes, any lack of smooth system operation could impede learning flow and negatively affect learning interactions. Therefore, for efficient operation of HyFlex courses, it is necessary to implement technology-based system management and provide a stable online environment to ensure simultaneity and interaction in online and offline classes. Furthermore, since the HyFlex model involves the simultaneous operation of online and offline learning contexts, it may place a considerable burden on instructors regarding course design and implementation. Thus, to improve the quality of HyFlex courses, it will be necessary to provide educational support for instructors regarding HyFlex course design and implementation.

This study identified the levels of learning flow, learning interaction, academic self-efficacy, and learning satisfaction among students who have experience taking HyFlex lectures and analyzed the factors affecting learning satisfaction. The findings of this study could help suggest measures to improve the quality of HyFlex courses and enhance learning satisfaction and learners' outcomes. However, there are limitations in generalizing the results to all students because the subjects were limited to students from a single university selected by convenience sampling, and also because the results were based on the subjects' subjective assessments of the variables. Future research should expand the regional scope and sample size and conduct replication studies. Moreover, since the results may vary depending on each college's system infrastructure and instructors' teaching competencies, there is a need for further research that compares and analyzes the learning outcomes of HyFlex courses from various perspectives.

5. Conclusions

This study aims to examine the levels of learning flow, learning interaction, academic self-efficacy, and learning satisfaction among students who have experienced HyFlex lectures, as well as to investigate the correlations between these variables and the factors affecting learning satisfaction. The subjects of this study were 198 students taking HyFlex lectures offered in the first semester of 2024 who agreed to participate in the research among those attending a university located in Chungbuk. Data were collected through self-administered questionnaires from June 3 to June 10, 2024, and descriptive statistics, t-tests, one-way ANOVA, Pearson's correlation coefficients, and multiple regression were performed using SPSS Statistics 22.0.

1. The results of analyzing the differences according to general characteristics showed that learning satisfaction varied by type of class ($F=4.728$, $p=.040$) and was higher for theory classes compared to practical classes, and it was also high when academic performance ($F=11.089$, $p=.003$) was 'above average'.

2. Learning satisfaction had significant positive correlations with learning flow ($r=.512$, $p<.001$) learning interaction ($r=.418$, $p<.001$), and academic self-efficacy ($r=.479$, $p<.001$).

3. The factors affecting learning satisfaction were academic performance ($\beta=.322$, $p<.01$), learning flow ($\beta=.377$, $p<.001$), learning interaction ($\beta=.395$, $p<.001$), and academic self-efficacy ($\beta=.297$, $p<.01$), and learning interaction was the variable with the most significant positive effect on learning

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satisfaction.

The results of this study can be used as foundational data for establishing improvement measures to enhance the quality of HyFlex lectures and the learning outcomes of learners.

Transparency:

The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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