

The Effect of Class Experiences via Online Education on Japanese University Students' Learning Outcomes amid the COVID-19 Pandemic

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Abstract. Implementing quality assurance of university students' learning outcomes is an important challenge. In response to the COVID-19 pandemic, wherein many universities are implementing online education as "a new form of education," there is a pressing need to rethink class methods. This study clarifies the effect of class experience via online education on Japanese university students' learning outcomes amid the COVID-19 pandemic. The results indicate that students acquire knowledge and skills through online education in the same way as conventional face-to-face education, but regardless of the specialized field, the knowledge and skills acquired differ according to the form of online education employed. Our finding that appropriate learning outcomes are assured even for online education in the same way as face-to-face education is likely to be of major significance.

Keywords: class experiences, COVID-19 pandemic, Japanese university students, learning outcomes, online education

Introduction

Implementing quality assurance of Japanese university students' learning outcomes is an important challenge. First, as the rate of college enrollment to Japanese universities is currently increasing and the entrance examinations to many universities have diversified, their screening functions are in decline. As of 2021, the rate of college enrollment to Japanese universities stood at over 50% and looks set to continue to rise in future. To borrow Martin Trow's (1976) statement, we are at the stage of universal access, and as per his prediction, we are in an era in which students with diverse

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academic abilities and interests are proceeding to university. Hence, in response to the characteristics of this era, university entrance examination screening has also introduced uniform tests with optional test subjects, which are now evaluated multilaterally and comprehensively via interests and club activities rather than academic ability alone. Other university entrance examinations have diversified to general screening or school-recommendation screening, and some universities are effectively no longer practicing any screening whatsoever. Similarly, another reason why implementing quality assurance of Japanese university students' learning outcomes is so important is because their education is delivered based on the allocation of government funding (taxpayer money). Therefore, Japanese universities now have a social obligation to academically clarify and be transparent and accountable to society in relation to the nature of the knowledge and skills that students are acquiring through their education and to the question of how Japanese universities are improving their class experiences to accomplish this.

In relation to evaluating Japanese university students' learning outcomes, various indicators in Japan such as "*Gakushiryoku*" (Central Council for Education in Japan, 2008) can be cited, and although still at the exploratory stage in terms of how to define them (Yamada, 2010), the systematization of degree program education based on learning outcomes is becoming a global trend in the reform of university education (Omori, 2010). A 2008 report by the Central Council for Education in Japan (2008), "Constructing Degree Program Education," called for the clarification of degree conferral policy (diploma policy: DP), curriculum design and improvement policy including class experience (curriculum policy: CP), and entrant admission policy (admission policy: AP) and proposed a direction in line with the international trend of the systematization of degree programs based on learning outcomes. However, this call for DP and CP at the program level based on learning outcomes is relatively recent, and the background thereto was the previous implementation of class improvement at the subject level (Watanabe, Omori, & Nagai, 2014). This was the 1998 Report of the Council for Higher Education in Japan (1998), "The Face of the 21st Century University and Future Improvement Policies," which preceded the 2008 Report of the Central Council for Education in Japan and is likely to have been key in making approaches to improve classes at the subject level.

Due to the COVID-19 pandemic, however, all Japanese universities were required to cooperate with the demand to suspend classes from April 22, 2020, and even now after this requirement has lifted, many universities are refraining from conventional face-to-face classes and are unavoidably having to implement online education as "a new form of education" using media such as Zoom. According to Robinson and Ikeda (2002), "online education" refers to education and learning provided via a network, and in response to the COVID-19 pandemic, wherein online education is being implemented by many universities as "a new form of education," there is a pressing need to rethink class methods. According to the "Report on the Survey of Taking Online Classes" conducted by Keio University (2020), while online education is regarded as a means to take live classes, it is crucial to address and shed light on online education in terms of the best methods to construct and

advance in the respective classes.

Based on the above research background, this study clarifies the effect of class experience via online education on Japanese university students' learning outcomes amid the COVID-19 pandemic by specialized fields. The following two research questions will be clarified: 1) *Does implementing classes in each of the online education formats of live, on-demand, and hybrid classes result in students acquiring appropriate knowledge and skills?* and 2) *Through what kind of class experience via these online education formats do students acquire learning outcomes?*

By clarifying the above, we are able to show whether live, on-demand, or live and on-demand classes (hybrid classes) are preferable for acquiring specific knowledge and skills and are also able to present an effective class practice for each online education format.

Literature review and discussion

Piccoli, Ahmad, and Ives (2001) were the first to present a systematic research framework in the research area related to online education and learning outcomes. They referred to the importance of considering learning outcomes in terms of six aspects in online education: students' desire to learn, students' learning style, faculty possessing sufficient knowledge of the class content, appropriate feedback from faculty, faculty's attitude to classes, and class composition. Students' desire to learn refers to the learning attitude of being committed to a specific goal (Zimmerman, 1994). Frankola (2001) demonstrated that students with a strong desire to learn are capable of acquiring appropriate knowledge and skills via online education. Similarly, such students have also been confirmed to have high graduation rates in online courses (Galusha, 1997). Moreover, in relation to students' learning style, Eom, Wen, and Ashill's (2006) analysis of student's learning style in online education as defined by Drago and Wagner (2004) demonstrated that the highest learning outcomes are acquired by visual learners, who learn by reading texts, and aural learners, who learn by listening. Similarly, in relation to faculty possessing sufficient knowledge of the class content, this was demonstrated to be valid for students who are taught classes by faculty members with sufficient knowledge (Huynh, 2005). Furthermore, in relation to appropriate feedback from faculty, it has been made clear that information on the learning process and attainment objectives are information that is essential for students (Butler & Winne, 1995), and that students can acquire appropriate knowledge and skills via online education through meta-cognitive feedback (Ley, 1999). Arbaugh (2000) also demonstrated the efficacy of the experience of interactive classes by faculty including this point. In addition, in relation to faculty's attitude to classes, it has also been demonstrated that students acquire appropriate knowledge and skills via online education the more they experience classes from which they sense that the faculty is proactively involved in the running of the class and materials are logical (Swan, 2001).

However, few studies have explored the factors in students' acquisition of learning outcomes

from the perspective of class experiences via online education at Japanese universities during the COVID-19 pandemic. This is because prior to the COVID-19 pandemic, face-to-face education was mainstream at many Japanese universities and only a mere 11 of 781 universities nationwide had a campus that incorporated online education. Moreover, since only a limited number of students took such classes, it has been difficult to verify the efficacy of class experience via online education. For this reason, although studies of the relationship between learning outcomes and class experience via exclusively face-to-face education have been mainstream and many studies such as that of Ogata (2008) have been implemented, many unknowns remain regarding the perspective of class experience

Table 1. Breakdown of valid respondents

	Faculty of Humanities (621)	Faculty of Social Sciences (511)	Faculty of Education (223)	Faculties of Medicine, Dentistry, & Pharmacy (93)	Faculty of Sciences (311)	Faculty of Engineering (411)	Faculty of Agriculture (417)
Freshman	223	198	91	12	101	156	167
Sophomore	229	251	111	21	122	233	237
Junior	169	62	21	20	88	22	13
Senior				15			
5th year				25			

Note: The number of samples by institution is as follows: National university A: 421 (53, 56, 63, 55, 54, 54, 86), National university B: 401 (51, 62, 69, 58, 51, 56, 54), National university C: 356 (41, 45, 52, 50, 51, 51, 66), National university D: 354 (40, 46, 53, 49, 52, 59, 55), Private university A: 425 (51, 52, 55, 51, 56, 56, 104), Private university B: 309 (41, 39, 40, 42, 45, 47, 55), Private university C: 321 (41, 38, 44, 46, 46, 48, 58). The numbers in parentheses are shown by specialized field.

Table 2. Survey items

Personal Circumstances of Respondents	
Sex	Which sex are you? 1. Male 2. Female
Name of affiliated university	To which university do you currently belong? [written open-ended question]
Name of affiliated school	To which school do you currently belong? 1. Humanities - 7. Medicine, Dentistry, or Pharmacy
University Year	Which university year are you in currently? 1. Freshman, 2. Sophomore, 3. Junior Medicine, Dentistry, & Pharmacy only: 4. Senior, 5. 5th Year
Circumstances of online education currently received	
Status of taking online classes	Are you currently taking online classes? 1. Yes, 2. No
Online Class Format	Which is the most common format of the online classes you are currently taking? 1. Live classes, 2. On-demand classes, 3. Hybrid classes
Class Experience	How useful were the following class methods in the online classes for deepening your studies? 1. Faculty possess sufficient knowledge of the class content, 2. Faculty are proactively involved in the running of the class, 3. Faculty give appropriate feedback on exams and tasks, 4. Class materials are logical and deepen students' understanding, 5. The aims and procedure of classes are explained appropriately Four levels from "Useful" to "Not useful"
Circumstances of Learning Outcomes	
Learning Outcomes	How much have you acquired the following knowledge and skills through the online classes you are currently taking? 1. Knowledge and skills related to future occupations, 2. Knowledge and understanding of the specialist field, 3. Theoretical understanding and knowledge of fundamental aspects of the specialized field, 4. Logical written composition skills, 5. Clear speaking skills, 6. Foreign language skills, 7. The ability to think analytically and critically, 8. The ability to identify problems and think of solutions, 9. A broad knowledge and perspective Four levels from "Acquired" to "Not acquired"

via online education. However, in other countries/regions, research on online education amid the COVID-19 pandemic and students' learning outcomes is already underway. Dhawan (2020) examined the attitudes of students toward online education amid the COVID-19 pandemic and found that online education is difficult to implement in poor countries/regions where the local internet infrastructure is not well developed and where many students do not have computers and internet connection. According to a study by Boffelli, Kalchschmidt, and Shtub (2021), students' acquisition of knowledge and skills and their grade point average were higher in 2020, when online education was implemented, than before 2019, when face-to-face education was conducted as routine. However, according to Bergeler and Read (2021), who compared face-to-face education and online education by imposing the same class content, class method, and amount of tasks for a physics class, all acquired the same knowledge and skills. It can be seen that the effects of face-to-face education and online education have not been completely determined even in previous studies in other countries/regions. Furthermore, in previous studies, the factors that improved students' learning outcomes through online education were not known, except for a study by Cho, Park, and Lee (2021) that focused on faculty's class methods. It has been clarified that the class's attitude including with regard to the faculty's facilitation is important. Therefore, even if we look at previous studies in other countries/regions, discussions on the effects of face-to-face education and online education are continuing, and it is not enough to consider which online education is desirable and to consider the class's experience. Hence, this study examined the relationship between online education and learning outcomes, and the relationship between class experience and learning outcomes through online education. Regarding the latter issue, based on Piccoli et al.'s (2001) study framework, this study performs an analysis from the perspective of class experience related to the faculty possessing sufficient knowledge of class content, appropriate feedback from faculty, faculty's attitude to classes, and the class structure.

Research method

Based on the "List of Universities in Japan," the subjects of this research were four national and three private universities that requested faculty members from 30 universities across Japan to cooperate in our survey. A web survey was conducted with freshman to junior level Japanese university students and senior and fifth year medical, dentistry, and pharmacy students enrolled at these universities and focused on students currently taking online education courses from August to September 2020 due to the COVID-19 pandemic. Via the faculties responsible for online classes at each university, responses were requested from the 3,790 students registered as taking those courses on the database; 2,587 valid responses were received (a response rate of 68%). A breakdown of the valid respondents is presented in Table 1. As shown in Table 2, the survey items were broadly divided into "Personal circumstances of the respondent," "Circumstances of online education currently received," and "Circumstances of

learning outcomes.” Moreover, once the responses were complete and the data were organized, an analysis was performed using IBM’s SPSS Statistics and Amos software.

Results and discussion

Table 3. Frequency analysis of learning outcomes acquired via online classes (N=2,587)

	Acquired	Somewhat acquired	Somewhat not acquired	Not acquired	Test Results (Covariance analysis)
Knowledge and skills related to future occupations	4.5% (116)	16.9% (437)	39.7% (1,027)	38.9% (1,007)	F (3, 38)=21.299, p < 0.01
Knowledge and understanding of the specialized field	20.9% (540)	24.5% (634)	29.1% (753)	25.5% (660)	F (5, 35)=19.021, p < 0.01
Theoretical understanding and knowledge of fundamental aspects of the specialized field	20.8% (538)	28.9% (748)	26.1% (675)	24.2% (626)	F (6, 36)=20.031, p < 0.01
Logical written composition skills	18.3% (473)	27.4% (709)	28.3% (732)	26% (673)	F (4, 31)=17.022, p < 0.01
Clear speaking skills	3.9% (101)	15.6% (404)	41.3% (1,068)	39.2% (1,014)	F (6, 36)=20.031, p < 0.01
Foreign language skills	1.1% (28)	8.4% (217)	44.2% (1,143)	46.3% (1,199)	F (2, 33)=17.019, p < 0.01
Ability to think analytically and critically	29.2% (755)	33.2% (859)	19.3% (499)	18.3% (474)	F (6, 34)=18.099, p < 0.01
Ability to identify problems and think of solutions	25.3% (655)	29.3% (758)	26.5% (686)	18.9% (488)	F (5, 35)=19.021, p < 0.01
A broad knowledge and perspective	26.2% (678)	32.4% (838)	22.2% (574)	19.2% (497)	F (7, 37)=21.155, p < 0.01

Note: F (Degree of freedom between groups, Degree of freedom within groups).

Level of university students' acquisition of learning outcomes

The analysis results of learning outcomes acquired via online classes currently taken are reported in Table 3. As Table 3 shows, the survey items that received high numbers of the positive responses “Acquired” and “Somewhat acquired” overall were “The ability to think analytically and critically” (29.2%/755 students, 33.2%/859 students, respectively), “A broad knowledge and perspective” (26.2%/655 students, 29.3%/758 students), and “The ability to identify problems and think of solutions” (25.3%/655 students, 29.3%/758 students). Conversely, the items that received high numbers of the negative responses “Somewhat unacquired” and “Not acquired” were “Foreign language skills” (44.2%/1,143 students, 46.3%/1,199 students, respectively), “Clear speaking skills” (41.3%/1,068 students, 39.2%/1,014 students), and “Knowledge and skills about future occupations” (39.7%/1,027 students, 38.9%/1,007 students).

Moreover, when viewed by specialized field, in liberal arts fields such as the humanities and social sciences, the items that received high numbers of positive responses were “A broad knowledge and perspective” (20.3%/126 students and 38.2%/237 students, 19.9%/102 students and 36.2%/185 students), “The ability to think analytically and critically” (20.1%/125 students and 35.8%/222 students, 19.1%/98 students and 33.1%/169 students), and “The ability to identify problems and think of solutions” (18.2%/113 students and 33.8%/210 students, 17.7%/90 students and 33.2%/170 students). In terms of the characteristics of the academic fields, the humanities and social sciences, in the DPs of many universities, it is often stated that emphasis is placed on the acquisition

of a broader academic knowledge such as in training human resources to possess specialized knowledge by developing problem-solving skills in addition to critically developing a basic academic ability in the humanities and social sciences from a broad perspective. Hence, as the CP must correspond to the DP and since classes are naturally implemented based on the CP, it is possible that there were high numbers of positive responses to the items related to broad academic knowledge.

Furthermore, in the education field, which includes a mixture of science courses for education practice, nursing experience, and obtaining a teaching license, the situation essentially differs from the humanities and social sciences fields. The items that received a high number of positive responses were “Knowledge and skills about future occupations” (20.1%/45 students and 33.8%/75 students), “Knowledge and understanding of the specialized field” (19.2%/43 students and 31.1%/69 students), and “Theoretical understanding and knowledge of fundamental aspects of the specialized field” (18.7%/42 students and 30.9%/69 students). Among the positive responses in the education field, one reason for the high numbers of items related to professional knowledge and skills and to specialized knowledge is that the Ministry for Education in Japan stipulates many classes in teaching subjects to obtain elementary, junior high, and high school teaching licenses. Furthermore, similar to the education field, which is the primary field oriented toward the acquisition of a license, the same trend can also be observed in the medicine, dentistry, and pharmacy fields. Specifically, there were high numbers of positive responses for “Knowledge and skills about future occupations” (23.2%/22 students and 37.3%/35 students), “Knowledge and understanding of the specialist field” (22.1%/21 students and 34.4%/32 students), and “Theoretical understanding and knowledge of fundamental aspects of the specialized field” (21.2%/20 students and 33.2%/31 students). Many students in the fields of medicine, dentistry, and pharmacy must sit the national examination for medical practitioners to obtain the qualification of a physician’s license. To pass, they must be fully versed in specialized knowledge for which they must study classes in relevant subjects; hence, it is likely that the high number of items related to professional knowledge and skills and specialized knowledge may reflect this.

In addition, the fields of science, engineering, and agriculture displayed a trend in between that of the humanities and social sciences fields, which saw many positive responses for items related to broad academic knowledge, and the fields of education and medicine, dentistry, and pharmacy, which saw a high number of positive responses for items related to specialized knowledge. There was a high number of positive responses for “A broad knowledge and perspective” (17.3%/54 students and 36.5%/114 students, 17.1%/70 students and 35.9%/148 students, 16.7%/70 students and 34.8%/145 students), “Knowledge and skills about future occupations” (18.9%/59 students and 30.1%/94 students, 18.1%/74 students and 29.7%/69 students, 17.6%/73 students and 28.1%/117 students), and “Theoretical understanding and knowledge of fundamental aspects of the specialized field” (18.1%/56 students and 29.9%/93 students, 17.9%/74 students and 29.1%/120 students, 73 students and 27.9%/116 students).

The relationship between the online education format and learning outcomes

Table 4. Cross analysis of the online education format and learning outcomes (N=2,587)

	Live classes (1,392)	On-Demand classes (321)	Hybrid classes (874)	Test Results (Covariance analysis)
Knowledge and skills related to future occupations	6.9% (96), 29.1% (405)	8.3% (27), 30.1% (97)	7.1% (62), 29.1% (254)	F (3, 38)=21.299, p < 0.01
Knowledge and understanding of the specialized field	6.7% (93), 28.7% (400)	10.1% (32), 32.4% (104)	6.8% (59), 28.7% (250)	F (4, 39)=23.301, p < 0.01
Theoretical understanding and knowledge of fundamental aspects of the specialized field	6.5% (90), 28.4% (395)	9.8% (31), 31.5% (101)	6.6% (58), 28.2% (246)	F (3, 37)=20.222, p < 0.01
Logical written composition skills	6.1% (85), 27.2% (379)	8.1% (26), 29.7% (95)	6.2% (54), 27.6% (241)	F (5, 40)=24.444, p < 0.01
Clear speaking skills	5.5% (77), 26.7% (372)	7.6% (24), 29.1% (93)	7.9% (69), 32.3% (282)	F (5, 41)=25.236, p < 0.01
Foreign language skills	5.1% (71), 26.4% (367)	11.3% (36), 35.2% (113)	12.9% (113), 38.9% (340)	F (5, 40)=24.444, p < 0.01
Ability to think analytically and critically	10.3% (143), 36.7% (511)	7.1% (22), 28.7 (92)	7.6% (66), 31.9% (279)	F (5, 37)=21.222, p < 0.01
Ability to identify problems and think of solutions	7.1% (99), 30.1% (419)	6.6% (19), 27.1% (87)	7.2% (63), 30.8% (269)	F (5, 36)=19.089, p < 0.01
A broad knowledge and perspective	7.9% (110), 33.5% (466)	6.3% (20), 26.9% (86)	8.2% (72), 33.9% (296)	F (5, 35)=18.281, p < 0.01

Note: F (Degree of freedom between groups, Degree of freedom within groups).

The results of analyzing the relationship between the online education format and learning outcomes are reported in Table 4. It is evident that overall, in the case of live classes, which is the most common class format of online classes currently taken, there was a high number of the positive responses for “Acquired” and “Somewhat acquired” for items related to broad academic knowledge, namely, “The ability to think analytically and critically” (10.3%/143 students and 36.7%/511 students), “A broad knowledge and perspective” (7.9%/110 students and 35.5%/466 students), and “The ability to identify problems and think of solutions” (7.1%/99 students and 30.1%/419 students). In contrast, in the case of on-demand classes, there was a higher number of positive responses for items related to foreign language skills and specialized knowledge such as “Foreign language skills” (11.3%/36 students and 35.2%/113 students), “Knowledge and understanding of the specialized field” (10.1%/32 students and 32.4%/104 students), and “Theoretical understanding and knowledge of fundamental aspects of the specialist field” (9.8%/31 students and 31.5%/101 students). As a situation peculiar to Japanese universities, there are many universities where the online education form is decided by the whole university or faculty. In these circumstances, students are likely to have a strong sense of acquisition for items related to foreign language skills and specialized knowledge in on-demand classes by imitating pronunciation without worrying about the eyes. This is thought to reflect the Japanese student’s temperament, which tends to be concerned about the surroundings. Moreover, being able to listen repeatedly and slowly to sections they do not understand is crucial to acquiring these skills and knowledge. Furthermore, in relation to hybrid classes, we can see a high number of responses for “Foreign language skills” (12.9%/113 students and 38.9%/340 students), “Professional knowledge and skills” (8.2%/72 students and 33.9%/296 students), and “Clear speaking skills” (7.9%/69 students

and 32.3%/282 students). The background to “Clear speaking skills” is that it is a newly added item, and it is likely that students deepen their understanding by repeatedly viewing recorded classes and then have discussions with the faculty.

Moreover, when viewed by specialized field, for live classes, a trend similar to the overall trend can be confirmed for liberal arts fields such as the humanities and social sciences. In other words, the items with a high number of positive responses were “The ability to think analytically and critically” (9.9%/34 students and 34.4%/214 students, 9.7%/28 students and 33.9%/99 students), “A broad knowledge and perspective” (9.5%/32 students and 33.1%/113 students, 9.1%/27 students and 33.0%/96 students), and “The ability to identify problems and think of solutions” (6.9%/24 students and 29.9%/102 students, 6.1%/18 students and 28.1%/82 students). In terms of the characteristics of the academic fields of the humanities and social sciences, it is likely that students have a strong sense of acquiring these kinds of broad academic knowledge by thinking about specific things comprehensively, via various live classes. However, the trend for on-demand classes appears to be somewhat different to the overall trend. There were a high number of positive responses for the items “Foreign language skills” (12.5%/12 students and 38.9%/36 students, 11.9%/11 students and 37.5%/35 students), “Logical written composition skills” (11.3%/10 students and 37.2%/34 students, 10.7%/10 students and 37.5%/35 students), and “A broad knowledge and perspective” (9.4%/9 students and 32.9%/30 students, 9.0%/8 students and 32.1%/30 students). Essentially, the fields of the humanities and social sciences are specialized fields that center on lecture-style study, but with on-demand classes, since the occasions in which students are basically writing reports alone outside classes have also increased, it is likely that students are developing a strong sense of having acquired “Logical written composition skills.” In addition, it is possible to concentrate on the class without worrying about the eyes in on-demand classes and write reports outside of class. Furthermore, for hybrid classes, there were a high number of positive responses for “Foreign language skills” (13.8%/26 students and 37.8%/71 students, 71 students, 12.9%/16 students and 37.1%/46 students), “Clear speaking skills” (12.1%/23 students and 34.9%/66 students, 11.8%/15 students and 32.2%/40 students), and “Logical written composition skills” (11.9%/22 students and 33.2%/62 students, 10.8%/14 students and 32.9%/41 students).

However, for live classes in the fields of education and medicine, dentistry, and pharmacy, the trend differs from that of the fields of the humanities and social sciences. For live classes, there was a high number of positive responses for items related to professional knowledge and skills and specialized knowledge, such as, “Knowledge and skills related to future occupations” (14.4%/22 students and 39.1%/60 students, 13.1%/9 students and 35.9%/25 students), “Knowledge and understanding of the specialized field” (13.6%/21 students and 36.2%/55 students, 12.1%/9 students and 34.3%/24 students), and “Theoretical understanding and knowledge of fundamental aspects of the specialized field” (12.4%/19 students and 34.7%/53 students, 11.1%/8 students and 31.2%/22 students). One factor in the strong sense of having acquired these items through live classes

is likely to be that in the education field, due to the COVID-19 pandemic, a measure has been implemented for this academic year only to approve live classes at university as credits in the place of educational or nursing practice. Similarly, in the fields of medicine, dentistry, and pharmacy, it is inferred that one aspect in the background to this is that clinical practice is now being performed via live classes. By contrast, with on-demand and hybrid classes alike, high numbers of positive responses are evident for items related to foreign language skills and broad academic knowledge, such as “Foreign language skills” (12.4%/3 students and 38.8%/8 students, 11.3%/1 student and 37.1%/3 students; 13.3%/7 students and 39.9%/20 students, 13.1%/2 students and 38.4%/5 students), “A broad knowledge and perspective” (11.3%/2 students and 37.9%/8 students, 10.9%/1 student and 36.3%/3 students; 14.9%/7 students and 36.1%/18 students, 13.9%/2 students and 35.9%/5 students), and “The ability to think analytically and critically” (10.3%/2 students and 34.9%/7 students, 10.1%/1 student and 34.4%/3 students; 13.4%/7 students and 38.9%/19 students, 12.9%/2 students and 38.1%/5 students).

Furthermore, in the fields of science, engineering, and agriculture, for all online educational formats, there was a high number of positive responses for the items “A broad knowledge and perspective,” “Knowledge and skills related to future occupations,” and “Theoretical understanding and knowledge of fundamental aspects of the specialist field,” and it was demonstrated that there is a discrepancy in the acquisition of specific knowledge and skills depending on the online educational format. Based on this result, these faculties have a well-designed curriculum that students can acquire their knowledge and skills in any form of online education.

The relationship between online educational format and class experience

Table 5. Cross analysis of the online education format and class experience (N=2,587)

	Live classes (1,392)	On-Demand classes (321)	Hybrid classes (874)	Test Results (Covariance analysis)
Faculty possess sufficient knowledge of the class content	20.8% (290), 52.9% (736)	15.3% (49), 43.7% (140)	22.3% (195), 55.8% (488)	F (3, 38)=21.299, p<0.01
Faculty are proactively involved in the running of the class	21.9% (305), 55.2% (768)	11.6% (37), 11.9% (38)	22.4% (196), 53.9% (471)	F (6, 44)=44.314, p<0.01
Faculty give appropriate feedback on exams and tasks	18.9% (263), 49.8% (693)	7.8% (25), 13.9% (45)	20.3% (177), 48.8% (427)	F (7, 45)=45.449, p<0.01
Class materials are logical and deepen students' understanding	14.3% (199), 45.3% (631)	20.3% (65), 49.7% (160)	21.9% (191), 51.1% (447)	F (8, 46)=46.792, p<0.01
The aims and procedure of classes are explained appropriately	17.9% (249), 46.2% (643)	14.5% (47), 13.8% (44)	19.1% (167), 45.4% (397)	F (6, 44)=44.314, p<0.01

Note: Data are shown for “Useful” and “Somewhat useful” items.

F (Degree of freedom between groups, Degree of freedom within groups).

The results of analyzing the relationship between online educational formats and class experience are reported in Table 5. It is evident that common to all online education formats in general, the items that were evaluated positively as “Useful” and “Somewhat useful” were of

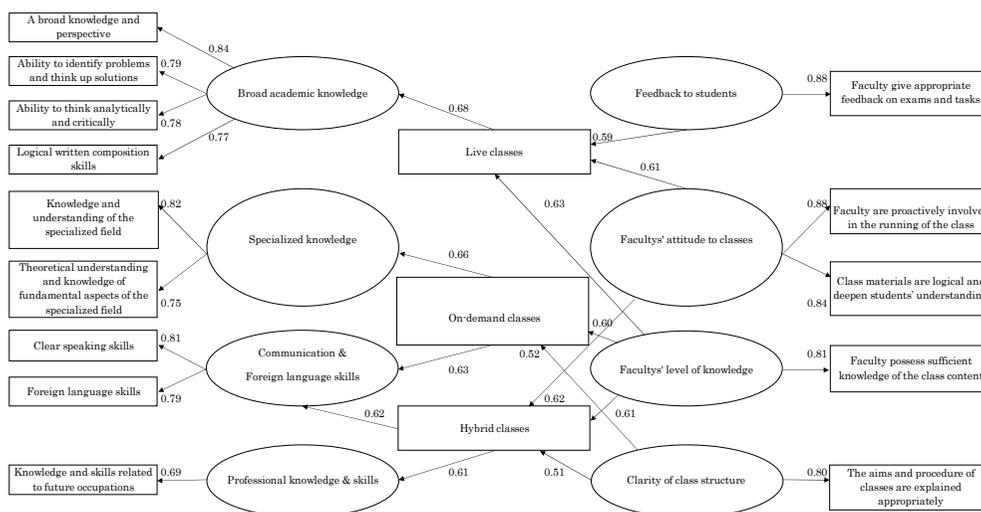
experiencing classes in which “Faculty possesses sufficient knowledge of the class content” (20.8%/290 students and 52.9%/736 students, 15.3%/49 students and 43.7%/140 students, 22.3%/195 students and 55.8%/488 students). Currently, not only faculty members with traditional doctoral degrees but also practitioner faculty members who have work experience in companies and schools are increasing in Japanese universities. As a result, there is a problem that faculty’s knowledge and their levels may differ. It suggests that faculty members need to have sufficient knowledge to take charge of classes, or that a system for judging from various perspectives is necessary. Similarly, for live classes, while there was a prominently high number of items related to the attitude of faculty toward engaging with the class and appropriate feedback, such as “Faculty is proactively involved in the running of the class” (21.9%/305 students and 55.2%/768 students), and “Faculty gives appropriate feedback on exams and tasks” (18.9%/263 students and 49.8%/693 students), in the case of on-demand classes, this trend was observed for items related to class structure, such as “Class materials are logical and deepen students’ understanding” (20.3%/65 students and 49.7%/160 students), and “The aims and procedure of the class are explained appropriately” (14.5%/47 students and 13.8%/44 students). According to an international comparative study of academic profession in Arimoto (2020), more Japanese university faculty members want to focus on research rather than class compared to other countries/regions. Based on this, it is important for faculties to face the class in live classes, and it is necessary to change the temperament of Japanese university faculties who bear the burden of the class. Moreover, in the case of live classes, the fact that classes can be run in real-time, thereby ensuring interaction between faculty members and students, is likely to give students a strong sense that faculty members have an attitude of engaging with the class and of the suitability of their feedback to questions. Conversely, in the case of on-demand classes, since many Japanese universities have a history of assuming face-to-face class and there are no students present and no comments, there is a greater need to prepare the class teaching materials in advance and clarify the class flow, and it is presumed that this facilitates a strong sense of clarity in terms of class structure. Furthermore, for hybrid classes, there was a high number of responses related to the items of live classes and on-demand classes alike, namely, “Faculty is proactively involved in the running of the class” (22.4%/196 students and 53.9%/471 students), and “Class materials are logical and deepen students’ understanding” (21.9%/191 students and 51.1%/447 students). For hybrid classes, it is likely that students are included facilitates a strong sense of both the faculty’s attitude of engaging with the class and of a clear class structure.

Moreover, when viewed by specialized field, a similar trend to that overall, which transcends specialized fields, is observed. For example, in the case of live classes, for the fields of the humanities and social sciences, “Faculty possesses sufficient knowledge of the class content” (21.3%/73 students and 55.1%/188 students, 20.9%/61 students and 54.9%/160 students), “Faculty is proactively involved in the running of the class” (20.3%/69 students and 54.1%/184 students, 19.9%/58 students and 53.2%/155 students), and “Faculty gives appropriate feedback on exams and tasks”

(18.3%/62 students and 48.1%/164 students, 17.1%/50 students and 47.5%/139 students). Similarly, in the case of on-demand classes, for the fields of education, medicine, dentistry, and pharmacy, “Faculty possesses sufficient knowledge of the class content” (21.2%/4 students and 56.9%/12 students, 23.2%/2 students and 57.2%/5 students), “Class materials are logical and deepen students’ understanding” (21.0%/4 students and 54.1%/11 students, 23.1%/2 students and 56.9%/5 students), and “The aims and procedure of the class are explained appropriately” (20.6%/4 students and 50.1%/11 students, 22.3%/2 students and 53.2%/4 students). For hybrid classes in the fields of the sciences, engineering, and agriculture, “Faculty possesses sufficient knowledge of the class content” (20.3%/18 students and 51.3%/46 students, 20.1%/44 students and 50.5%/111 students, 19.5%/37 students and 49.1%/93 students), “Faculty is proactively involved in the running of the class” (19.5%/17 students and 50.2%/45 students, 18.4%/40 students and 49.7%/109 students, 17.9%/34 students and 48.6%/92 students), and “Class materials are logical and deepen students’ understanding” (18.9%/17 students and 49.1%/44 students, 17.8%/39 students and 48.7%/107 students, 16.9%/32 students and 46.3%/88 students).

The relationship between learning outcomes, online educational format, and class experience

Table 6. Covariance structure analysis of the causal relationship between learning outcomes, the online educational format, and class experience (N=2,587)



Note: Goodness of fit index (GFI)=0.65, Adjusted goodness of fit index (AGFI)=0.63, Comparative fit index (CFI)=0.61, Root mean square error of approximation (RMSEA)=0.59, Akaike information criterion (AIC)=396.318

The results of this study’s covariance structure analysis of the causal relationship between students’ learning outcomes, online educational format, and class experience are reported in Table 6. As can be seen, student’s learning outcomes were aggregated fourfold into “*Broad Academic*

Knowledge,” “*Specialized Knowledge*,” “*Communication/Foreign Language Skills*,” and “*Professional Knowledge and Skills*,” Class experience was also aggregated fourfold into “*The Level of Knowledge of Faculty*,” “*The Attitude of Faculty to Classes*,” “*Feedback to Students*,” and “*Clarity of Class Structure*.”

A significant causal relationship with “*Broad Academic Knowledge*” was observed for students taking mostly live classes among their current online classes. Moreover, it was demonstrated that there are significant relationships between “*Specialized Knowledge*,” “*Communication/Foreign Language Skills*” the more students take on-demand classes, and “*Professional Knowledge and Skills*” and “*Communication/Foreign Language Skills*” the more students take hybrid classes. This result supports Table 4, hence, it can be argued that it indicates a disparity in the acquisition of specific knowledge and skills according to the differences in the online education formats.

Moreover, in relation to the causal relationship between the online education formats and class experiences, there is a significant relationship with “*The Level of Knowledge of Faculty*,” “*The Attitude of Faculty to Classes*,” and “*Feedback to Students*” the more students take live classes. In addition, it was demonstrated that there is a significant relationship with “*The Level of Knowledge of Faculty*” and “*Clarity of Class Structure*” the more students take on-demand classes, and moreover with “*The Level of Knowledge of Faculty*,” “*The Attitude of Faculty to Classes*,” and “*Clarity of Class Structure*” the more students take hybrid classes. Therefore, in other words, a situation is arising such that depending on the differences in online education formats, not only do the students’ learning outcomes that can be obtained differ, but the effective class experiences also differ.

Furthermore, looking at the results of analyzing by specialized field, these more or less support the results in sections 2 and 3. First, in the fields of the humanities and social sciences, a significant correlation was seen with “*Broad Academic Knowledge*” the more students take live and on-demand classes. However, unlike in section 2, no significant correlation was seen between on-demand classes and “*Communication/Foreign Language Skills*.” One reason for this could be that since this factor is comprised of “*Clear Speaking skills*” and “*Foreign Language Skills*,” it was likely to be insignificant in live and on-demand classes where no students are present. Similarly, for hybrid classes, it was demonstrated that there was a significant correlation with “*Broad Academic Knowledge*” and “*Communication/Foreign Language Skills*.” Second, in the fields of education, medicine, dentistry, and pharmacy, a significant correlation with “*Professional Knowledge and Skills*” and “*Specialized Knowledge*” was observed the more students take live classes. In addition, for on-demand and hybrid classes alike, a significant correlation was demonstrated with “*Broad Academic Knowledge*” and “*Communication/Foreign Language Skills*.” Similarly, in the fields of science, technology, engineering, and agriculture, a significant correlation was demonstrated between all online educational formats and “*Broad Academic Knowledge*,” “*Specialized Knowledge*,” and “*Professional Knowledge and Skills*,” and no difference in learning outcomes were observed by online education format.

Third, looking at the relationship between online educational formats and class experience by specialized field, it was confirmed that the same significant correlation exists as that of the overall results from all fields.

Conclusion

With the aim of clarifying the effect of class experiences via online education on Japanese university students' learning outcomes amid the COVID-19 pandemic, this study established and investigated the following two questions: 1) *Does implementing classes in each of the online education formats of live, on-demand, and hybrid classes result in students acquiring appropriate knowledge and skills?* and 2) *Through what kind of class experience via these online education formats do students acquire learning outcomes?*

From the results, while we learned that students acquire knowledge and skills through online education in the same way as conventional face-to-face education, we also found that regardless of the specialized field, the knowledge and skills that are acquired differ according to the form of online education selected. While all universities have been promoting online education during the COVID-19 pandemic, amid the Ministry of Education's shift in policy to publish the name of universities with less than 50% face-to-face education from second semester classes in 2020 onward, the finding of the present research that appropriate learning outcomes are assured even for online education in the same way as face-to-face education is likely to be of major significance. However, when we consider that the level of attainment of learning outcomes of the student population with lower academic ability shows greater decline than under face-to-face education as the newspaper the *Mainichi Shinbun* (2020) highlighted, a future challenge for Japanese universities will also be how to capitalize on the qualities of online education while substantially supporting those students who are likely to be negatively impacted. Similarly, the results also revealed that effective class experiences differ according to the format of online education used to obtain appropriate learning outcomes. When faculty members write class syllabuses, it is of course important to choose the appropriate online education format according to the type of skills they envisage students will acquire as the lesson's attainment targets, but it is also important to continue to adapt the class methods in response.

The limitations of this research and future issues will be described. The first limitation of this research was the goodness-of-fit index of the covariance structure analysis as shown in Table 6. A root mean square error of approximation of 0.59 was obtained. Hence, it cannot be said that the model was optimal, and it needs to be reviewed further. This indicates that the other variables may have influenced the outcome. The second limitation of this study was that the data were collected amid the COVID-19 pandemic (August–September 2020) and some students have a high ability to acquire learning outcomes amid any class experience, while others do not. Therefore, when analyzing the relationship between class experiences and learning outcomes, it is desirable to compare the same

individual at two points in time, e.g., before and after the pandemic. Third, covariance structure analysis was used to clarify the relationship between learning outcomes, online educational format, and class experiences, but after controlling for variables such as specialized fields, it may have been easier to measure the direct effect of class experiences using multiple regression analysis. There are many issues left unaddressed by this study, but by tackling these issues one by one, further refined research results are expected.

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