Learning at Home vs. in the Classroom: Exploring Self-Directed E-Learning

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Article Info

Abstract

The rapid expansion of e-learning has sparked debate over whether learning environments, i.e. home versus classroom, affect academic outcomes when using digital materials. This study investigates the effectiveness of e-learning for undergraduate students by comparing two settings: (1) self-paced learning at home and (2) structured e-learning in a classroom. Participants were provided identical digital resources (lecture videos and a PDF textbook) and checked by engagement levels, learning outcomes, and satisfaction. Data were collected through surveys, online learning systems, and academic performance from over 500 students enrolled in an information science course as part of their general education requirements. Results reveal significant difference in learning time, with students in the classroom group spending less time than those in the home group. The classroom learning group also shows better degree of understanding, lower dropout rate, and higher level of satisfaction. The findings suggest that while e-learning can be equally effective in both contexts, the learning environment plays a crucial role in shaping student learning experiences. This study provides valuable insights for educators and institutions seeking to optimize e-learning instruction, particularly in the context of hybrid or fully online engineering courses.

Introduction

In recent years, the field of education has been transformed by the rapid integration of information technologies. The global Internet, coupled with the development of digital tools and platforms, has revolutionized how education is delivered and accessed. E-learning has emerged as a flexible and scalable alternative to traditional face-to-face classroom learning, offering students the ability to engage with educational contents from virtually anywhere. The shift towards e-learning is not only driven by advancements in technology but also by a growing recognition of its potential to enhance educational access, equity, and personalized learning. In addition, the unforeseen challenges posed by the COVID-19 pandemic highlighted the critical importance of online education. With the closure of schools, universities, and training centers across the globe, many educational systems were forced to rapidly adopt online e-learning solutions. The pandemic revealed the potential of technology in maintaining educational continuity during a crisis.

Despite of its increasing importance, online e-learning is still under debate regarding its effectiveness and impact. Some people emphasize more on online learning's merits such as flexibility, accessibility, and cost-efficiency, others argue that it lacks face-to-face interaction, potentially reducing engagement and deepening educational inequalities for those with limited digital access.

There are many positive findings supporting online learning regarding student academic performance. For example, Tallent-Runnels et al. (2006) find that online learning is not inferior to classroom learning in student satisfaction and learning performance. Müller & Mildenberger (2021) find that a reduction in classroom time between 30 and 79 percent in blended learning would produce almost equivalent learning outcomes as conventional classroom learning. Chang (2021) finds that dental students tend to view the effectiveness of online learning as better than that of physical classroom learning. In contrast, there are also negative voices about online learning, most of them being related to time management and student engagement. For example, Chang (2021) finds that students prefer the convenience and fairness of physical classroom examination than that of online examination. Van Doorn & Van Doorn (2014) find that online courses have higher rates of failure and lower retention rates than classroom courses. Shen et al. (2025) find that student evaluation of clinical practice abilities in face-to-face learning was notably higher than that of the online group, and their satisfaction with the effectiveness of face-to-face learning was also higher than that of the online group.

The differences in research findings can be the result of many factors. One factor that should be taken into consideration is the type of online learning, i.e. whether it is synchronous or asynchronous. Synchronous online learning requires everyone to be online at the same time and both instructors and students interact in real time (Chang, 2021). It is more like a "traditional" class experience where everyone is seen through a camera. The challenges it faces include requiring infrastructure to support many simultaneous accesses to an online meeting. Asynchronous online learning provides students with all the materials beforehand and enables them to access course documents, lecture videos, and assignments at any time. It offers students the opportunity of self-paced learning, but provides less direct interaction with instructors and classmates. It may require a higher level of self-discipline and time management (Núnez, 2023).

This study focuses on asynchronous e-learning in undergraduate education. One reason is that the university infrastructure does not support delivering synchronous lectures to a large number of students, which might cause heavy workload to some servers. Another reason lies in the positive effectiveness of asynchronous e-learning in flipped classrooms. Asynchronous e-learning is often used in, and associated with, flipped courses, where students are asked to access the materials before class.

There are numerous studies about asynchronous online learning and flipped courses, and most of them present positive results. For example, Jaca et al. (2024) find that students in technology universities tend to prefer asynchronous online learning using digital tools such as Google Classroom and messengers. Decman et al. (2025) examine the perceived and experienced drivers and barriers associated with flipped courses, including the use of video lectures, self-directed learning, self-discipline, social isolation, motivation, and time management. The results show that students appreciated the flexibility of learning at their own pace and being able to re-watch video lectures. Other studies also provide evidences of various positive effects of flipped learning (Bredow et al., 2021; Jeong & Gonzalez-Gomez, 2021).

Since some researchers find that the effectiveness of flipped classroom in achieving better learning outcomes remains uncertain and may vary depending on the subject area, performance level of learners, and other factors (Shaffi et al., 2023), this study aims to investigate the impact of the factor: learning environment, i.e. at home vs. in the classroom, in the subject area of information science.

We collected data from over 500 undergraduate students enrolled in an information science course at a national public university in Japan. The students were divided into two groups and provided with identical digital resources including lecture videos and a PDF textbook. Benefits from both video-based learning and text-based learning were expected. Video-based learning is found to be important for more engagement in self-paced learning (Lapitan et al., 2023; Walsh, 2024), and text-based e-materials have merits such as key words searching. There are evidences that students underscored re-watching videos for improving their understanding and performance in assessments (Weng & Zheng, 2023; Parkes et al., 2024).

Information science is a vital subject within STEM education, bridging technology, data, and human-centric systems to drive innovation in fields like artificial intelligence, cyber security, and data analytics. STEM education has become indispensable today, equipping learners with critical thinking, technical skills, and adaptability to solve global challenges. The education prepares students to master data, design intelligent systems, and ethically navigate the information-driven future, ensuring a workforce ready to advance scientific, economic, and societal progress. To our knowledge, there has been no study comparing the two settings, home e-learning and classroom e-learning, in this subject area, and this study aims to make up this void.

The research questions of this study are:

    1. Is student academic performance of self-directed e-learning at home the same as that in the classroom?

    2. Do students spend the same amount of time on e-learning at home as that in the classroom?

    3. Is student level of satisfaction in e-learning at home the same as that in the classroom?

Method

Participants and Curriculum

This study involved more than 500 undergraduate students enrolled in an information science course at a national public university in Japan. The course was part of the university's general education curriculum and did not require background knowledge in related fields. The university followed a quarter-based academic calendar, dividing the academic year into four terms, and the course was offered in each quarter. Data for this study were collected over the span of two quarters. During this period, the course structure remained consistent: the same textbook was used, assessments were identical, and the course was taught by the same instructor, ensuring uniformity across both terms.

Material Design

To support student learning in the course, we created and provided students with both text-based and video-based materials. These included a PDF textbook and videos that recorded PowerPoint (PPT) presentations of all the contents in the textbook. Table 1 gives a list of contents of the textbook. The PPT slides condensed the textbook contents into concise bullet points and included all the figures and tables to maintain alignment with the textbook. The contents were presented by using the slides with oral explanations, animations, and laser pointer movements. The explanations involved reading the most relevant excerpts from the textbook while pointing at the specific element being explained, allowing students to engage with the material through both visual and auditory channels. This multimedia approach aimed to reinforce understanding and accommodate different learning preferences.

Table 1. List of Contents

Chapter	Title	Contents
1	Computer	Characteristics of a computer, digital and analogue, program, components of a computer, hardware, software, expression of information inside a computer, mechanism of computing, logical gates and calculations
2	Flowchart	Typical boxes of a flowchart, how to create a flowchart, notes on flowcharting, examples
3	Time complexity	Expression of time complexity, meaning of time complexity, how to view time complexity from the polynomial of the number of executions, how to view time complexity from a flowchart, evaluation of a program
4	Artificial intelligence (AI) - mathematical modelling	Introduction to AI, expert systems, soft computing, importance of modelling a problem, how to model a problem and two examples, how to encode a problem and two examples
5	Artificial intelligence (AI) - genetic algorithm (GA)	Target problems of GA, flowchart of GA, initial population, evaluation, selection, crossover, mutation, termination criteria, examples

Chapter	Title	Contents
6	Artificial intelligence (AI) - machine learning	Introduction to machine learning, regression, neural network, how a neuron works, the model function of a neuron, Threshold Logic Unit (TLU), how to use a TLU to realize logical calculations, learning of a TLU, deep learning
7	Network	Information network, methods of switching, network topologies, wired LAN (standards, copper cabling, fibre optic cabling), wireless LAN (standards, comparison with wired LAN), Internet, protocols, hierarchical models of protocols, IP address, domain name, Internet of Things (IoT)
8	Database	Relational database, five types of calculations in relational database and examples
9	Information security	Information security, information assets, security measures (for users and for administrators), encryption, digital signature, digital authentication

The course was delivered in both Japanese and English to meet the needs of both national and international students. The materials, including textbook and videos, were identical across both languages. In this paper, we present the English-language version of the materials. Figure 1 provides a screenshot of one lecture video, illustrating how a specific flowchart is explained through the medium. The arrows and symbols between the text and figure are progressively shown in animation, and a laser pointer moves dynamically between the other elements as the explanation unfolds.
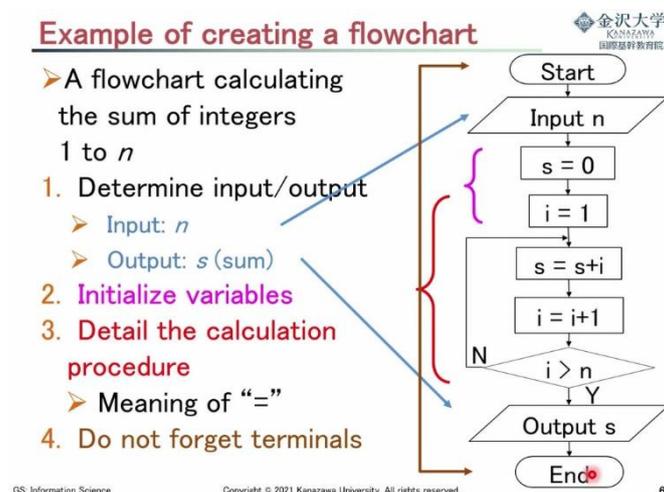

Figure 1. A Screenshot of a Lecture Video

All the materials were available to students through the university's official e-learning platform. Printout textbooks were also available upon request. The textbook consisted of nine chapters (as shown in Table 1), which were covered across seven lectures. Each lecture had a duration of 90 minutes, including both video component and time for completing assessments. For each chapter, the duration of the video was between 20 and 30 minutes to maintain student engagement, avoiding problems such as lengthy or logically not well connected talks. By focusing on delivering only necessary and essential explanations, the videos served as streamlined and focused

supplements to the textbook.

Assessment Design

The assessment for each lecture was a quiz at the end of each chapter. Students needed to complete one to two specified chapters in each lecture. The assessments were open-note, since students were able to access all the materials including the textbook, videos, and their own notes. The quiz questions were intentionally designed to emphasize the application and transfer of knowledge, rather than simple memorization or retention. For example, in Chapter 2, which focused on flowcharts, one of the quiz questions challenged students to apply their understanding in the following way:

Quiz: Create a flowchart that details the procedure of a jumping exercise, in which you should jump up 15 times or for 20 seconds, whichever comes earlier.
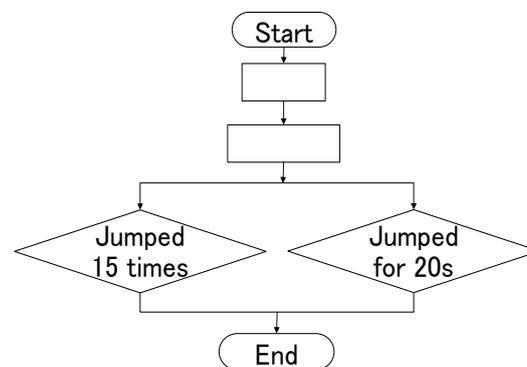
Figure 2. A Sample Flowchart Requiring Improvements from Students

For this quiz problem, students were instructed to create a well-structured flowchart with all details. An unqualified sample flowchart (Figure 2) was shown first. This sample was chosen from flowcharts created by students in the past to illustrate common mistakes and areas for improvement. In the video, we walked students through the example, explaining in detail what aspects were problematic, why those issues mattered, and how the flowchart could be revised to meet higher standards. The goal was to encourage critical thinking and thoughtful revision, rather than replication. Therefore, students who simply copied the sample without making meaningful improvements received few points. In contrast, those who applied the taught skills and improved all the instructed weaknesses were awarded high scores. Such explicit guidance was provided through all the videos for more than half of the quiz problems across the nine chapters.

The difference between the two groups lies in that the first group learned at home in the lecture time, being allowed to engage with the materials and assessments at their own pace, whereas the second group learned in the classroom, being instructed when to access the materials and when to work on the assessments. The deadline for completing the assessments was the same for the two groups, which was 15 minutes before the lecture end. The last 15 minutes in each lecture was used for explanation of solutions to the assessments, providing quick feedbacks to students on their performance and room for improvement. For students in the first group, we supported them

by answering their questions through messages in the e-learning platform. For students in the second group, the instructor answered their questions individually in the classroom. These ensured that students could seek clarification or further explanation when needed. In fact, the number of questions from students were few in both groups due to clarity of the videos.

The total score from the nine quizzes was used as the final score for each student. At the end of the course, students were asked to complete a questionnaire to evaluate the effectiveness of the lecture. This survey included three questions relevant to this study: (1) Do you think the materials and explanations are easy to understand? (2) How well have you understood the contents of this lecture? (3) What is your level of satisfaction with this lecture? Responses were collected using a 10-point Likert scale, where students selected the option that best reflected their personal experience and perception of the course.

Results

Descriptive Statistics

Over two academic quarters, a total of 501 students participated in the course. During the first quarter, 263 students were enrolled and they learned at home. These students were categorized as Group 1. In the second quarter, 238 students were enrolled and they received instructions in the classroom. These students were designated as Group 2. The learning materials were identical, and the lectures were given by the videos provided to both groups. The instructor in the classroom group mainly guided students on time allocation and provided solution explanations.

To remove data that may reduce validity of the research findings, we did not include in the analysis students dropped out. Students who failed to complete over half of the required assessments were classified as dropouts. The dropout rates for both groups are summarized in Table 2.

Table 2. Dropout Rates of the Two Groups

	Learning Environment	Total Enrolled (N)	Dropouts	Dropout Rate
Group 1	Home	263	34	0.129
Group 2	Classroom	238	17	0.071
Total		501	51	0.102

A comparative analysis was conducted between Group 1 (home learners) and Group 2 (classroom learners) across three key dimensions: learning performance, learning time, and overall satisfaction. To evaluate learning performance, we analyzed students' final scores, which served as a direct indicator of academic achievement. The scores were derived from the results of the nine quizzes throughout the course.

Table 3 summarizes the learning performance (final scores) for both groups, including the mean final score, standard deviation, and the result of an ANOVA (Analysis of Variance) test to check whether there is statistically significant difference between groups.

ANOVA was employed as the statistical method of choice because it allows for the comparison of mean values across groups while taking into account within-group variability. In this context, the p-value derived from the ANOVA indicates the probability that any observed difference in means between the two groups could have occurred by chance. A p-value less than 0.05 was used as the threshold for statistical significance, in line with conventional standards in social science and educational research. This means that if the p-value reported in any of the tables is less than 0.05, the difference between the two groups is considered statistically significant, suggesting that the variation observed is unlikely to be due to random variation alone and may be attributed to the differing conditions or interventions experienced by each group. The results in Table 3 show that although Group 1 (home learners) had a slightly higher average score than Group 2 (classroom learners), the difference was not statistically significant (p = 0.1126).

Table 3. Learning Performance of the Two Groups

	Learning Environment	N	Mean Score	Standard Deviation	ANOVA p-value
Group 1	Home	229	81.56	11.31	
Group 2	Classroom	221	79.90	10.84	0.1126
Total		450	80.74	11.08	

For the analysis of learning time, we used data extracted from the university's e-learning management system, which automatically records and stores detailed logs of student activities. These log files provide an objective and systematic record of each student's engagement with the platform. As shown in Figure 3, the log dataset includes student name, student ID, total number of times logged in, cumulative time spent using the platform, and detailed activities such as specific actions taken during each logged session. For the purpose of data analysis, we used the value reported in the "total time of use" column as a student's total learning time. To show the learning time for each lecture, we divided the total learning time by the times of lecture and listed it in Table 4. We performed an ANOVA test to check if there is significant difference between the two groups.

氏名 ▲ ▼	ユーザID ▲ ▼ 数字部分 ▲ ▼	権限 ▲ ▼	ログイン回数 ▲ ▼	合計利用時間 ▲ ▼	詳細ログ
	2452110065	User	40	19:24:05	» 詳細
	2453030274	User	20	06:01:53	» 詳細
	2352120083	User	13	08:57:10	» 詳細
	2153050280	User	16	04:28:31	» 詳細
	2451020119	User	16	11:05:15	» 詳細
	2551070125	User	36	08:59:19	» 詳細
	2352110082	User	22	03:27:45	» 詳細
	2352130057	User	22	05:47:17	» 詳細
	2451010423	User	8	15:35:47	» 詳細
	2451030172	User	43	09:25:30	» 詳細
	2451060458	User	17	09:40:14	» 詳細
	2252110068	User	6	02:28:42	» 詳細
	2452130004	User	13	08:35:19	» 詳細
	2455010416	User	35	09:16:30	» 詳細

Figure 3. A Screenshot of the E-learning System Log File

Table 4. Learning Time (per Lecture) of the Two Groups

	Learning Environment	N	Mean	Standard Deviation	ANOVA p-value
Group 1	Home	229	105.69	52.59	0.0000
Group 2	Classroom	221	82.86	43.66	
Total		450	94.48	48.20	

To get student feedbacks and check their level of satisfaction, we collected their responses from the questionnaire distributed at the end of the course. The data were collected anonymously to encourage honesty and were analyzed quantitatively to identify trends and differences between the two groups. Figures 4-6 show student responses for various aspects of their learning experience: friendliness of learning materials, degree of understanding, and level of satisfaction. In the figures, the ratings on a 10-point Likert scale by the two groups are represented in blue (Home) and orange (Classroom). Each bar corresponds to the number of students who selected a specific rating from 1 to 10, with the exact number displayed above each bar. For example, in Figure 4, at the lowest rating of 1, 8 students from the Home group and 2 students from the Classroom group selected this rating. Similarly, at rating 2, both groups had 3 and 2 students, respectively. This visual representation allows for a direct comparison of the distribution of ratings between the two groups.
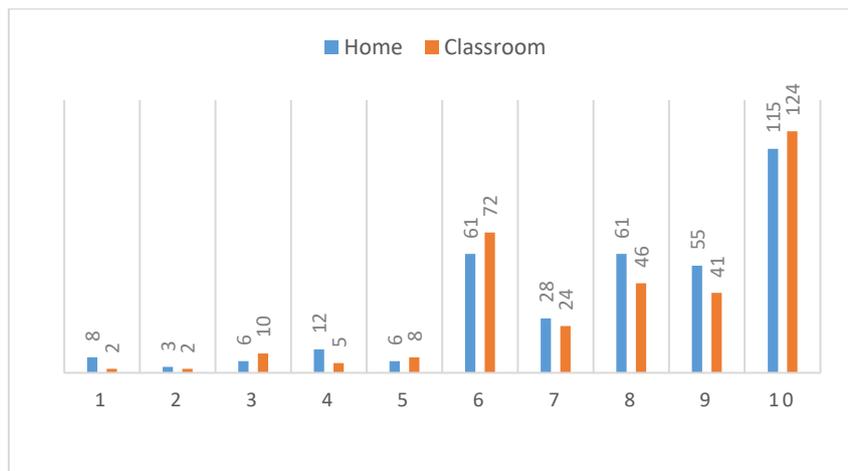

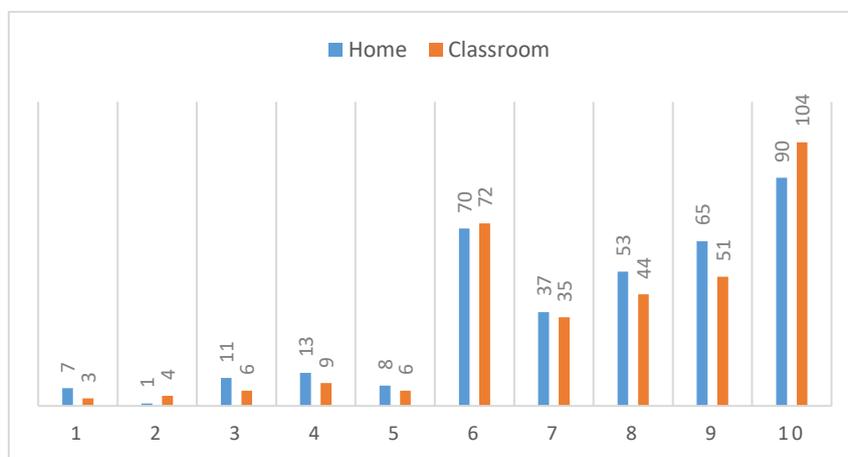Figure 4. Friendliness of Materials Rated by the Two Groups

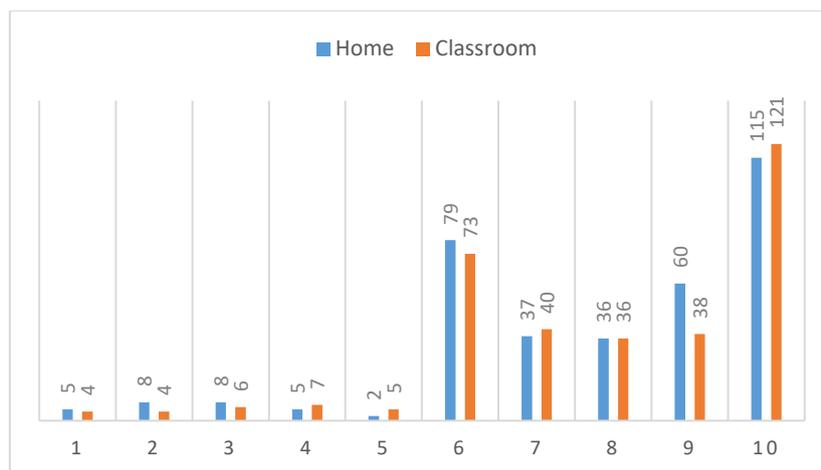Figure 5. Degree of Understanding Rated by the Two Groups

Figure 6. Level of Satisfaction Rated by the Two Groups

Table 2 presents the dropout rates of students in the two learning environments. Overall 51 students dropped out, resulting in an average dropout rate of 10.2%. A closer comparison reveals a notable disparity between the two groups. The Home group experienced a dropout rate of 12.9% (34 out of 263 students), which is nearly double the 7.1% dropout rate observed in the Classroom group (17 out of 238 students). This suggests that students engaged in home learning may be more likely to discontinue their participation compared to those in the classroom.

Several factors could contribute to this difference. Students learning at home may face challenges such as reduced interaction with peers and instructors, lower levels of engagement, distractions in the home environment such as voices, televisions, and food, or difficulties with self-regulation and time management. In contrast, classroom learning typically offers more structure, better atmosphere, and immediate support from instructors, which may contribute to higher participation rates.

This highlights the importance of addressing the specific needs of students in home learning environments to reduce attrition. Interventions such as increased support, regular check-ins, and improved instructional design for remote materials could help mitigate the higher dropout tendency observed in this group.

Table 3 summarizes the learning performance of students in the two learning environments based on their final scores. The analysis includes the mean score, standard deviation, and result from an ANOVA test. In terms of average performance, the Home group (N = 229) achieved a slightly higher mean score of 81.56 compared to 79.90 in the Classroom group (N = 221). Although the difference of 1.66 points may suggest a modest advantage for the Home group, the ANOVA p-value of 0.1126 indicates that this difference is not statistically significant. Therefore, we cannot confidently conclude that the learning environment had a meaningful effect on students' learning outcomes.

In terms of score variability, both groups show similar standard deviations, 11.31 for Home and 10.84 for Classroom, indicating a comparable spread in individual scores within each group. The total mean score across both groups is 80.74, with an overall standard deviation of 11.08, reflecting a fairly consistent level of performance

among the 450 students. Taken together, the data suggests that while students learning at home performed slightly better on average, the difference is not statistically significant.

This finding implies that learning performance was largely equivalent across the two environments, at least in terms of scores. It also suggests that both home and classroom learning can be similarly effective in supporting academic outcomes

Table 4 presents the results comparing the average learning time per lecture between the two groups. Group 1 (Home) reported a mean learning time of 105.69 minutes per lecture with a standard deviation of 52.59 minutes. In contrast, Group 2 (Classroom) showed a significantly lower mean learning time of 82.86 minutes, with a standard deviation of 43.66 minutes. The combined data for both groups (N = 450) yielded a total mean of 94.48 minutes and a standard deviation of 48.20 minutes.

The ANOVA test comparing the mean learning times of the two groups produced a p-value of 0.0000, indicating a highly statistically significant difference in learning time between the two groups. Group 1 students spent a time that is longer than the lecture duration whereas Group 2 students spent a time that is less than the lecture duration. Considering that the final average score was almost the same between the groups, it can be stated that the lecture time is enough for students to reach a satisfactory level of understanding. However, due to the home environment, Group 1 students spent about 27.6% more time to reach this level. This reflects that the learning environment plays an important role in student engagement and learning efficiency. The higher variability (as indicated by the standard deviation) in the home group further implies that learning time at home may be more influenced by individual factors, such as self-discipline or time management.

Figure 4 shows the ratings given by students to the question "Do you think the materials and explanations are easy to understand?". It can be observed that over 90% students rated the materials positively, with the highest frequencies appearing at the upper end of the scale (ratings 6~10), indicating the answer "Yes". This reflects that the learning materials including the textbook and videos are both well designed and sufficient for self-learning. If we transform the 10-point ratings into a 100-point score, i.e. transforming 1 to 10, 2 to 20, …, and 10 to100, the average scores given by Group 1 and Group 2 students are 79.01 and 80.03, respectively. This indicates that the classroom learning group had a slightly better experience with the materials though there is no significant difference between groups.

In addition, there are slight differences in how each group distributed their ratings. Group 1 (Home) had a small number of students rating the materials at 1~5 (e.g., 8 students at rating 1, 6 at 3, and 12 at 4). Group 2 (Classroom) followed a similar pattern but with slightly fewer low-end ratings, such as only 2 at rating 1 and 5 at rating 4. This suggests that negative perceptions of the materials were limited, though marginally more prevalent among home learners. A shift occurs starting at rating 6, where ratings become significantly more frequent. Group 1 had 61 students choosing 6, while Group 2 had an even higher count at 72. At rating 7, Group 1 had 28 students, while Group 2 had 24. This indicates that the classroom group leaned more toward moderate positivity, especially around rating 6. The most prominent frequencies are observed at rating 10, indicating strong positive perceptions.

Group 2 (Classroom) reported the highest single count of 124 students, surpassing Group 1's 115. At ratings 8 and 9, Group 1 rated higher than Group 2 (61 vs. 46 at rating 8 and 55 vs. 41 at rating 9). This implies that students learning at home were more likely to assign slightly lower but still positive ratings (8 or 9), while classroom learners were more decisive in giving a perfect score (10).

Overall, both groups perceived the learning materials as friendly and accessible, as evidenced by the strong concentration of responses on the upper end of the scale. However, students in the classroom setting showed a stronger tendency to give the highest possible rating (10), which might reflect greater clarity, support, or effectiveness of material presentation in that environment. In contrast, home learners showed slightly more dispersed high ratings, potentially due to variability in how well they could interpret or engage with the materials independently. The result suggests that while material friendliness is affirmed across learning environments, the classroom context may enhance confidence or satisfaction with instructional resources to a greater extent than home learning.

Figure 5 provides a comparative analysis of student ratings to the question "How well have you understood the contents of this lecture?". The data offer insights into the depth of comprehension perceived by learners in each setting. The overall distribution for both groups is positively skewed, with relatively few students selecting low ratings (1~5), and over 88% students selecting high-end ratings (6~10). This suggests that most students, regardless of learning environment, felt they understood the material to a moderate or high degree, indicating that the textbook and videos were easy to understand and helpful for learning.

Rating 6 marks a clear increase in student counts: 70 home students and 72 classroom students selected this rating. This suggests that a large portion of both groups felt moderately confident in their understanding, with nearly equal representation. It may indicate a "safe" or neutral score where students are neither fully confident nor entirely uncertain. At the highest level of perceived understanding (rating 10), it can be observed that classroom students outnumbered home students. This reveals that classroom learners were more likely to rate their understanding as "very high", while home learners, although also reporting high levels, did so with less frequency.

The data strongly suggest that classroom learning contributes to a higher sense of mastery or confidence, particularly at the upper end of the scale. While home learners span a broader range of understanding, including more low-end ratings, classroom learners' responses are more tightly clustered in the higher range, indicating more consistent outcomes. Possible contributing factors include more structured guidance and feedback in the classroom and greater engagement due to a controlled learning environment.

Figure 6 presents the distribution of ratings by the students to the question "What is your level of satisfaction with this lecture?". Across both groups, the distribution is skewed toward the higher end of the Likert scale. Few students selected ratings 1 to 5, while over 92% students chose ratings 6 to 10, indicating overall high levels of satisfaction with their learning experiences. In total, only 28 home students and 26 classroom students rated their satisfaction between 1 and 5. This indicates that dissatisfaction was not a significant issue for the majority of students in either group.

Rating 6 was selected by 79 home learners and 73 classroom learners. This suggests that a significant number of students felt moderately satisfied, with a fairly balanced distribution between the two groups. It may reflect students who had mixed or neutral feelings about their learning experience, or who perceived it as adequate but not exceptional. From ratings 7 to 10, the majority of student responses are concentrated, reflecting a high degree of satisfaction among both groups. This distribution strongly suggests that most students, regardless of learning environment, experienced high satisfaction, with rating 10 dominating the scale.

Both groups follow a similar distribution curve, but a few subtle differences emerge: The home group had a higher number of students selecting rating 9, suggesting a slightly broader distribution in the top-tier satisfaction ratings. The classroom group had a slightly higher peak at rating 10, indicating slightly more students felt completely satisfied with their in-person learning experience. These results highlight the overall effectiveness of both learning environments in meeting students' expectations and delivering a satisfactory educational experience.

Conclusion

In this study, we investigated the e-learning effects of an information science course under two different learning environments: home and classroom. We collected data from over 500 participants enrolled in a university course in Japan. The participants were provided with e-learning materials including an e-textbook and lecture videos. The two groups differed only in the learning environment, and we compared between them learning performance, dropout rate, learning time, degree of understanding, and level of satisfaction.

We found that both groups achieved the same level of learning performance, regardless of being at home or in the classroom. Notably, the classroom group achieved this with significantly less time than the home group and had a lower dropout rate. This implies that the efficiency of classroom learning is higher, potentially due to focused instruction, time-bound sessions, and fewer distractions. On the other hand, home learning may require more time investment to reach similar outcomes, possibly due to the need for self-regulation, limited immediate support, and variation in learning environments.

In addition, the questionnaire results reveled advantage for classroom learning in building student confidence and satisfaction, as seen by the larger proportion of students giving ratings of 9 or 10 in a 10-point Likert scale. Meanwhile, the wider spread of responses in the home learning group may reflect greater variability in independent learning outcomes.

In conclusion, while both modes of e-learning can be effective and satisfying for students, the classroom setting appears to foster greater efficiency and understanding, particularly in less time. This indicates that the learning environment and atmosphere has a significant impact on student engagement and learning experience. When the learning atmosphere is better, students would not only achieve the same performance in a shorter time, but also show more confidence in understanding and a higher level of satisfaction. On the other hand, home learning may foster more self-reported comprehension due to self-paced flexibility, but may require more time to match classroom performance. These insights can inform educational policy, instructional design, and learner support

strategies in both formal and flexible e-learning contexts.

Acknowledgements

References

Bredow, C. A., Roehling, P. V., Knorp, A. J., & Sweet, A. M. (2021). To flip or not to flip? A meta-analysis of the efficacy of flipped learning in higher education. *Review of Educational Research, 91*(6), 878–918. https://doi.org/10.3102/00346543211019122

Chang, J. Y.-F., Wang, L.-H., Lin, T.-C., Cheng, F.-C., & Chiang, C.-P. (2021). Comparison of learning effectiveness between physical classroom and online learning for dental education during the COVID-19 pandemic. *Journal of Dental Sciences, 16*, 1281-1289.

Decman, M., Klun, M., & Stare, J. (2025). Online flipped classroom in university social science courses: Impact on student experience and success. *Computers and Education Open, 8*, 100261

Jaca, C. A., Gador, S., & Mangompit, R. M. (2024). Higher education students' online class experiences during the COVID-19 pandemic. *International Journal of Education and Practice*, *12*(3), 1068-1079.

Jeong, J. S., & Gonzalez-Gomez, D. (2021). A STEM course analysis during COVID-19: a comparison study in performance and affective domain of PSTs between F2F and F2S flipped classroom. *Frontiers in Psychology, 12*. https://doi.org/10.3389/fpsyg.2021.669855

Lapitan Jr, L. DS., Chan, A. L. A., Sabarillo, N. S., Sumalinog, D. A. G., & Diaz, J. M. S. (2023). Design, implementation, and evaluation of an online flipped classroom with collaborative learning model in an undergraduate chemical engineering course. *Education for Chemical Engineers, 43*, 58-72.

Müller, C., & Mildenberger, T. (2021). Facilitating flexible learning by replacing classroom time with an online learning environment: A systematic review of blended learning in higher education. *Educational Research Review 34*, 100394.

Núnez, M. E., García, P. M., & Abbas, A. (2023). The mediating role of self-regulation between emotional intelligence and student performance in online global classroom-based collaborative international online learning (COIL): Empirical evidence from four partner universities of Latin America. *Research in Globalization 7*, 100178.

Parkes, R. S. V., Langebœk, R., Wu, J., Hendrickson, D. A., Ciappesoni, J., & Lalèyê, F.-X. (2024). Responses to and reflections on clinical skills teaching and assessment during COVID-19: a global survey. *Journal of Veterinary Medical Education*, *51*, DOI: 10.3138/jvme-2023-0073.

Shaffi, S., Tarek, S., & Watson, A. (2023). Enhancing business education through flipped classroom pedagogies: the systematic review. *Creative Education, 14*(7). https://doi.org/10.4236/ce.2023.147094.

Shen, J., Zhang, S., Sun, D., Ge, R., Chen, S., Fang, J., & An, Q. (2025). Comparison of face-to-face teaching and online teaching in neurosurgery education for medical students. *BMC Medical Education, 25*, 232.

https://doi.org/10.1186/s12909-025-06817-4

Tallent-Runnels, M. K., Thomas, J. A., Lan, W. Y., Cooper, S., Ahern, T. C., Shaw, S. M., et al. (2006). Teaching courses online: A review of the research. *Review of Educational Research, 76*, 93–135.

Van Doorn, J. R., & Van Doorn, J. D. (2014). The quest for knowledge transfer efficacy: Blended teaching, online and in-class, with consideration of learning typologies for non-traditional and traditional students. *Frontiers in Psychology, 5,* 324.

Walsh, J. N. (2024). Using cluster analysis to identify procrastination and student learning strategies in a flipped classroom. *The International Journal of Management Education, 22*, 100936.

Weng, W., & Zheng, M. (2023). Comparison between powerpoint slides and videos in effectiveness for e-learning. *EDULEARN23 Proceedings*, 5887-5893.