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Factors Affecting University Students' At-home Learning during the COVID-19 Pandemic -Implications for a Student Support System-

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The purpose of this study is to collect data that can be useful in designing systems that support the out-of-class learning of undergraduate students in Japanese universities. The authors investigated students' at-home learning activities during the COVID-19 pandemic and tried to provide implications for designing out-of-class learning support systems for such students. Two surveys were conducted in June and October 2020, in which students recorded all their learning activities for an entire week. After which, they were asked to complete a questionnaire. Both surveys showed year-wise differences; that is, first-year students had more supportive aspects than senior students. An examination of the influence of self-directed learning readiness scale factors showed that factors concerning learning skills affected learning time in most categories; this finding has important implications for system development.

Keywords: COVID-19, Self-Directed Learning Readiness Scale (SDLRS), Student Support System, Student Year

Introduction

The COVID-19 pandemic forced universities worldwide to transition to remote teaching and learning modules, and Japanese universities were no exception. As the pandemic worsened, students' learning environments shifted away from university campuses. According to MEXT (2020, p. 1), 83.9% of all Japanese universities conducted online classes by July 2020. Many students began attending classes from home using web conferencing systems, such as Zoom. Aside from topics related to accessing financial aid and renting laptop computers and Wi-Fi routers, only a few reports have discussed best learning-support-related practices for students in remote learning environments as of the beginning of 2021 when this paper was being written (Meiji University 2020; Ochanomizu University 2020; Tohoku University 2020). While the Association for the Advancement of Computing in Education in the United States published a number of case studies on technological responses to COVID-19, learning support systems for students were not addressed (Fertig et al.

2020).

Due to the rapid spread of infection, the transition to online lectures began abruptly as an emergency measure during the pandemic. Universities therefore prioritized financial support and the technicalities of implementing online lessons. While this can be considered a reasonable course of action, most universities still lack the resources to understand students' learning situations and develop appropriate support methods. As a mutant strain of the highly infectious new coronavirus has been reported, and a cure for COVID-19 is yet to be found, the current outlook remains uncertain; thus, students may still have to depend on home learning for some time to come.

The authors previously developed a student enrollment support system using institutional research data from their university (Matsuda et al. 2020a; Matsuda et al. 2015). In the fiscal year 2020, they had planned to develop a support system for academic decision-making, such as choosing a seminar and studying abroad. However, considering the pandemic situation, they felt there was a need to survey students to assess their home-based learning situations.

Materials and Methods

Purpose

The purpose of this study is to collect data that can be used to design systems that support out-of-class learning and to provide implications and hypotheses for their development. In addition, the system is to be developed based on the assumption that students' self-directed learning (SDL) readiness affects out-of-class learning. To achieve this objective, the current study investigated Japanese undergraduate students' at-home learning activities during the COVID-19 pandemic. In other words, we do not intend to create a generalized student model, but rather, a prototype for a useful system. Therefore, we aimed to collect data that could be used in the prototype data design. More precisely, this research aimed to narrow down "data to be inputted" based on the actual situation of the system user.

Subjects

Study data were collected through two surveys. The first was conducted in June 2020 and the second in October of the same year. The June survey was designed to collect data about the learning experiences of 30 undergraduate students at four universities (A, B, C, and D) during the COVID-19 pandemic. It was sent out via e-mail mid-June, when more than a month had passed since classes had completely transitioned to an online format. The authors recruited students who were representative of different years in degree programs. Fourth-year students who spend most of their time in job hunting and research activities, and less time in lectures, were excluded. Participation in the survey was voluntary.

The October survey was conducted during the second week of the month. The recruitment method and question items for this survey were almost the same as those in the June survey. Of the 52 respondents, 20 had also participated in the June survey (Table 1).

Table 1

Survey participants

University	1st Year		2nd Year		3rd Year		Total	
	June	October	June	October	June	October	June	October
A (Public)		15	8	8 (3)	11	14 (8)	19	37 (11)
B (National)	2	6 (3)*		4 (3)			2	10 (6)
C (Private)	4		3			2 (2)	7	2 (2)
D (Private)		3 (1)			2		2	3 (1)
Total	6	24 (4)	11	12 (6)	13	16 (10)	30	52 (20)

*Numbers in parentheses indicate those who participated in the June survey.

Methods

The surveys were conducted over a seven-day period from June 13 to 19 and October 12 to 19, 2020. Students entered all their learning activities into an Excel spreadsheet for both surveys throughout one week before they were asked to complete a questionnaire. The June survey questionnaire contained five parts: 1) learning habits and orientation, 2) course selection criteria, 3) self-directed learning readiness scale (SDLRS), 4) adult career maturity scale, and 5) online learning benefits and improvement points. The October survey replaced Question 4 from the June survey with a question on the changes that occurred during the second semester of the year.

The question items in the current research focused on the SDLRS because it is required for learning activities and is an important part of acquiring college credits, as explained in the authors' previous study on enrollment advising (Matsuda et al. 2020a). Based on the SDLRS, which was developed by Guglielmino (1998) as a measurement method, this paper presents information regarding unit availability using the Japanese version developed by Matsuura et al. (2003). The Japanese SDLRS comprises 58 items, and seven factors were extracted from their research. Participants answered each question using a five-point Likert scale ("Almost never true for me" to "Almost always true for me"). In this study, we used a subset of the Japanese SDLRS selected by Matsuda et al. (2014) and utilized in subsequent studies, such as Matsuda et al. (2015, 2020a). A total of 16 items (Table 2) were extracted from one to three items with high factor loadings from the original question items that corresponded to each factor.

To design an advice system for their individual learning situations, this study classified students according to several criteria. Each category was analyzed by considering useful support-oriented characteristics based on four classification criteria in the first survey: year, SDL readiness, learning that is unrelated to university courses, and learning planning habits. The authors compared the students' learning records with their questionnaire answers.

Matsuda et al. (2020b), who reported the first survey findings, stated that participants' year and SDL readiness affected other variables, particularly learning that was unrelated to their classes (Table 3). The reasons for this difference could be explained as follows. With many students performing laboratory work during their third year, the number of required credits decreases and the share of specialized subjects simultaneously increases. Furthermore, third-year students focus on finding employment or enrolling in graduate school. Consequently, as the year progresses, SDL readiness for love of learning, responsibility, and study skills increases. However, it is possible that third-year students' self-efficacy and expectations for the future, which first-year students experience because of many elective subjects and a wider range of future possibilities, tend to decline. With regard to SDLRS-related values, factors other than factors 4 (inquisitive mind) and 3 (acceptance of responsibility in learning), which included factors 1 (love of learning), 2 (ability to use basic study and problem-solving skills), 5 (initiative and independence in learning), 6 (self-efficacy), and 7 (positive orientation to the future) may have influenced learning time that was unrelated to classes.

Table 2

SDLRS items in the questionnaire

Factor	Item※
1. Love of Learning	1. I love to learn.
	12. The more I learn, the more exciting the world becomes.
	13. Learning is fun.
2. Ability to Use Basic Study Skills and Problem-Solving Skills	2. *I do not work very well on my own.
	3. I can learn things on my own better than most people.
	16. I can learn effectively both in a classroom situation and on my own.
3. Acceptance of Responsibility in	4. Only I am truly responsible for what I learn.
	6. *Even if I do not learn a given content, I do not hold any responsibility

Factor	Item※
Learning	for it.
	15. Only I am responsible for my learning.
4. Inquisitive Mind	11. *I do not like dealing with questions where there is no single right answer.
	14. *I always prefer well-known ways of learning to novel learning methods.
5. Initiative and Independence in Learning	5. If there is something I have decided to learn, I can find time for it no matter how busy I am.
	7. I can learn almost everything that I need to know.
6. Self-Efficacy	8. I have a great deal of curiosity about everything.
	9. I am good at thinking of unusual ways to do things.
7. Positive Orientation to the Future	10. I like to think about my future.

※The number in front of the question item indicates the question order.
* Reverse items

Table 3

Average learning hours based on year

Year	Total Time	Per session	Unrelated to courses
First	35h 47m	1h 18m	2h 35m
Second	37h 29m	1h 32m	6h 32m
Third	41h 47m	1h 38m	9h 49m

Considering the functions of supportive systems for student learning, the target of support should not be activities that tackle learning during class hours and class tasks. In most cases, students carry out such learning based on the instructions of the teacher in charge of each class. In short, the system should target factors that influence decision-making for the number of classes selected based on certain standards and choosing ways to engage in any learning that is not causally related to the courses. Therefore, the October survey focused on students' year-related differences and SDL readiness, as explained in the Results section.

Results

Table 4 presents the overall results of the October survey. Compared to the June survey, there was a decrease in the average number of learning sessions, total learning time per week, and learning time unrelated to courses, while the average duration per session and number of registered courses did not change or only increased slightly.

Year-wise differences were widely observed in both surveys. As the academic year progressed, learning time per session, learning time unrelated to the lesson, the proportion of students with learning planning habits, and the proportion of students who agreed that "learning is fun" increased. Among students in all years, those in their first year spent the greatest number of hours on learning and took the most number of courses. They were also the largest group, which suggests that they could not learn well (Factor 2). Furthermore, they showed lower learning initiative and independence than second- and third-year students (Factor 5) and did not think of themselves as being very self-efficacious (Factor 6). (Tables 5 and 6; Figure 1).

Table 4

Overall results of the October survey (N=52)

Indicator	Total	Average*
Number of learning sessions	1,125	21.63 (26.67)
Total learning time	1,672h 56m	32h 10m (39h 0m)
Duration per session		1h 29m (1h 27m)

Time unrelated to courses		283h 55m	5h 27m (7h 10m)
Number of registered courses		672	12.92 (12.03)
SDLRS	Q2. I do not work very well on my own.		2.81 (3.31)
	Q13. Learning is fun.		3.96 (3.83)

* Average: per student except for "Duration per session"
Numbers in parentheses indicate the participants in the first survey.

Table 5

Average value based on year

Year	Learning time			Number of learning sessions	Number of courses
	Total	Out-of-class	Unrelated to course		
First	33h 28m	13h 41m	2h 59m	23.50	15.29
Second and Third	31h 03m	17h 44m	7h 34m	20.04	10.89

Table 6

Average SDL readiness based on year

Year	F1	F2	F3	F4	F5	F6	F7
First (A)	3.81	3.04	4.46	2.23	3.02	3.21	3.71
Second and Third (B)	4.26	3.21	4.39	2.45	3.30	3.59	3.68
Difference (B-A)	0.46	0.17	-0.07	0.22	0.28	0.38	-0.03

Reversed items have been processed.

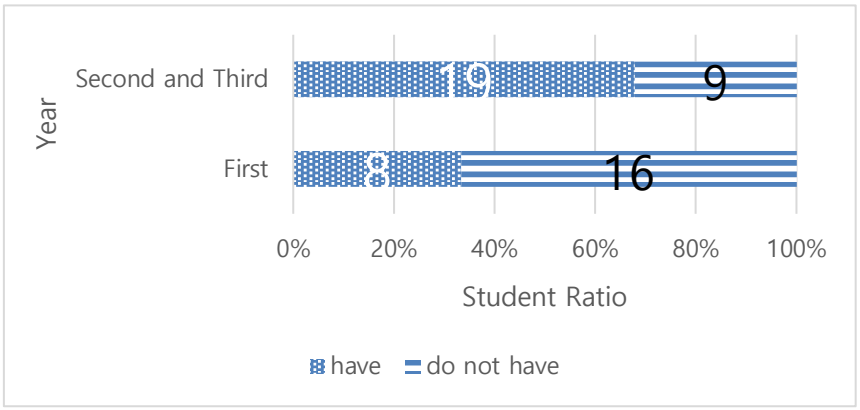

Figure 1. Students with or without planning habits

Table 7

Correlation between the SDLRS and learning time

SDLRS	Learning Time			
	Total	Week-end	Out-of-class	Unrelated to course
Q.13 Learning is fun.	0.252	.282*	.382**	0.243
Factor 1. Love of Learning	0.187	0.177	.321*	0.189
Q.16 I can learn effectively both in a classroom situation and	0.239	0.150	.372**	.312*

SDLRS	Learning Time			
	Total	Week -end	Out-of-class	Unrelated to course
on my own.				
Factor 2. Ability to Use Basic Study and Problem-Solving Skills	.288*	0.270	.427**	.334*
Q.15 Only I am responsible for my learning.	0.270	0.077	0.214	0.215
Factor 3. Acceptance of Responsibility in Learning	0.240	0.182	0.194	0.159
Factor 4. Inquisitive Mind	-0.002	0.042	0.152	0.169
Q.5 If there is something I have decided to learn, I can find time for it, no matter how busy I am.	.324*	0.186	.347*	0.015
Factor 5. Initiative and Independence in Learning	.298*	0.237	.292*	0.089
Q.8 I have a great deal of curiosity about everything.	0.162	.350*	0.127	0.051
Factor 6. Self-Efficacy	0.072	0.134	0.140	0.086
Factor 7 (= Q. 10). Positive Orientation to the Future	0.251	.369**	.299*	-0.010

Spearman: *p<.05, **p<.01; Reversed items have been processed.

Next, we examined the influence of SDL readiness on each categorized learning time. The examination of the rank correlation (Spearman) between the SDLRS and categorized learning time indicated significant correlations between cumulative learning time, out-of-class learning time, and learning time unrelated to courses (Table 7). The characteristic correlation for each factor showed that the correlation between each factor and learning time tended to be different.

Factor 2 was the only one correlated with three of the four learning time categories: learning time unrelated to courses, learning time outside the class, and total learning time. A scatter plot for the mean value of Factor 2 and the distribution of learning time outside class and unrelated to class showed that there was a high correlation between Factor 2 and out-of-class learning time (Figures 2 and 3).

Factor 5 was correlated with total learning time and out-of-class learning time. Question 5 showed a particularly high correlation.

Factor 7 indicated a correlation between weekend and out-of-class study time. Factors 3, 4, and 6 did not correlate significantly with the categorized learning time. Of the questions forming these three factors, only Question 8 (Factor 6) correlated with weekend learning time. No significant correlation was detected for the remaining items.

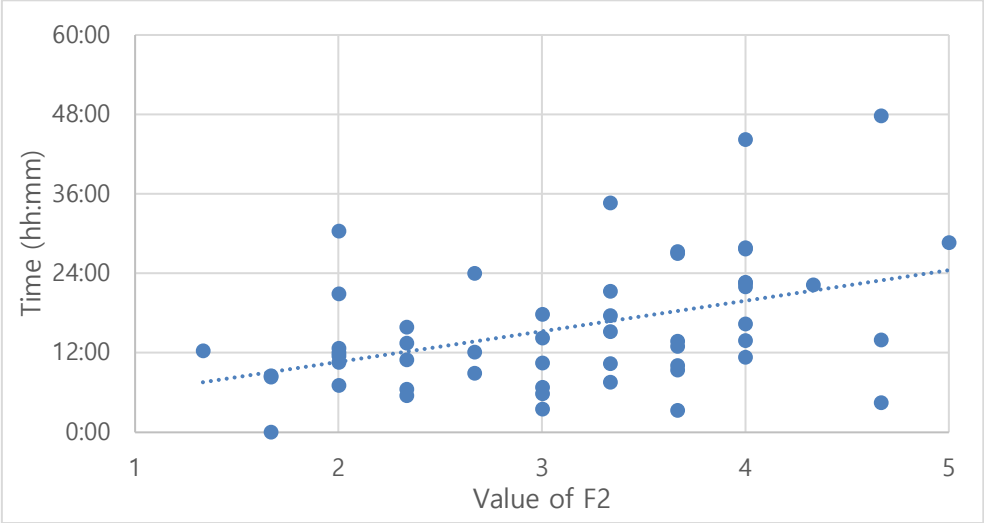

Figure 2. Value of Factor 2 of the SDLRS (horizontal) and out-of-class learning time (vertical)

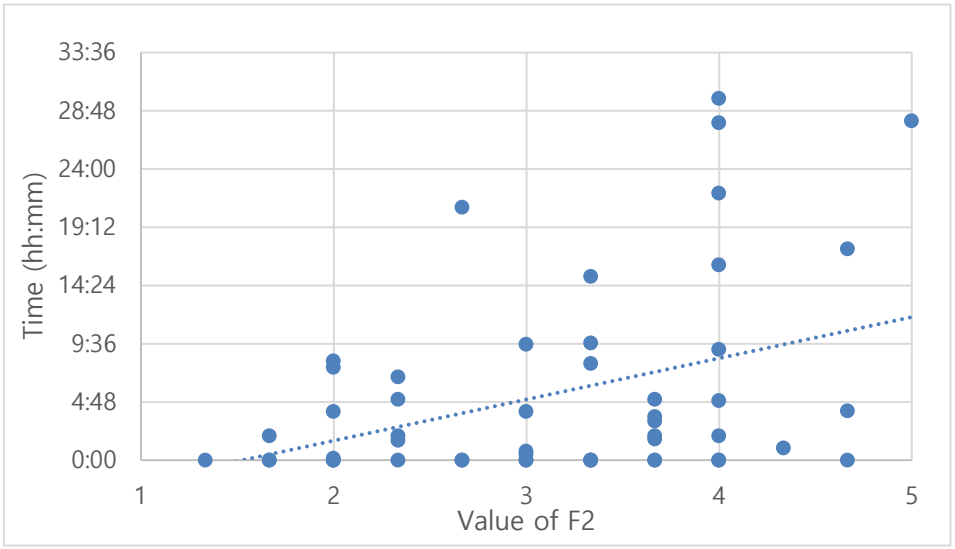

Figure 3. Value of Factor 2 of the SDLRS (horizontal) and time unrelated to courses (vertical)

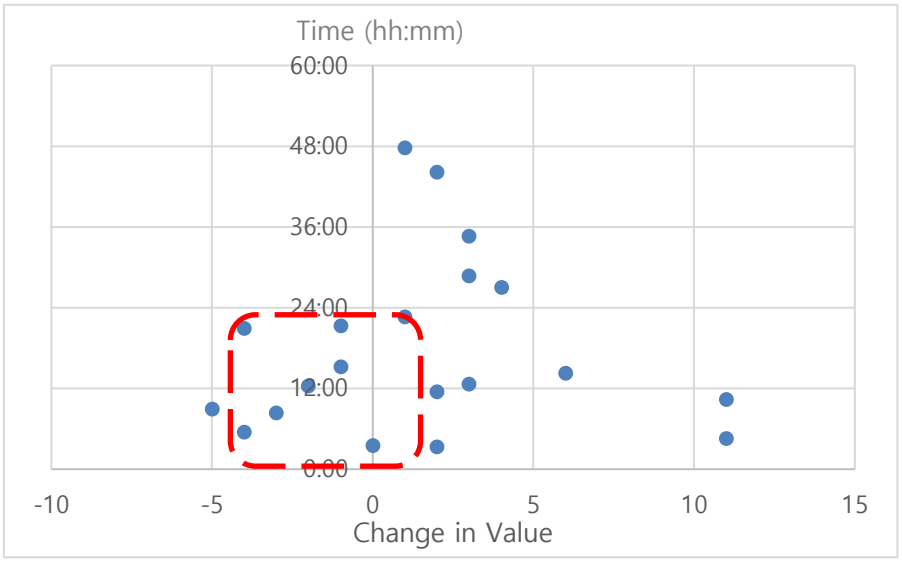

Figure 4. Increase or decrease of total value of the SDLRS (horizontal) and out-of-class learning time (vertical)

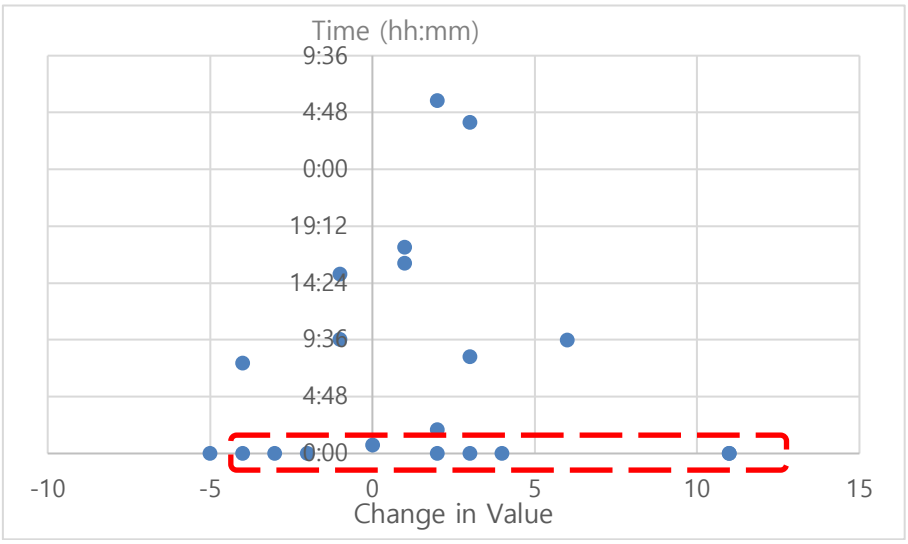

Figure 5. Increase or decrease of total value of the SDLRS (horizontal) and learning time unrelated to course (vertical)

As mentioned earlier, 20 of the 52 student participants from the October survey also participated in the June survey. We confirmed the changes in these students' overall SDLRS scores; the total SDLRS value of 12 students increased, while that of seven students decreased. Figure 4 shows the relationship between the increase or decrease in SDLRS value and out-of-class study time. Students with lower SDLRS values (surrounded by the red dashed line) tended to have shorter out-of-class study time. Furthermore, the SDLRS values of students who did not record study time unrelated to class were concentrated in groups that showed a decrease or hardly showed any increase (Figure 5).

Discussion

Findings of the October survey

Based on the findings of the June survey, it could be expected that the difference in students' years would affect study time and SDL readiness, even in October. This could be because the 2020 class of first-year students could not experience various learning styles at the university due to the prolonged pandemic situation during the survey period. Under such circumstances, many of them seemingly focused on their lessons and tasks, and learned passively without much planning, as indicated by SDLRS Factors 1 and 5. There may have been little room to foster love for and independence in learning.

The correlations of individual factors showed that, first, Factor 1 affected out-of-class learning time but did not significantly affect learning time unrelated to lessons. In short, students with high scores for this factor were more likely to engage in lesson-related learning, but less likely to extend their reach to any learning that was unrelated to their courses.

Second, Factor 2 affected learning time in most categories. This finding is convincing considering the unending pandemic situation and the fact that this was the first time many students had to continue studying at home for over half a year. Thus, even if the factor values related to learning attitudes and motivation were high, it could be inferred that it is difficult for first-year students to induce actual learning if readiness in finding ways to learn in an unknown environment is low.

Of the three factors that did not show a significant correlation with learning time, Factor 3 could be statistically explained. Its mean values (4.46, in the first year; 4.39, in the second and third years) showed that most of the students responded with 4 and 5 to the questions that form this factor. Therefore, it was, in fact, difficult for

the correlation with other variables to be significant.

On the other hand, the reasons why Factors 4 and 6 did not affect learning time differed from those for Factor 3's lack of effect. Even if the SDL readiness indicated by Factors 4 and 6 was high, it did not lead to any attempts for it to be implemented in the form of out-of-class learning in situations where interactions between students in the classroom, on campus, and in actual group learning were restricted because such students did not know how to make the most of their qualities.

Factor 7 showed a similar tendency to that of Factor 1, but it notably had the greatest effect on weekend learning time among all factors. Thus, students who thought more positively about their future spent more hours learning on weekends, which is a useful finding when considering the direction of system-provided support.

Finally, the number of classes taken, which was greatly influenced by the year, showed an interesting result. Both surveys indicated a weak negative correlation between the number of classes taken and learning time unrelated to the class (r=-.25, p=.183 in June; r=-.21, p=.145 in October [based on Pearson]). Initially, we thought this finding would be attributable to the fact that students who took more lessons had to study more often and were likely less able to handle other studies; however, no such phenomenon was observed.

As Figure 6 shows, the number of learning sessions per week of students without any unrelated course learning peaked at around 30 regardless of the number of courses taken. Furthermore, since there was a weak negative correlation between the number of lessons and all SDLRS factors, support for SDL readiness could increase out-of-class learning, especially learning time not related to lessons.

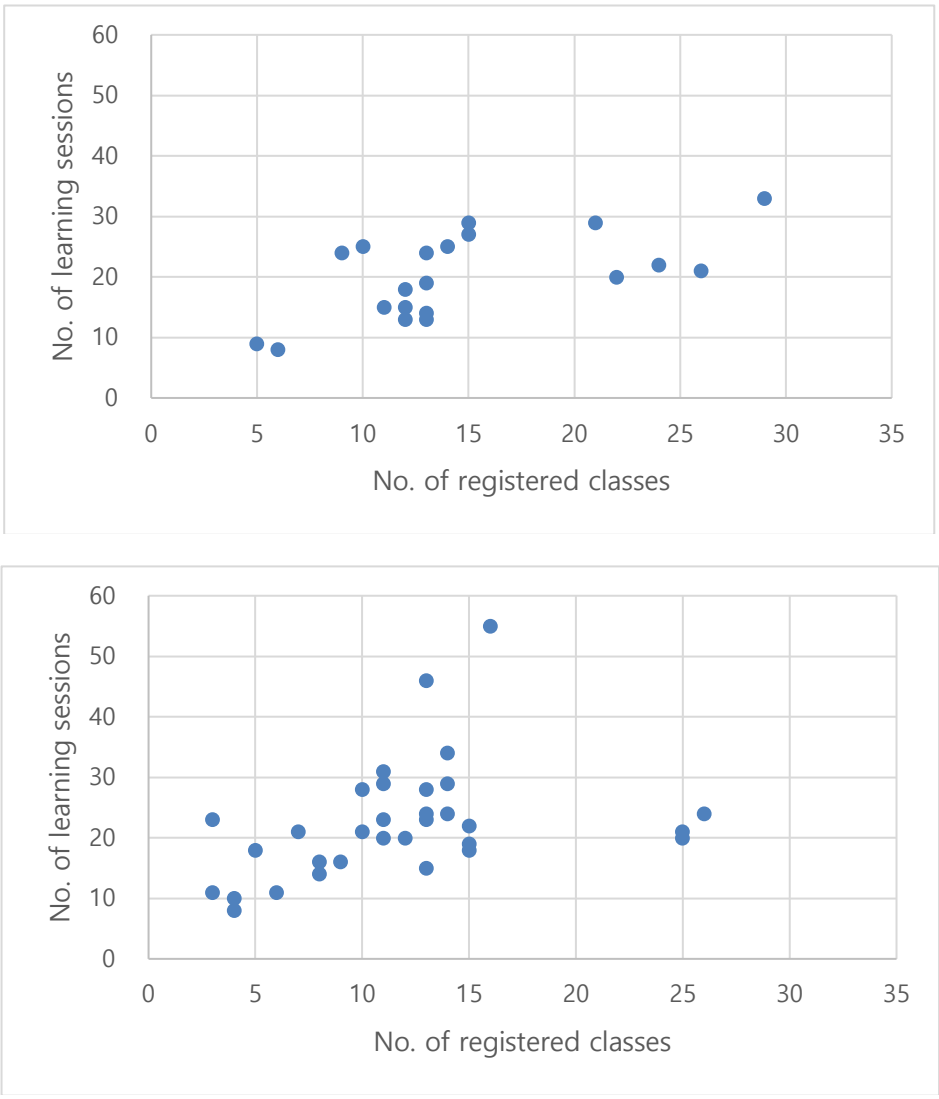

Figure 6. Number of classes registered (horizontal) and number of learning sessions per student (vertical) Sessions of all students, students with no time unrelated to courses, and students with time unrelated to courses (from top to bottom)

Implications for the prototype design

The following hypotheses can be made regarding system development: First, first-year students require more support than students in the succeeding years. Specifically, those who stop planning and concentrate on earning credits once they are in university should receive more attention. While not having any learning time that is unrelated to course work is not detrimental for a student, more support for increasing SDL readiness is needed since low SDL readiness is one cause of poor academic performance.

It can be inferred that Factor 2 of the SDLRS had the most significant effect on learning time, which is an especially important implication for system development. This finding was more attributable to the fact that the learning skills included in Factor 2 made it easier to give specific advice and confirm its effect, compared to the love for learning included in Factor 1 and the self-efficacy included in Factor 6. Therefore, with regards to the development of a learning support system, it is important to prioritize Factor 2, that is, the function of promoting out-of-class learning by supporting learning methods. Concurrently, showing the future caused by

each kind of learning could enhance the features of Factor 7. Moreover, this study suggests that it would be beneficial to develop the functions to improve situations where the curiosity-related potential of students with high values for Factors 4 and 6 is not being demonstrated.

In the school year 2021, face-to-face lessons will resume in earnest at universities in large cities in Japan, so we will continue to collect data on learning times and the SDLRS, as well as develop prototypes utilizing data from the two surveys.

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