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Proposal for Cross-Border Educational Connection by Virtual Flipped-Classroom

Nasen Chen *

Abstract

Together with the advance of globalization, the internationalization of higher education is becoming more and more diverse. Cross-border, broad-based higher education associations is more complex than that of high school and university within the same country and poses more challenges in terms of quality assurance. On the other hand, with the recent development of ICT, Flipped Classroom, a form of education that utilizes e-learning, has been attracting attention in higher education in many countries, including Japan. Based on the results of a questionnaire survey to Japanese and Chinese university students and an analysis of case studies of pre-entrance education initiatives using e-learning, this paper discusses the possibilities and challenges for applicable methods to flipped-classroom (hereinafter referred to as Virtual Flipped-Classroom) of pre-overseas education as an attempt to facilitate cross-border educational associations.

Keywords: Virtual Flipped-Classroom, Cross-border, Educational Connection

1 Introduction

Together with the advance of globalization, the conformation afforded to cross-border higher education has been diversified including partnerships with overseas educational institutions, the establishment of overseas branch campuses, and even transnational education. In addition to the traditional teaching style, various educational activities are being carried out, including the development of distance learning using an e-learning system[1][2][3]. However, these forms of education are more complex than the traditional so-called one-country educational associations with high school because of many cases not involving high school education, also, being offered across national borders. For this reason, there are more than a few cases in which the system does not always work well and coupled with increasing competition among universities. As a result, it faces various issues including keeping educational quality[4][5][6][7].

In particular, if we take the example of educational associations between Japan higher educational institutions and overseas educational institutions, language issues are a major barrier because many foreign countries do not offer Japanese language classes at the primary and secondary

* Kansai University of International Studies, Hyogo, JAPAN

schools. It is a major hurdle to overcome for students to graduate from a Japan university with a professional education to take classes in Japanese without sufficient language skills. For this reason, it is important for Japan educational institutions to understand the educational system and the characteristics of educational activities in the overseas universities, as well as the consciousness and attitudes of the students they accept, in order to ensure a smooth transition to educational activities after acceptance, in other words, mean much to a cross-border educational associations[8].

Kubota (co-researcher, 2002) stated in his research on the optimization of learning model in higher education that the ways of higher education in the age of globalization are required to significantly change the methods of creating and transmitting "knowledge", in addition to pointing out that the "spatio-temporal coordinate system" as a framework was introduced for the aspect of creating and transmitting "knowledge" in the common learning system of higher education, and the higher education institutions were positioned in this coordinate system massively. On the horizontal axis, the spatial positional relationship between teachers and students (learning space axis) is set to "shared space (for example, face-to-face lessons)" or "different space (for example, distance lessons)". And the vertical axis shows the learning time relationship of teachers and students (learning time axis) was classified into "simultaneous" and "non-simultaneous" respectively.

Furthermore, he points out that the directional movement of communication between teachers and students is roughly divided into "two-way" or "one-way", and the quality and quantity of communication will sort out differently based on whether online or offline. And Kubota predicts that it can be achieved if the "knowledge database" is enriched and the artificial intelligence learning system (learning support robot) with the power of activated processing is realized, it will be close to face-to-face lessons by the accumulation of learning records including the learner's facial expressions during learning.

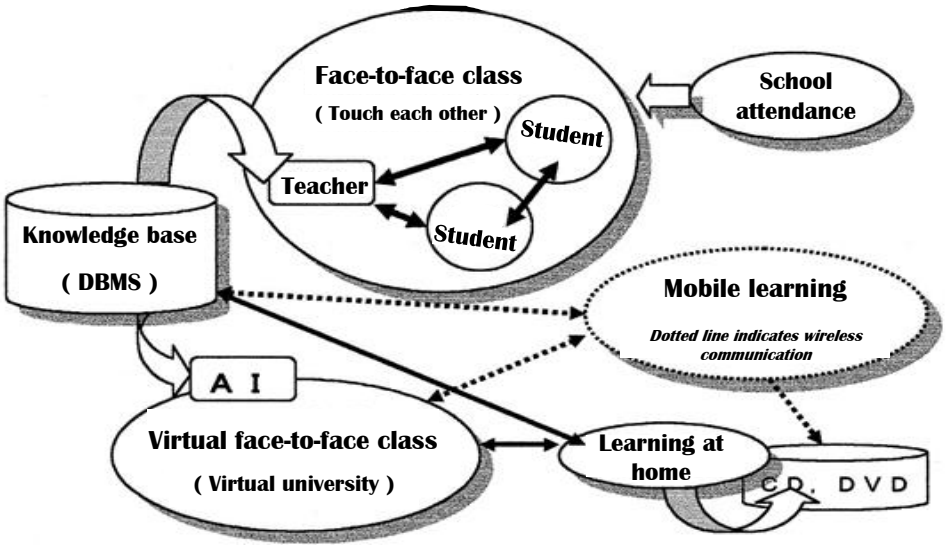

Figure 1: Conceptual diagram of common "learning system" in higher education

As above, Kubota had the foresight early in the day how the learning style would be changing by utilizing ICT in the educational field, and showed a conceptual diagram (Figure1). The conceptual diagram suggests that ICT -based learning styles, such as virtual face-to-face learning, on-

demand home learning, and mobile learning, is becoming more important for Cross-Border Education[9].

In recent years, however, "Flipped Classroom" has been attracting attention as an educational method that utilizes e-learning in higher education in Japan and other countries. "Flipped Classroom" means that the contents of the teacher's plan for students to learn in the class are summarized in a video and distributed in advance, and the learners are required to study before beginning classes outside the classroom using a PC, tablet terminal, smartphone, etc. This is a class style in which students are encouraged to confirm what they are learning when they have face to face classes in classroom and engage in group work and other activities to ensure that their knowledge is firmly established and also more advanced contents can be learned[10][11].

The researchers (2015-2019), beginning with trial of "Flipped Classroom" from the 2014 academic year, have adopted this method in various types of class subjects such as practice-based and lecture-based courses in a phased and continuous manner. Based on the results of analysis for the data of learning record and the characteristics of the distribution of VTR viewing time corresponding to the percentage of correct answers on face-to-face confirmation tests, it could be confirmed that, although there were various issues such as the status of student engagement, the skills and intentions of the teachers, and the handling of content copyrights, there were effects such as an increase the amount of time spent in studying outside the classroom, an improvement in overall class performance, and the elimination of academic gaps among students[12][13][14][15].

Sato (2016), a member of the research group, examined the possibility of "Flipped Classroom" in universities as a methodology for redesigning learning time. In this paper, he has given suggestions that the merit of "Flipped Classroom" is that by "spitting out" the transfer part of knowledge outside the classes, it naturally increases the learning time of outside classes, while at the same time secure extra time within the framework of class time. By an analysis that is given in Carroll's learning time model, he suggests that the implementation of flipped classroom has the potential to have a surprisingly revolutionary effect on the improvement and innovation of higher education, because the implementation of flipped classroom not only increases the amount of out-of-class learning time, but also requires a fundamental rethinking of the design philosophy of the class itself[16][17] [18][19][20].

In this paper, Based on the conceptual diagram of Kubota shown in Figure 1, we examine the possibilities and issues related of the applicable methods of Virtual Flipped-Classroom for cross-border pre-college education as an attempt to smoothly associate the cross-border education by analyzing the results of a questionnaire survey conducted with the aim of understanding how the students in Chinese universities, which send a good many students abroad accompanying globalization, perceive the applicable methods of flipped classroom, as well as the results of similar surveys conducted in Japan up to now and the approached cases of pre-college education actively using e-learning systems.

2 Survey Outline

2.1 Questionnaire survey for Japanese university students

The researchers conducted a nationwide survey similar to the one described below for university students in Japan at the end of 2015[21][22]. Since the trends of the data are almost the same, we would like to first show here that the survey data in Japan also adopted almost the same number of samples in terms of comparison with the survey for Chinese university students to be discussed below.

A questionnaire survey was conducted on the developmental methods of flipped classroom among students at K University in Japan. The researchers mainly asked students to answer questions related to the video content for advance viewing (time and number of viewings, etc.) and questions related to the method of flipped classroom (Pros and cons of the method, understanding of the class, adoption in other classes, etc.). The questionnaires were administered in an online format at the final classes, which were in the spring and fall semesters of 2017, the two classes with the same subject contents. The response rate was 100% in both cases. The total number of samples recovered was 67.

2.2 Awareness survey for Chinese university students

A questionnaire survey was conducted among the students of Japanese language department at Q University in China regarding the educational conformation of flipped-classroom, Mainly asking students to answer questions related to the video content for advance viewing (time and number of viewings, etc.) and questions related to the method of flipped-classroom (Pros and cons of the method, understanding of the class, adoption in other classes, etc.).In December 2017, the researchers went to the overseas local site and conducted a group questionnaire survey using the paper questionnaire in an anonymous manner. A total of 106 samples were recovered and the recovery rate was 100%.

3 Results of The Survey

In this study, the researchers mainly focused on the comparative deliberation based on the questionnaire survey related to the information terminals used for viewing video contents, the location of viewing, the educational conformation of flipped classroom and the desirable length of viewing time for advance video content.

Some of the results of the analysis are shown in Figures 2 to 7. First, let's compare the viewing locations of video contents and the information devices used. As shown in Figure 2, more than 60% of students at K University (in Japan) use their own notebook PCs to view videos and other contents, while only 20% of students at Q University (in China). In contrast, only about 30% of students at K University (in Japan) use smartphones, while more than 70% of students at Q University (China). It can be seen that there are major differences between the two countries.

As shown in Figure 3, the main locations for viewing videos and other contents were “in the classroom” and “at home/dormitory”. Among them, one in four students at K University (in Japan) views contents such as video “in the classroom”, compared to just over 10% at Q University (China). A high percentage of university students did “at home/dormitory” about 90% at Q University (in China), compared to just over 70% at K University (in Japan).

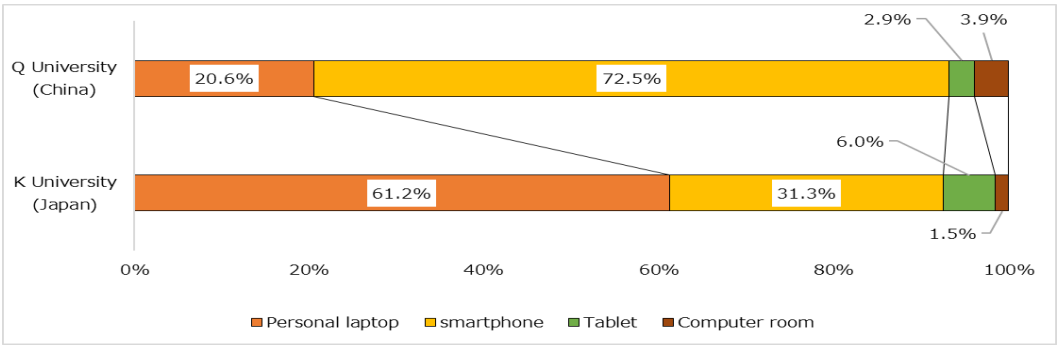

Figure 1: Information equipment frequently used for VTR viewing

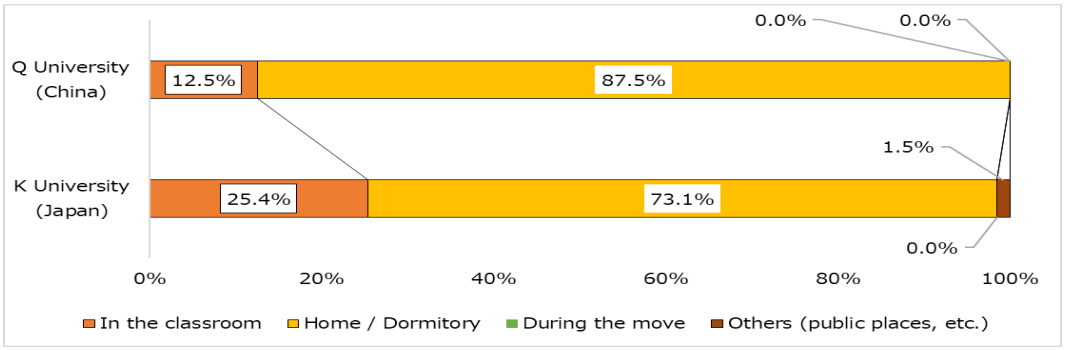

Figure 2: Locations commonly used for VTR viewing

Next, let's see the best viewing time per content. As can be seen by comparing Figures 4 and 5, 23% of the students from K University (in Japan) had 5-10 minutes, 31% had 10-15 minutes, 25% had 15-20 minutes, and 6% had 20-25 minutes, while in the case from Q University (in China), 9% had 5-10 minutes, 25% had 10-15 minutes, 38% had 15-20 minutes, and 16% had 20-25 minutes, respectively indicating that there was a significant difference in the length of viewing time that was considered the best to per content when the t-test was performed without any consideration of student coincident ($t=-4.234$, $df=167$, $p<.001$). When this result is compared to Figures 4 and 5, it can be interpreted that the students in china consider the best viewing time to per content to be longer than that of the students in Japan.

Finally, we would like to show how the university students in Japan and China perceive the educational associations of “Flipped Classroom”. As can be seen by comparing Figures 6 and 7, university students in both countries showed the same trends when coming to the items that “thinking it is a good method” “the level of understanding the class contents will be improved” and “the use of worksheets together suits for this method”. However, more than 40% of students at K University (Japan) thought that “be able to fully understand the lesson content without in this method” was “all right and applicable”, while only about 30% of students at Q University (China) thought it “apply well and apply very well”. In addition, 34.3% of students at K University (Japan) thought that “hoping this method to be adopted in many other classes” was “apply well + apply very well”, while 57.3% of students at Q University (China) thought that it was “apply well + apply very well”.

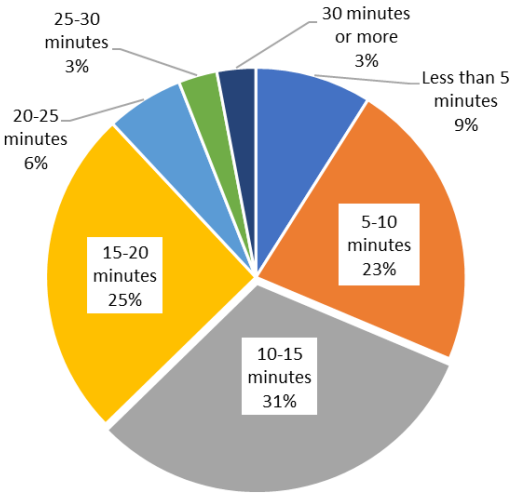

Figure 3: Viewing time per content (Japan, K University)

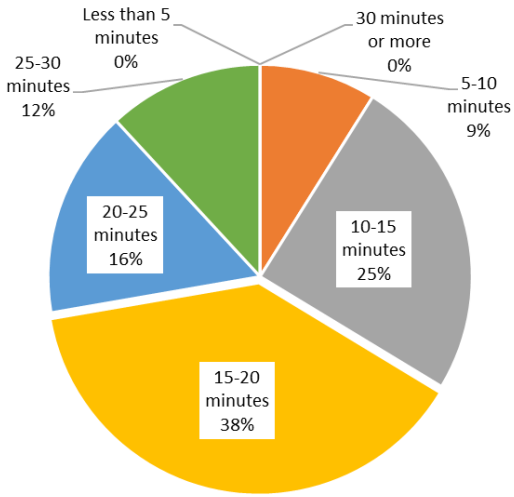

Figure 4: Viewing time per content (China, Q University)

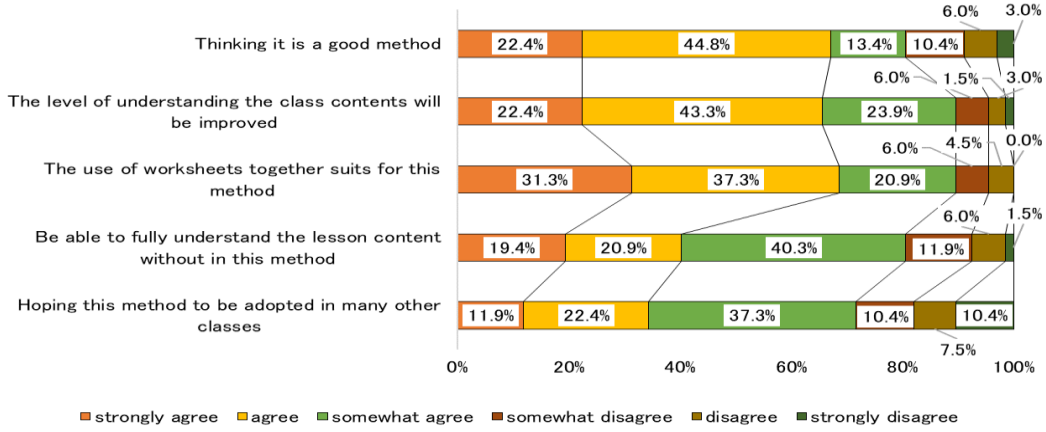

Figure 5: The method of Flipped Classroom (Japan, K University)

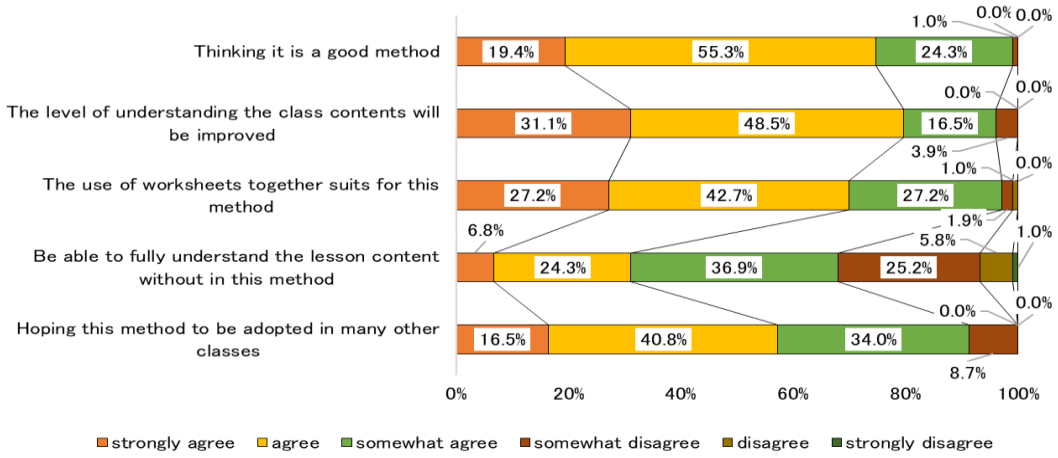

Figure 6: The method of Flipped Classroom (China, Q University)

Since the ratings were biased in the positive direction for all five horizontal items of Fig.5 and Fig.6, which show that the examinees were asked to rate on a six-point scale, a normality test was conducted. As a result, it was found that all five items were found to be non-normative. Therefore, the non-parametric tests for independent samples were conducted to determine whether there were statistical differences in the way Chinese and Japanese university students perceived these items, and the results are summarized in Table 1.

According to the results, Significant differences were found in the three items of "The level of understanding the class contents will be improved" ($p<.05$, Mann-Whitney's U test), "Hoping this method to be adopted in many other classes" ($p<.001$, Mann-Whitney's U test), and "Be able to fully understand the lesson content without in this method" ($p<.05$, Mann-Whitney's U test), but no significant differences were found in the two items of "Thinking it is a good method" (n.s., Mann-Whitney's U test) and "The use of worksheets together suits for this method" (n.s., Mann-Whitney's U test).

Table 1: Results of non-parametric tests for independent samples

	Group	N	Mean	Median	SD	Mean Rank	p-Value
Thinking it is a good method	Q Univ.(cn)	103	2.21	2.00	0.978	82.631	0.307
	K Univ.(jp)	67				89.910	
The level of understanding the class contents will be improved	Q Univ.(cn)	103	2.07	2.00	0.927	79.641	0.039 *
	K Univ.(jp)	67				94.507	
The use of worksheets together suits for this method	Q Univ.(cn)	103	2.10	2.00	0.940	85.413	0.976
	K Univ.(jp)	67				85.634	
Be able to fully understand the lesson content without in this method	Q Univ.(cn)	103	2.89	3.00	1.112	91.252	0.049 *
	K Univ.(jp)	67				76.657	
Hoping this method to be adopted in many other classes	Q Univ.(cn)	103	2.65	3.00	1.179	75.544	0.001 **
	K Univ.(jp)	67				100.806	

* p<.05, ** p<.001, Mann-Whitney's U test.

4 The Case Study of Pre-Enrollment Education Using e-Learning

K-university in Japan continues to implement the following initiatives for prospective students each year in order to ensure a smooth transition from high school to university and to maintain and improve their academic performance after enrollment.

1) Before enrollment, students are required to complete a "pre-enrollment assignment" using a drill-type e-learning system at home and a one-day warm-up course at the home university.
2) Immediately after enrollment, all new students will be given a basic academic ability test.
3) At the end of the first semester of the first year, the distribution of scores on the Basic Academic Proficiency Test and the GPA based on the initiative status of the Pre-Entry Assignment will be tabulated.
4) Based on the results of 3), students' study plan from the fall semester will be reviewed and course guidance will be put in.

Table 2: GPA averages according to the score situation of "Basic Academic Proficiency Test" and "the initiative status of Pre-Entrance Assignments"

2017 **(Pre-entrance asignments & Activity Status of Drill)**

	0%		1% – less than 50%		50% – less than 100%		100%		Total	
(Basic Academic Proficiency Test)	Number of student	Average GPA	Number of student	Average GPA	Number of student	Average GPA	Number of student	Average GPA	Number of student	Average GPA
No exam	6	0.68	1	2.1	3	2.41	3	2.95	13	**1.71**
Both less than 10 points	12	1.92	10	2	5	1.87	23	1.98	50	**1.96**
Only one has less than 10 points	11	1.84	16	2.02	22	2.2	95	2.46	144	**2.32**
Both 10 points or more	10	2.21	34	2.32	36	2.64	239	2.79	319	**2.71**
Total	39	**1.78**	61	**2.19**	66	**2.42**	360	**2.65**		

2018 **(Pre-entrance asignments & Activity Status of Drill)**

	0%		1% – less than 50%		50% – less than 100%		100%		Total	
(Basic Academic Proficiency Test)	Number of student	Average GPA	Number of student	Average GPA	Number of student	Average GPA	Number of student	Average GPA	Number of student	Average GPA
No exam	1	2.39	1	2.43	1	1.88			3	**2.23**
Both less than 10 points	22	1.50	13	1.44	13	2.01	24	2.44	72	**1.89**
Only one has less than 10 points	19	1.68	24	2.05	20	2.08	63	2.30	126	**2.12**
Both 10 points or more	11	2.23	24	2.30	36	2.52	281	2.86	352	**2.77**
Total	53	**1.73**	62	**2.02**	70	**2.29**	368	**2.74**		

2019 **(Pre-entrance asignments & Activity Status of Drill)**

	0%		1% – less than 50%		50% – less than 100%		100%		Total	
(Basic Academic Proficiency Test)	Number of student	Average GPA	Number of student	Average GPA	Number of student	Average GPA	Number of student	Average GPA	Number of student	Average GPA
No exam	1	1.21	2	0.23	2	0.66	2	0.61	7	**0.60**
Both less than 10 points	13	1.42	14	1.80	9	1.79	18	2.20	54	**1.84**
Only one has less than 10 points	18	2.16	38	2.24	25	2.30	65	2.55	146	**2.38**
Both 10 points or more	10	2.70	53	2.26	55	2.84	238	2.98	356	**2.84**
Total	42	**2.04**	107	**2.15**	91	**2.54**	323	**2.83**		

Table 2 shows the results of the average GPA for the first year of the spring semester, crossing the scores of the "Basic Academic Proficiency Test" and "the initiative status of Pre-Entry Assignment" of the students who have been enrolled in the most recent three years. Based on these tables, although there are cases where the number of students in some items is small and the data number is reversed, by looking at the total column, it can be known that the higher the status of scores and efforts, the higher the average GPA.

Figure 8 expresses the simplification of the relationship between GPA averages and the initiative status of Pre-Entrance Assignments in Table 2. The results in Figure 8 indicate a similar trend in the most recent three years. It can be seen that the higher the status of scores and efforts, the higher the average GPA. It suggests that the scores on the "Basic Academic Proficiency Test" and the initiative status of "Pre-Entrance Assignments" are useful for predicting students' GPA (post-entry academic performance). In other words, these results can be used actively to provide effective learning support and course guidance in more efficient way.

Deciding the contents of "Pre-Entrance Assignments" are based on the Academic field of each department. For the "Basic Academic Proficiency Test", the questions are to measure students' ability to use Japanese and to think logically in linguistic and non-linguistic ways.

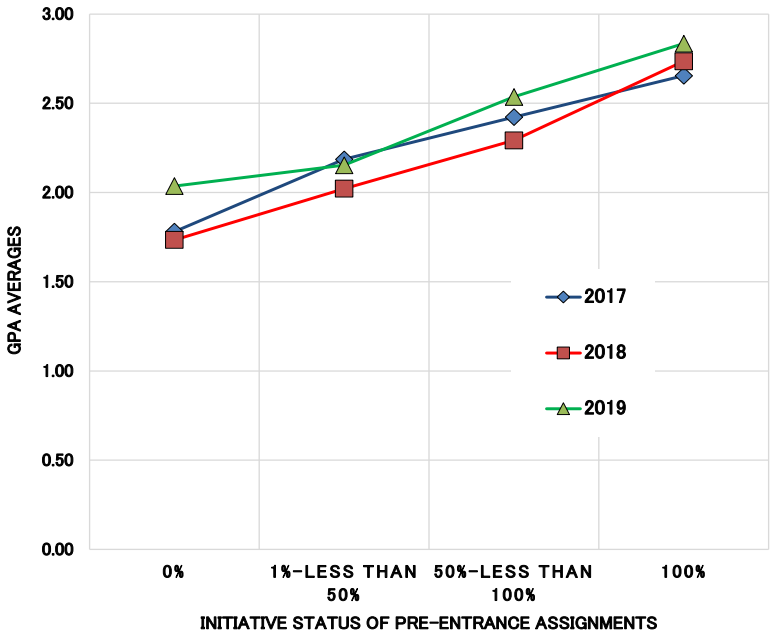

Figure 7: GPA averages according to the score situation of "the initiative status of Pre-Entrance Assignments"

5 Discussion Considerations

Based on the results of a questionnaire survey of university students in Japan and China and an analysis of the case study of pre-entrance education initiatives using e-learning actively at K

University, as following from several perspectives as an attempt to connect smoothly Cross-border higher education, the possibility of applying method for the Flipped Classroom of pre-entrance education will be discussed.

1) From past research and surveys (what we have known)

Over the past few years, the researchers have conducted a nationwide survey of university students in Japan and in some universities in China to investigate the following

- Primarily, what kind of information devices are used to watch video content on the Internet, in what locations, at What times with that much length and frequency?
- What problems and worries have been had when using the Internet?
- How do university students perceive the lesson conformation of "Flipped Classroom" in Japan and China?

The results of the analysis on these items reveal the following

- Both Japanese and Chinese university students spend a lot of time at home and in the classroom watching videos and other content on smart devices such as smart phones.
- When using the Internet, most students have some kind of anxiety, especially about security.
- Both Japanese and Chinese university students positively perceive the use of smart devices such as smartphones and tablets in their academic activities.
- To both Japanese and Chinese university students, 15-20 minutes is the best viewing time for per content as Pre-learning of Flipped Classroom.

2) Case studies of pre-entrance education initiatives using e-learning (what has been revealed)

As for the case study of K University, the distribution of scores on the "Basic Academic Proficiency Test" and the initiative status of "Pre-Entrance Assignments" showed over time that the better these scores were, the higher the average GPA increased. In other words, it is speculated that prior learning outside the classroom prior to enrollment has a sustained positive impact on academic performance after enrollment. In this sense, it can be interpreted that it may lead to an improvement in the quality of university education as a whole if the above initiative can be reliably implemented at each university.

In addition, due to the rapid development of the ICT environment in recent years, many countries are developing e-learning environments that utilize smartphones, tablet devices, and notebook PCs. With the current spread of the new coronavirus, the number of people using telecommuting and online learning is increasing rapidly, even as the global movement of people is being restricted worldwide. It is good to say that learning through online is being reformed globally just as the work reform through telework is progressing.

3) Possibility of Virtual Flipped-Classroom for Cross-Border educational associations

Considering the above two points (1) and (2), it is believed that the learning activities depending on the Flipped Classroom using e-learning can contribute to the smooth educational association to the higher education provided across national borders if the scope of its application is broadened. The results of a series of surveys revealed that both Japanese and Chinese university students view video and other contents on smart devices such as smartphones on an almost daily basis, they are not particularly resistant to viewing video contents for lectures using small information terminals such as smartphones, they would rather actively consider its use in their academic activities.

It is also clear that the level of initiative status of "Pre-Entrance Assignments" imposed by K University as a part of the pre-entrance education program on prospective students positively affected their scores on the confirmation of achievement test at the time of admission and their academic performance after enrolment. Now, there are not many examples of such case studies, but given the nature of the system, it would be natural that positive effects can be obtained no matter which university it is implemented in.

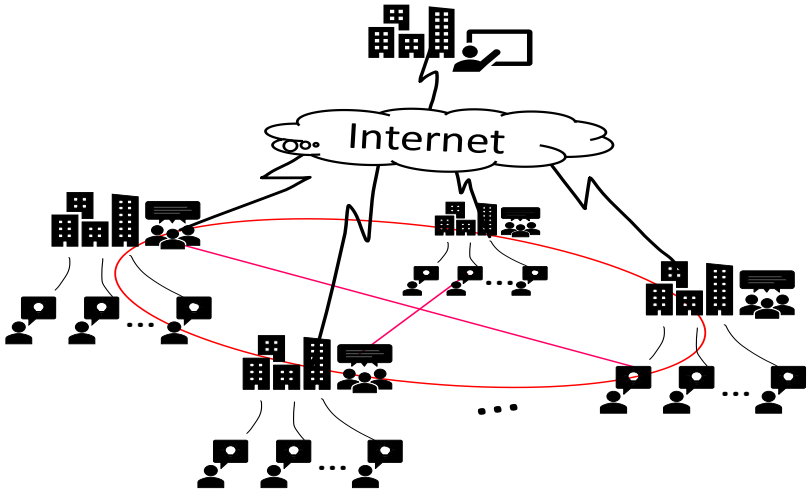

Figure 9: Conceptual diagram of pre-entrance education for the cross-border educational association

Based on these points, Figure 9 shows the Conceptual diagram of the learning activities in the educational association conducted smoothly to the higher education provided across national borders in order to contribute to the quality assurance of education. The mechanism of Figure 9 can be understood as follows.

a) Study contents are distributed in advance through the LMS of the host university, etc., and the students study with their own using information terminals, solve related tasks, and submit them through LMS, etc.
b) Distance lectures (confirmation tests, lectures, assignments for next time, etc.) by host university faculty members. Remote conference services such as Zoom can be used easily.
c) During the pre-learning period, it is possible to set up meeting rooms for each course in LMS to stimulate the discussion among the participants. Learning support from student mentors at the host university could also be considered. Of course, group and individual guidance by lecturers is also available.
d) Those who have completed all the pre-entrance learning tasks will be given a passing grade and will be recognized as credits after admission.

To putting the learning activities into action shown in Figure 9, the potential can be considered from several aspects. These include the viewing devices used by the students, the network environment for stress-free viewing of video content, and the preparation of self-study content for the students.
First, as a means of viewing video content, smartphones have become an indispensable

communication tool in daily life in many countries, and smartphones are more widely used than laptops. Seen by the size of the screen, laptops and tablets would be probably more desirable, from the viewpoints of ownership rate and effective use of free time, and excellent portability, the use of smartphones is probably the most practical[21][22][23][24].

Next, as network environment, 5G is expected to spread in earnest in the future, and by taking advantage of its ultra-high speed, large capacity, and ultra-low latency, the viewing environment for video content for pre-learning will not only be greatly improved, but it will also be possible to enjoy the realism of an actual classroom when teaching face-to-face lesson from a distance. In other words, viewing devices are becoming low-pricing and more sophisticated, and 5G will enter a period of full-scale expansion in terms of the network environment, so the hardware environment for smooth implementation of such cross-border educational association should be considered to be in place.

Finally, regarding the preparation of self-study content for students, a variety of content creation tools have been released in recent years, but it is necessary for teachers to take into account the original skills and the new burden of mastery and need to pay attention to the handling of copyrights. It would be desirable to have specialized staff depending on the difficulty and workload of content creation and maintenance. By doing like this, the learning activities proposed here would also be more effective, as this would allow course instructors to focus on pre-learning and the overall design of the face-to-face lessons by distance[25][26][27].

In any case, considering the widespread use of handheld information terminals with smartphones as the mainstay, and the fact that they are widely supported by university students in many countries and are used in their possession without taking them off their hands, it is likely that the widespread use of 5G will bring out the power of its ultra-high-speed, high-capacity and ultra-low latency in a variety of situations, especially in overseas communication, its power will be demonstrated.

Particularly, with the recent evolution of AI and its active usage in the field of education, it is thought that an artificial intelligence learning system (learning support robot) with the enhanced “knowledge database” and the power of activated processing is being realized[28]. If the learning records including the learner's facial expressions during learning is accumulated, it will be possible, as Kubota predicts, to realize the distance learning close to face-to-face lesson[9].

In contrast, however, even in today's highly developed transportation system, there are still many constraints of time and cost on the physical access of cross-border. Based on the above, approaches such as pre-entrance education for international students and the use of Virtual Flipped-Classroom for language education, which are becoming relatively effective, are worth implementing by the perspective of educational quality assurance in order to facilitate the educational association of cross-border, and in terms of viewing devices, network environments, content creation tools, and other aspects, it seems that the approaches are becoming easier to realize[1][29].

6 Conclusions

In this paper, the results of a questionnaire survey of Japanese and Chinese university students and an analysis of examples of initiatives for pre-entrance education using e-learning are used to examine the possibility of implementing pre-entrance education using Virtual Flipped-Classroom as an attempt to smoothly connect education across national borders.

From the results of the analysis, it became clear that both Japanese and Chinese university students, even though they have some anxiety about using the Internet on a regular basis, it is clear that they actively use their smartphones to watch video content for a long period of their time, and they do not feel any particular resistance to using it in their learning activities. On the other hand, however, even in today's highly developed transportation system, there are still many constraints of time and cost on the physical access of cross-border.

Based on the above, approaches such as pre-entrance education for international students and the use of Virtual Flipped-Classroom for language education, which are becoming relatively effective, are worth implementing by the perspective of educational quality assurance in order to facilitate the educational association of cross-border, and in terms of viewing devices, network environments, content creation tools, and other aspects, it seems that the approaches are becoming easier to realize.

As lower cost and higher performance of viewing devices for students are expected to continue further and the communication bandwidth and speed of viewing devices are expected to continue to increase from now on, it will be an issue to be examined in the future how the course instructors design the entire class, how to create quality content that is easy to be understood and for students not to be bored, furthermore how to provide attractive face-to-face classes in “remote teaching”.

Acknowledgment

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