Research on the Selection of the Science Course in Lower and Upper Secondary School (Outline)

Full text of the report is available on the website of National Institute for Educational Policy Research (http://www.nier.go.jp/)

1. Objectives and Summary of the Study

(1) Objectives of the Research

This research was conducted to clarify issues in the course selection between humanities and science through a nationwide survey. In the survey, we tried to understand the current situation of how junior and senior high school students perceived the importance and usefulness of each subject when thinking about their career and making a selection between two courses, and how related factors such as educational activities in and out of school had affected their selections.

In addition, an additional field survey was conducted to look for remarkable case studies, based on our hypothesis that high motivation and positive attitudes are necessary for making a good career choice, which comes from one of the results of the nationwide survey.

(2) Summary of the Study

A nationwide questionnaire survey and a field survey targeting at junior and senior high school students were conducted. The details are as follows.

[Research period: FY 2010–FY 2012; Principal researcher: Kenichi Goto (Senior Researcher, Department for Curriculum Research)]

(i) Nationwide survey

The questionnaire survey was conducted in September 2011, targeting at junior and senior high schools and their students in Japan to understand the current situation of students' selection between humanities and science courses; for example, how they feel the importance and usefulness of each subject when making a course selection, and how related factors such as educational activities in and out of school had affected the selection (number of respondents: 485 junior high schools, 6,410 ninth grade students (last year of junior high school), 488 high schools, 33,071 tenth grade students (first year of high school), and 33,127 twelfth grade students (last year of high school)).

(ii) Field survey based on the nationwide survey outcomes

The field survey was conducted from November 2012 to January 2013 in selected schools that showed distinctive results in the nationwide survey, specifically

- schools with a high percentage of students (including humanities course students) who "like a lot" or "like" mathematics and/or science and
- schools with a high percentage of students who think mathematics and/or science are "very important" or "important" in their future.

(Pilot survey: three schools; main survey: six junior high schools, nine high schools, and one provincial educational center)

The school visits aimed to look for specific case studies and understand factors for their effectiveness such as learning opportunities, school system, learning instructions, and attitudes. Then, through discussions in an open seminar and conferences, implications were summarized.

(iii) Open seminar as a research overview

The open seminar was held on Saturday, January 12, 2013, to report the overview of the nationwide survey and to summarize and conclude the outcome of the field survey.

2. Summary of the Findings

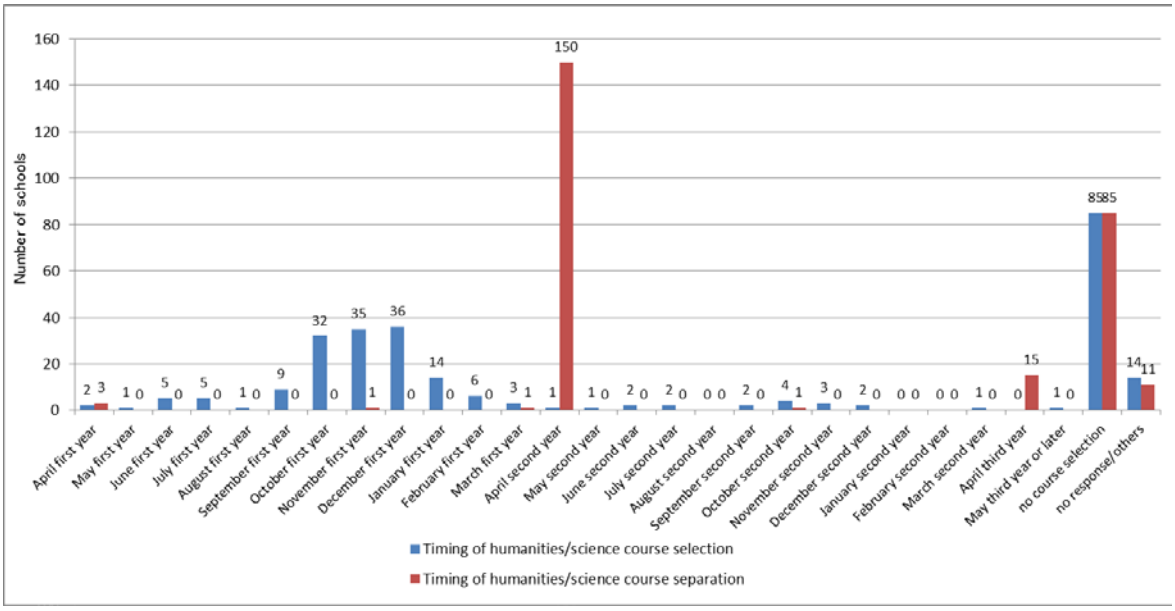
(1) Summary of the Nationwide Survey

A detailed report of the survey outcome has already been completed and released on the institute's website (http://www.nier.go.jp/kaihatsu/pdf/zokuseichi-report.pdf (in Japanese)). In this paper, therefore, we would like to share some findings of the survey and the result of an additional analysis done after the completion of the report.

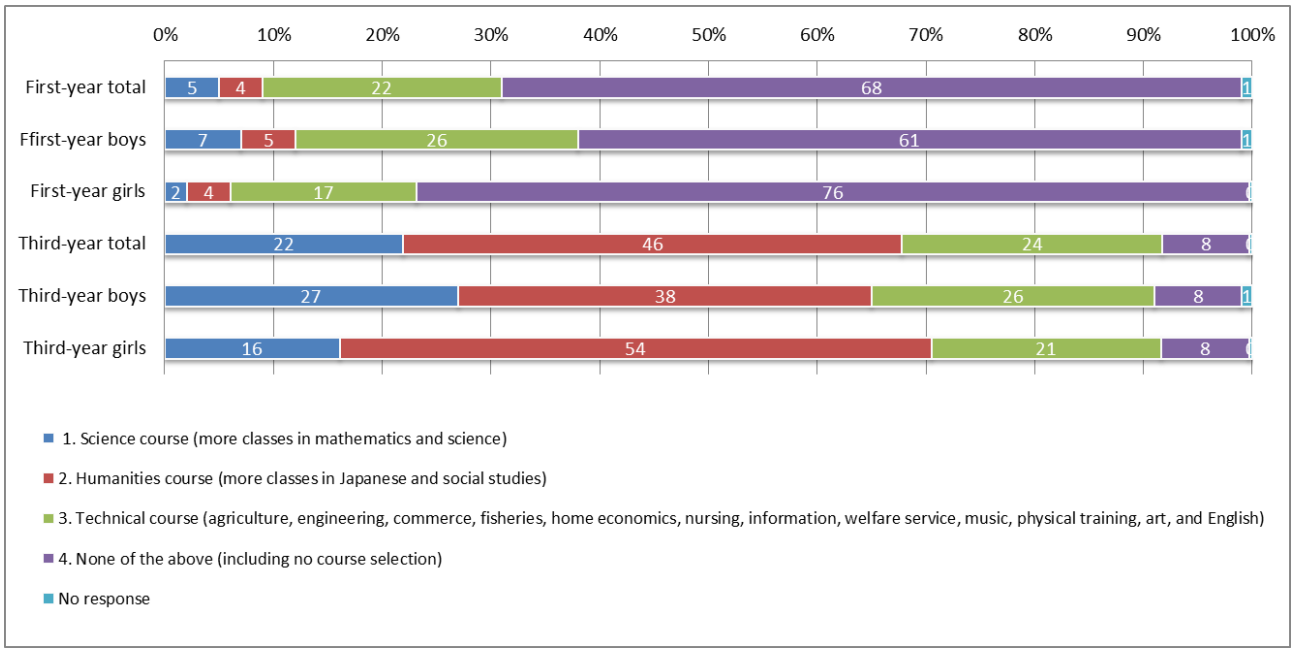
(i) Result of the questionnaire survey for schools and students (selected issues)

a) Two out of three high schools make students select humanities or science course. **The majority of schools reported that the timing of decision-making is from October to December of the first year**. **Most schools actually separate the courses in April of the second year, while some others separate the courses in April of the third year** (Figure 1). Of the third-year students in high school, 22% take the science course (27% of boys, 16% of girls), while 46% take the humanities course (38% of boys, 54% of girls) (Figure 2).

[Figure 1] Timing of humanities/science course selection (high school), N= 267

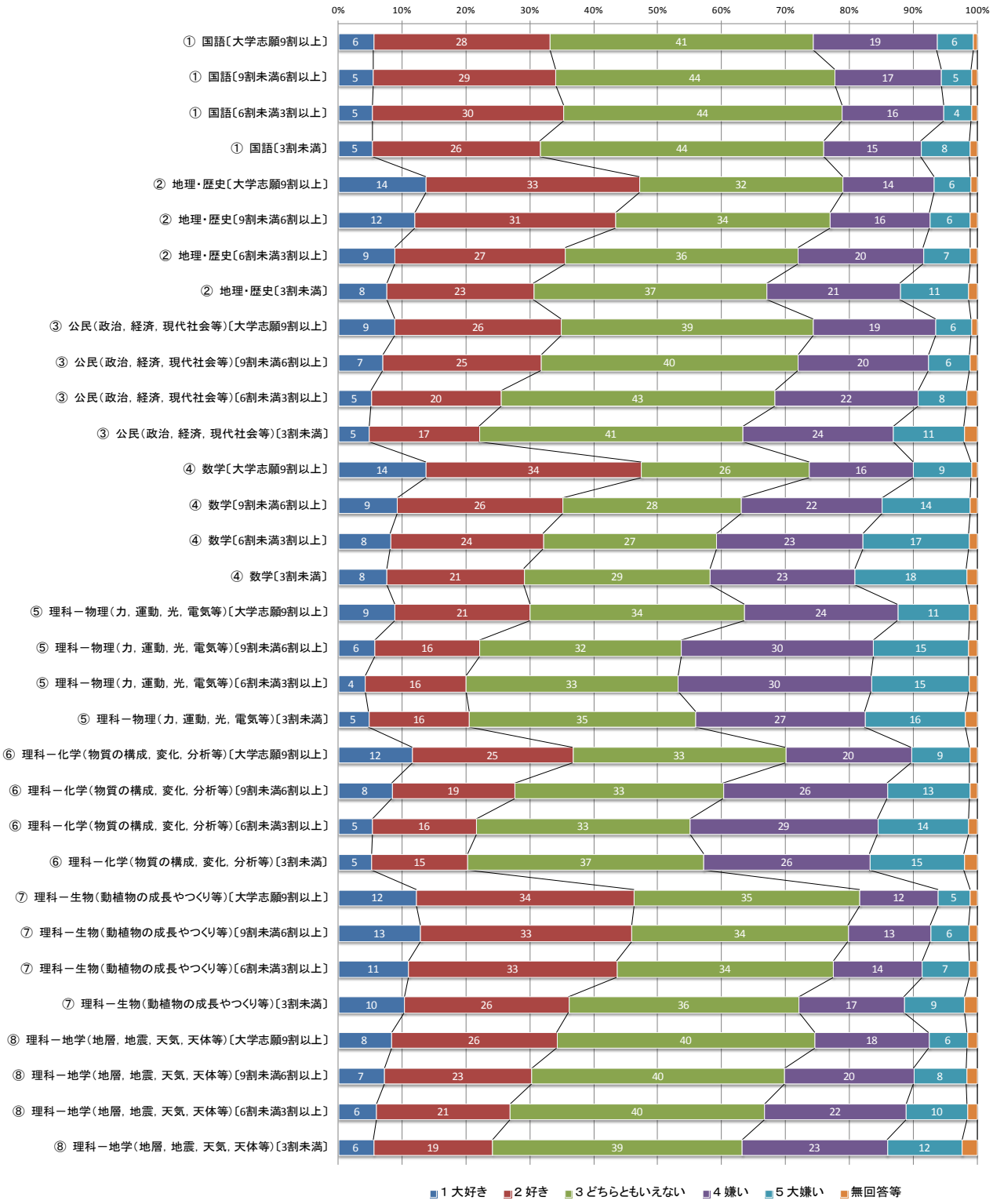


[Figure 2] Selected course (high school)



b) Looking at **the rate of students who "like a lot" or "like" a subject**, there is not much difference depending on the size of the region for junior high school students. **For some subjects in high schools, there is a clear difference in students' liking about each subject. S** Specifically, **high schools with higher rate of university applicants tend to have more students** who "like a lot" or "like" a subject. **"Geography and history," "civics," "mathematics," and "foreign language"** clearly show this tendency. For science, slightly more students in the schools with 90% or more university applicants tend to "like a lot" or "like" **"physics"** and **"chemistry"** s (Figure 3-(1)(2)).

[Figure 3-(1)] Favorite subjects—first year of high school (by the rate of university applicants: Japanese–science)



(Vertical axis)

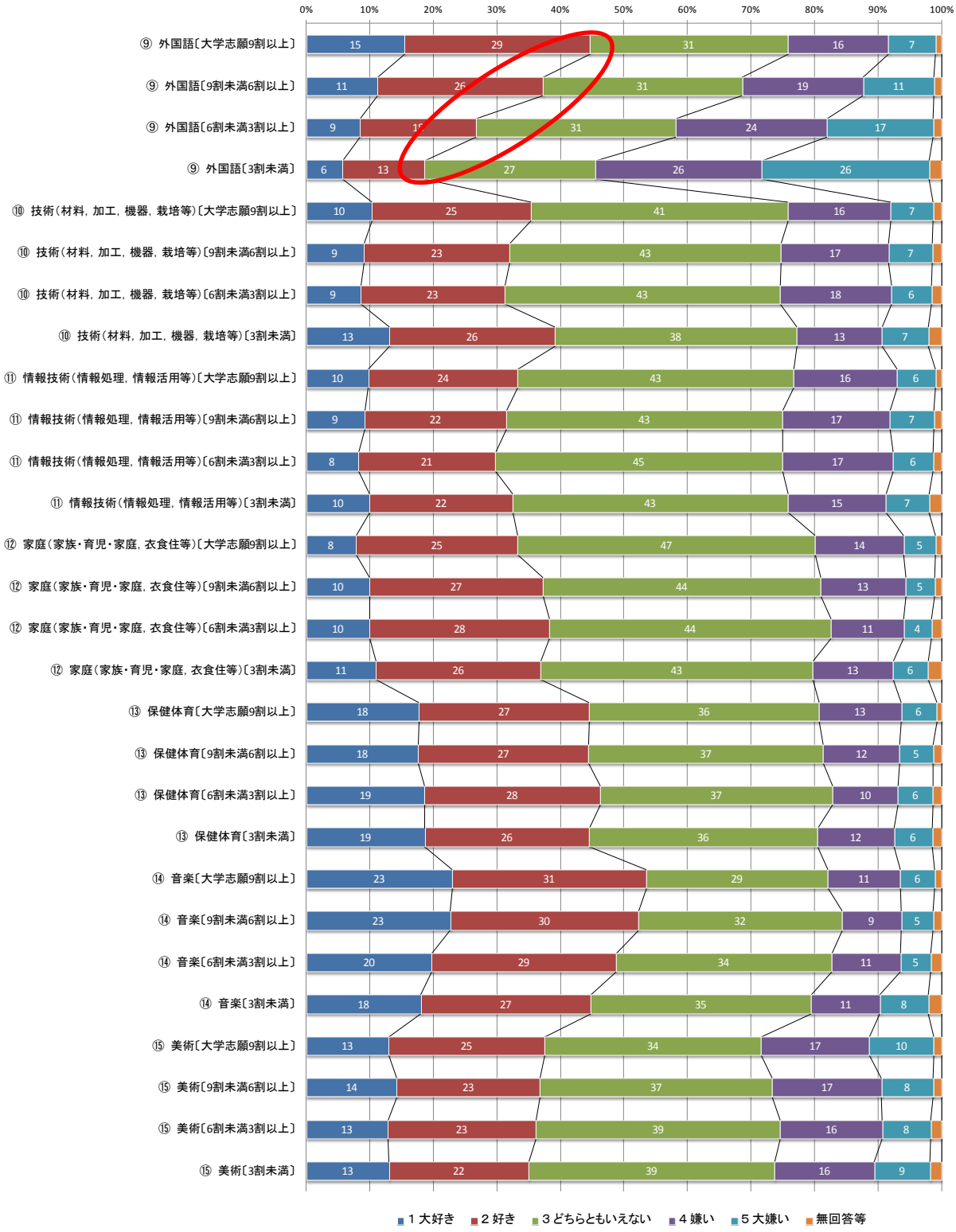
①Japanese (90% or more applicants), ①Japanese (60–90%), ①Japanese (30–60%), ①Japanese (less than 30%), ②geography, history (90% or more applicants), ②geography, history (60–90%), ②geography, history (30–60%), ②geography, history (less than 30%), ③civics (politics, economics, contemporary society, etc., (90% or more applicants), ③civics (politics, economics, contemporary society, etc.) (60–90%), ③civics (politics, economics, contemporary society, etc.) (30–60%), ③civics (politics, economics, contemporary society, etc.) (less than 30%), ④mathematics (90% or more applicants), ④mathematics (60–90%), ④

mathematics (30–60%), ④mathematics (less than 30%), ⑤science—physics (mechanics, motion, optics, electricity, etc.) (90% or more applicants), ⑤science—physics (mechanics, motion, optics, electricity, etc.) (60–90%), ⑤science—physics (mechanics, motion, optics, electricity, etc.) (30–60%), ⑤science—physics (mechanics, motion, optics, electricity, etc.) (less than 30%), ⑥ science—chemistry (constituents, changes and analysis of substances, etc.) (90% or more applicants), ⑥science—chemistry (constituents, changes and analysis of substances, etc.) (60–90%), ⑥science—chemistry (constituents, changes and analysis of substances, etc.) (30–60%), ⑥science—chemistry (constituents, changes and analysis of substances, etc.) (less than 30%), ⑦ science—biology (development and structure of flora and fauna, etc.) (90% or more applicants), ⑦science—biology (development and structure of flora and fauna, etc.) (60–90%), ⑦science—biology (development and structure of flora and fauna, etc.) (30–60%), ⑦science—biology (development and structure of flora and fauna, etc.) (less than 30%), ⑧science—geoscience (stratum, earthquakes, weather, astronomy, etc.) (90% or more applicants), ⑧science—geoscience (stratum, earthquakes, weather, astronomy, etc.) (60–90%), ⑧science—geoscience (stratum, earthquakes, weather, astronomy, etc.) (30–60%), ⑧ science—geoscience (stratum, earthquakes, weather, astronomy, etc.) (less than 30%).

(Legend)

1. like it a lot, 2. like it, 3. nether like nor dislike it, 4. dislike it, 5. dislike it a lot, no response

[Figure 3-(2)] Favorite subjects—first year of high school (by the rate of university applicants: foreign language–art)



(Vertical axis)

⑨foreign language (90% or more applicants), ⑨foreign language (60–90%), ⑨foreign language (30–60%), ⑨foreign language (less than 30%), ⑩technical course (materials, processing, equipment, cultivation, etc.) (90% or more applicants), ⑩technical course (materials, processing, equipment, cultivation, etc.) (60–90%), ⑩technical course (materials, processing, equipment, cultivation, etc.) (30–60%), ⑩technical course (materials, processing, equipment,

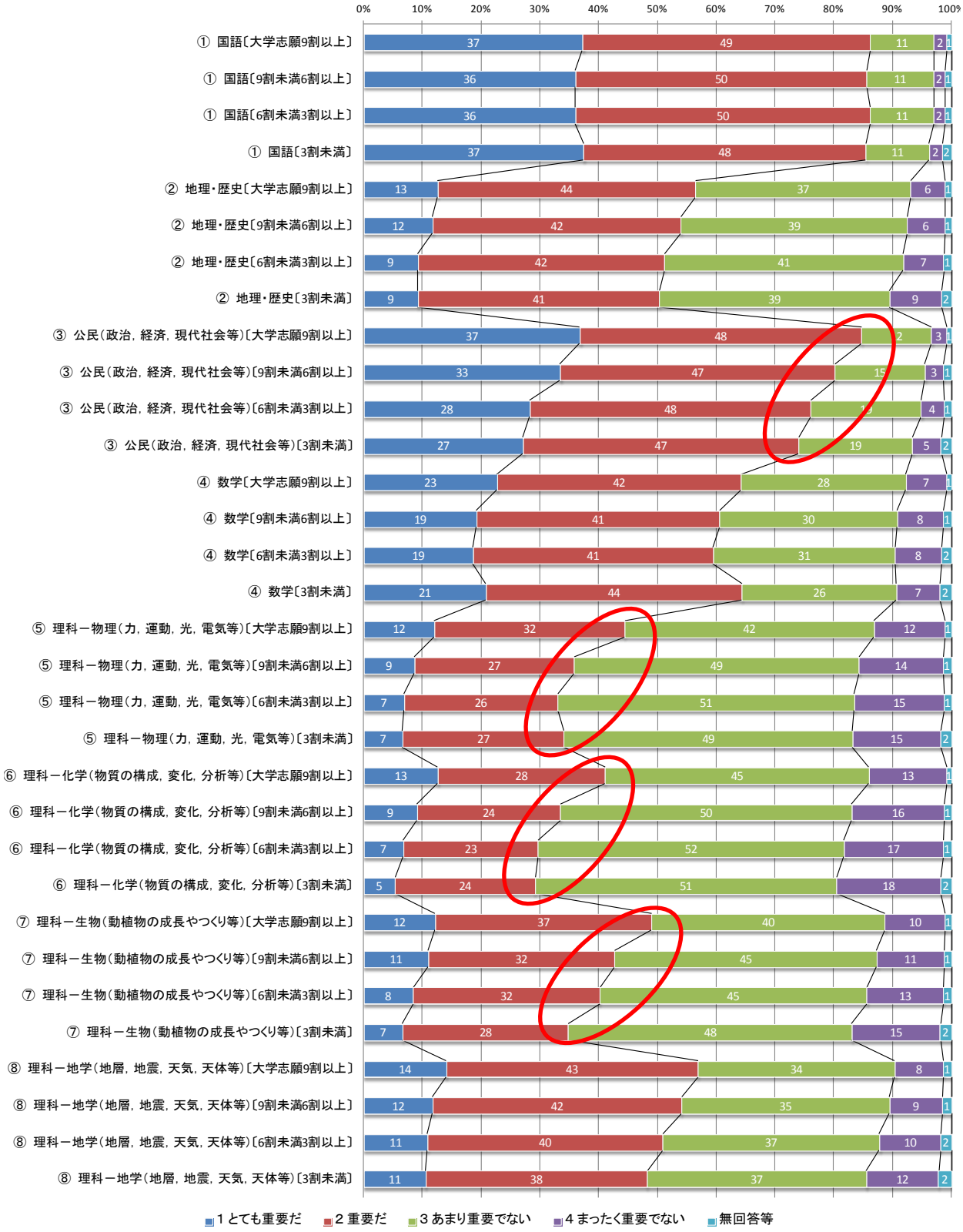
cultivation, etc.) (less than 30%), ⑪IT (information processing and application, etc.) (90% or more applicants), ⑪IT (information processing and application, etc.) (60–90%), ⑪IT (information processing and application, etc.) (30–60%), ⑪IT (information processing and application, etc.) (less than 30%), ⑫home economics (family, nursing, household, necessities of life, etc.) (90% or more applicants), ⑫home economics (family, nursing, household, necessities of life, etc.) (60–90%), ⑫home economics (family, nursing, household, necessities of life, etc.) (30–60%), ⑫home economics (family, nursing, household, necessities of life, etc.) (less than 30%), ⑬health and physical education (90% or more applicants), ⑬health and physical education (60–90%), ⑬health and physical education (30–60%), ⑬health and physical education (less than 30%), ⑭music (90% or more applicants), ⑭music (60–90%), ⑭music (30–60%), ⑭music (less than 30%), ⑮art (90% or more applicants), ⑮art (60–90%), ⑮art (30–60%), ⑮art (less than 30%)

(Legend)
1. like it a lot, 2. like it, 3. nether like nor dislike it, 4. dislike it, 5. dislike it a lot, no response

c) In junior high school, again, there is not much difference in **the rate of students who think the subject is "very important" or "important" for** their life in the future, depending on the size of the region. **For some subjects in high schools, there is a clear difference among schools that in students' perception of the importance of each subject.** Specifically, **high schools with higher rate of university applicants tend to have more students** who think the subject is "very important" or "important."

"Civics," "foreign language," and **"IT"** clearly show this tendency. For science, slightly more students in the schools with 90% or more university applicants tend to think that **"physics," "chemistry," and "biology"** are "very important" or "important" (Figure 4-(1)(2)).

[Figure 4-(1)] Importance of the subject in the future—first year of high school (by the rate of university applicants: Japanese–science)



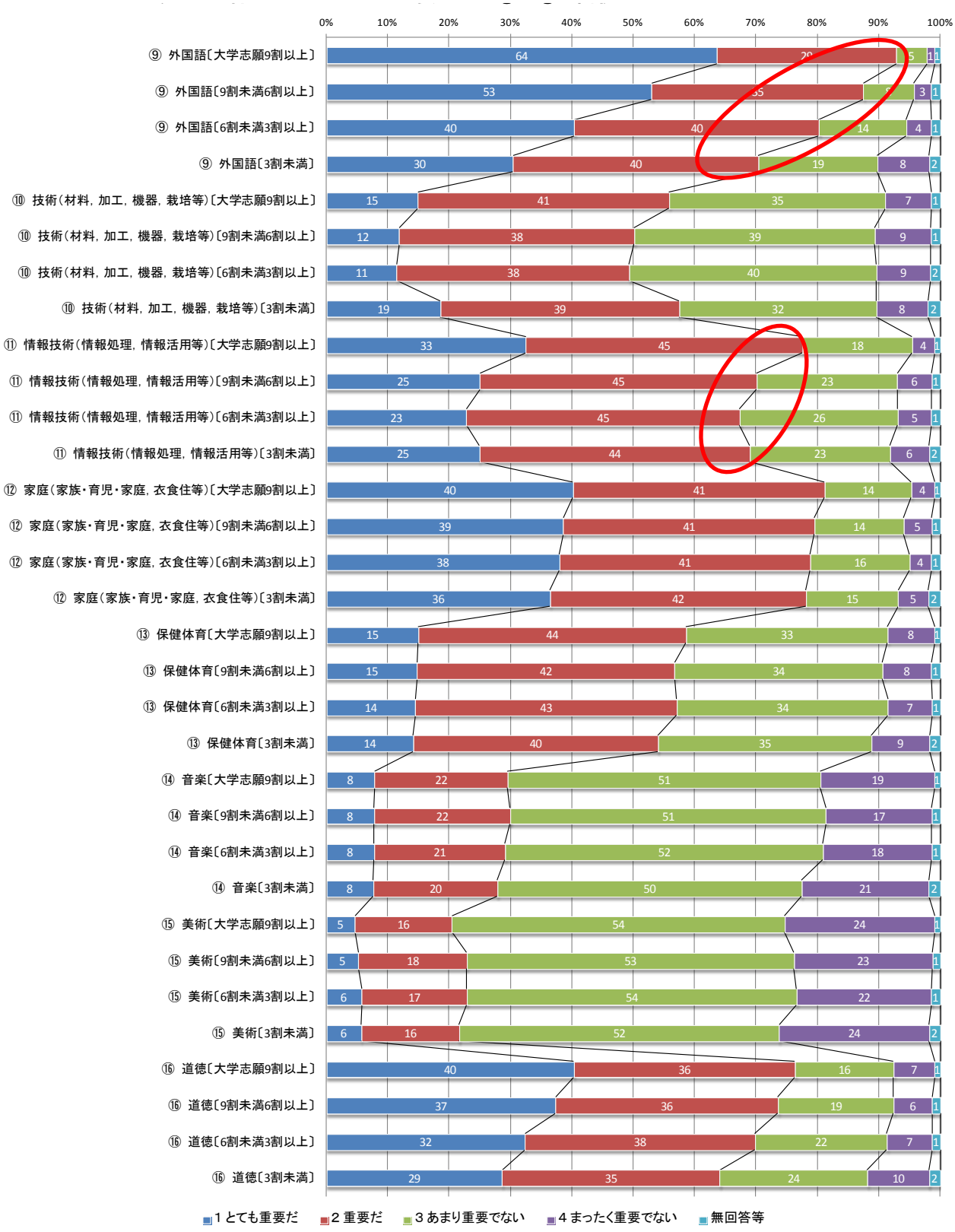
(Vertical axis)

①Japanese (90% or more applicants), ①Japanese (60–90%), ①Japanese (30–60%), ①Japanese (less than 30%), ② geography, history (90% or more applicants), ②geography, history (60%–90%), ②geography, history (30–60%), ② geography, history (less than 30%), ③civics (politics, economics, contemporary society, etc.) (90% or more applicants),

③civics (politics, economics, contemporary society, etc.) (60–90%), ③civics (politics, economics, contemporary society, etc.) (30–60%), ③civics (politics, economics, contemporary society, etc.) (less than 30%), ④mathematics (90% or more applicants), ④mathematics (60–90%), ④mathematics (30–60%), ④mathematics (less than 30%), ⑤ science—physics (mechanics, motion, optics, electricity, etc.) (90% or more applicants), ⑤science—physics (mechanics, motion, optics, electricity, etc.) (60–90%), ⑤ science—physics (mechanics, motion, optics, electricity, etc.) (30–60%), ⑤science—physics (mechanics, motion, optics, electricity, etc.) (less than 30%), ⑥ science—chemistry (constituents, changes and analysis of substances, etc.) (90% or more applicants), ⑥ science—chemistry (constituents, changes and analysis of substances, etc.) (60–90%), ⑥science—chemistry (constituents, changes and analysis of substances, etc.) (30–60%), ⑥science—chemistry (constituents, changes and analysis of substances, etc.) (less than 30%), ⑦science—biology (development and structure of flora and fauna, etc.) (90% or more applicants), ⑦science—biology (development and structure of flora and fauna, etc.) (60–90%), ⑦ science—biology (development and structure of flora and fauna, etc.) (30–60%), ⑦science—biology (development and structure of flora and fauna, etc.) (less than 30%), ⑧science—geoscience (stratum, earthquakes, weather, astronomy, etc.) (90% or more applicants), ⑧science—geoscience (stratum, earthquakes, weather, astronomy, etc.) (60–90%), ⑧science—geoscience (stratum, earthquakes, weather, astronomy, etc.) (30–60%), ⑧science—geoscience (stratum, earthquakes, weather, astronomy, etc.) (less than 30%).

(Legend)
1. very important, 2. important, 3. somewhat important, 4. unimportant, no response

[Figure 4-(2)] Importance of the subject in the future—first year of high school (by the rate of university applicants: foreign language–moral education)



(Vertical axis)
⑨foreign language (90% or more applicants), ⑨foreign language (60–90%), ⑨foreign language (30–60%), ⑨foreign language (less than 30%), ⑩technical course (materials, processing, equipment, cultivation, etc.) (90% or more applicants), ⑩technical course (materials, processing, equipment, cultivation, etc.) (60–90%), ⑩technical course (materials, processing, equipment, cultivation, etc.) (30–60%), ⑩technical course (materials, processing, equipment, cultivation, etc.) (less than 30%), ⑪IT (information processing and application, etc.) (90% or more applicants), ⑪IT (information processing and application, etc.) (60–90%), ⑪IT (information processing and application, etc.) (30–60%), ⑪IT (information processing and application, etc.) (less than 30%), ⑫home economics (family, nursing, household, necessities of life, etc.) (90% or more applicants), ⑫home economics (family, nursing, household, necessities of life, etc.) (60–90%), ⑫home economics (family, nursing, household, necessities of life, etc.) (30–60%), ⑫home economics (family, nursing, household, necessities of life, etc.) (less than 30%), ⑬health and physical education (90% or more applicants), ⑬health and physical education (60–90%), ⑬health and physical education (30–60%), ⑬health and physical education (less than 30%), ⑭music (90% or more applicants), ⑭music (60–90%), ⑭music (30–60%), ⑭music (less than 30%), ⑮art (90% or more applicants), ⑮art (60–90%), ⑮art (30–60%), ⑮ art (less than 30%), ⑯moral education (90% or more applicants), ⑯moral education (60–90%), ⑯moral education (30–60%), (16) moral education (less than 30%).

(Legend)
1. very important, 2. important, 3. somewhat unimportant, 4. unimportant, no response

(ii) Result of the additional analysis

Based on the result of the nationwide survey, an additional analysis focusing on non-technical high schools was conducted. The purpose of this analysis was to find out if students' favorability of each subject, their perception of importance, change in their favorability since junior high school, and their awareness of academic and career path in the future are affected by factors such as whether the school has the course selection, when students make their decision, and when the courses are actually separated.

(Note) This analysis compares the response from students in their third year of high school (non-vocational) by the rate of university applicants. This was done for all subjects, and below, this paper shows the result of mathematics as an example.

a) Difference in students' attitudes by the presence of course separation (twelfth graders)

Students in schools with course separation tend to have higher favorability and importance awareness toward subjects (Table 1). As for the change in students' favorability since junior high school, no uniform tendency was found, depending on the presence of course separation (Table 2). In addition, while students without course separation tend to have clearer idea toward their future career, **students with course separation tend to desire to move on to a higher level of education** (Figures 5, 6).

Table 1: Comparison of favorability and importance awareness (math)

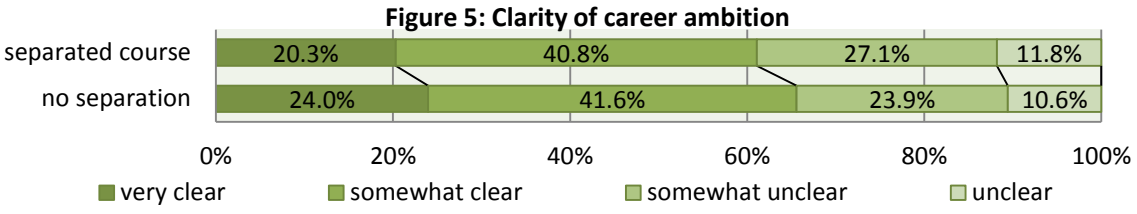
Rate of university applicants	Favorability		Importance awareness	
	No separation	Separated course	No separation	Separated course
Total	2.79	**3.12**	2.57	**2.64**
90% or more	3.06	**3.30**	2.58	**2.68**
60–90%	2.96	**3.10**	2.52	2.60
30–60%	2.68	**2.90**	2.55	**2.62**
Less than 30%	2.64	2.76	2.60	2.60

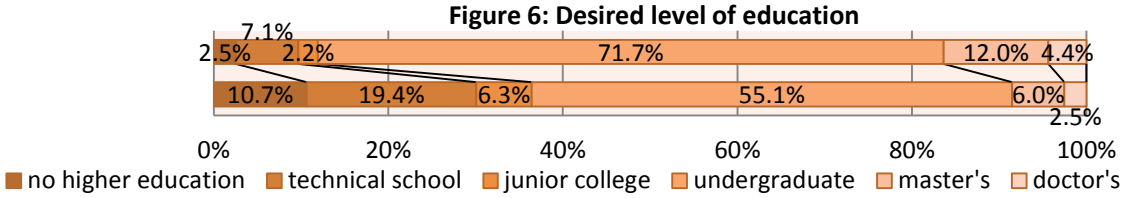
Note: Numbers with a statistically significant difference are highlighted in yellow, with larger numbers written in red (significance level of 5%).

Table 2: Comparison of the change in favorability (math)

Rate of university applicants	Total	90% or more	60–90%	30–60%	Less than 30%
No separation	**−0.16**	−0.34	−0.28	−0.24	0.15
Separated course	−0.23	−0.29	−0.24	**−0.15**	0.17

Note: Numbers with a statistically significant difference are highlighted in yellow, with larger numbers written in red (significance level of 5%).





b) Difference in students' attitudes by the timing of course decision and separation (twelfth graders)

Students who decided their course during the second year and started the course in April of the third year tend to have higher favorability and importance awareness, compared to students who decided their course during the first year and started the course in April of the second year (Tables 3, 4). As for the change in students' favorability since junior high school, there was not much difference by the timing of course decision and separation in most cases (Table 5). In addition, although the clarity of students' career ambition shows no statistical difference by the timing of course decision and separation, students who chose their course during the second year and started the course in April of the third year tend to have clearer idea (Figure 7). Also, while the students' desired level of higher

education shows no statistical difference by the timing of course decision and separation, students who chose their course during the second year and started the course in April of the third year tend to have diversified ideas about desired level of higher education (Figure 8).

Table 3: Comparison of favorability (math)

Rate of university applicants	Total				Science course				Humanities course			
	Decision timing		Seperation timing		Decision timing		Seperation timing		Decision timing		Seperation timing	
	First year	Second year	Spring of second year	Spring of third year	First year	Second year	Spring of second year	Spring of third year	First year	Second year	Spring of second year	Spring of third year
Total	3.12	**3.23**	3.13	**3.29**	3.56	**3.67**	3.56	**3.69**	2.68	**2.82**	2.69	**2.89**
90% or more	3.29	**3.39**	3.29	**3.40**	3.62	**3.85**	3.62	**3.85**	2.93	2.95	2.93	2.95
60–90%	3.10	2.99	3.11	2.99	3.57	3.40	3.58	3.40	2.60	2.61	2.61	2.61
30–60%	2.89	**3.06**	2.91	**3.21**	3.40	3.44	3.40	3.50	2.46	**2.72**	2.46	**2.92**
Less than 30%	2.70	**3.04**	2.70	**3.04**	3.44	3.48	3.44	3.48	2.43	2.35	2.43	2.35

Note: Numbers with a statistically significant difference are highlighted in yellow, with larger numbers written in red (significance level of 5%).

Table 4: Comparison of importance awareness (math)

Rate of university applicants	Total				Science course				Humanities course			
	Decision timing		Seperation timing		Decision timing		Seperation timing		Decision timing		Seperation timing	
	First year	Second year	Spring of second year	Spring of third year	First year	Second year	Spring of second year	Spring of third year	First year	Second year	Spring of second year	Spring of third year
Total	2.63	**2.71**	2.64	**2.74**	2.87	2.94	2.87	**2.96**	2.39	**2.50**	2.40	**2.53**
90% or more	2.68	2.71	2.68	2.72	2.90	2.95	2.90	2.96	2.44	2.48	2.45	2.48
60–90%	2.60	2.78	2.61	2.78	2.85	2.86	2.86	2.86	2.34	**2.71**	2.35	**2.71**
30–60%	2.61	**2.71**	2.61	**2.81**	2.86	2.95	2.86	**3.01**	2.39	**2.51**	2.39	**2.61**
Less than 30%	2.61	2.68	2.61	2.68	2.92	2.82	2.92	2.82	2.50	2.48	2.50	2.48

Note: Numbers with a statistically significant difference are highlighted in yellow, with larger numbers written in red (significance level of 5%).

Table 5: Comparison of the change in favorability (favorability during high school – favorability during junior high school) (math)

Rate of university applicants	Total				Science course				Humanities course			
	Decision timing		Seperation timing		Decision timing		Seperation timing		Decision timing		Seperation timing	
	First year	Second year	Spring of second year	Spring of third year	First year	Second year	Spring of second year	Spring of third year	First year	Second year	Spring of second year	Spring of third year
Total	−0.24	**−0.16**	−0.24	**−0.16**	−0.25	−0.17	−0.25	−0.17	−0.23	−0.15	−0.23	−0.15
90% or more	−0.29	−0.21	−0.29	−0.21	−0.30	−0.20	−0.30	−0.20	−0.29	−0.22	−0.29	−0.22
60–90%	−0.24	−0.32	−0.24	−0.32	−0.24	−0.34	−0.24	−0.34	−0.25	−0.29	−0.25	−0.29
30–60%	−0.16	−0.12	−0.16	−0.12	−0.19	−0.17	−0.19	−0.17	−0.14	−0.08	−0.14	−0.08
Less than 30%	0.12	0.24	0.12	0.24	0.14	0.21	0.14	0.21	0.11	0.29	0.11	0.29

Note: Numbers with a statistically significant difference are highlighted in yellow, with larger numbers written in red (significance level of 5%).

Figure 7: Clarity of career ambition

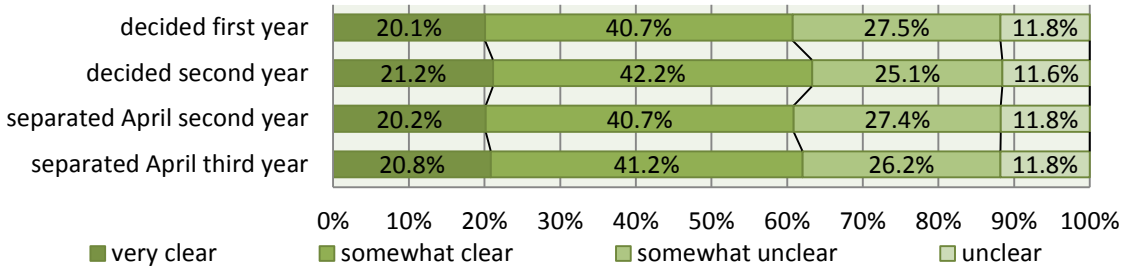
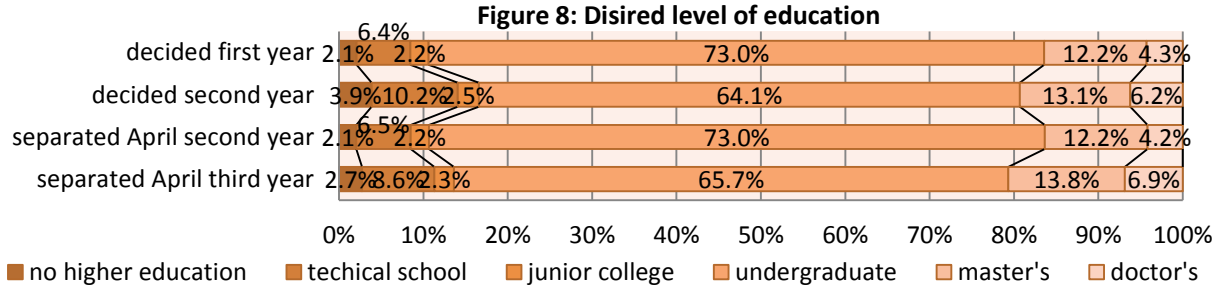


Figure 8: Disired level of education



c) Summary of the additional analysis

- Looking at the result of (a) and (b) above, which analyzes the difference by **the presence and timing of course separation**, it seems that **the practice of course separation has more advantages** in fostering favorability, importance awareness, and career consciousness. Moreover, for the schools with course separation, it seems better to **make decision during the second year and start in April of the third year, compared to making decision during the first year and start in April of the second year**.

  (Note) This analysis does not include students' academic abilities of each subject and actual record of admission to higher education.

- Letting students make decision earlier, or deciding their course during the first year and starting in April of the second year, might have been considered one way to help students prepare for and be conscious of their future career. However, **the analysis of students' attitudes toward study subjects and their career consciousness shows that it is not always effective**. It implies that it is important to consider a better way of helping students develop their career consciousness and to improve teachers' instruction of each subject.

(2) Summary of the Field Survey Based on the Nationwide Survey

Below is the summary of activties we found during the field survey, which seems to be effective for the improving students' awareness.

	New activities	Existing activities
A: Issues related to curriculum	- effort to develop general skills - effort to make more comprehensible classes - emphasis on hands-on experience	- student-centered learning guidance - development of students' ability to propound questions - thorough instruction until students completely understand - consideration for slow-learning students - emphasis on research activities - establishment of basic study habit - thorough instruction in writing - clearer class objectives
B: Issues related to external cooperation and others	- lectures for junior high school students by university teachers on their research topics - project-type learning on familiar issues	- information sharing with the community and parents - tighter cooperation with families - meeting with parents, home visit
Issues related to both A and B	- strong spirit that the community is responsible for children's growth - experiential research projects (including the humanities course)	・no left-out student (extra teaching sessions, personal instructions, frequent exams, correspondence correction, quizzes) - experiential visit to universities and companies - trust development between teachers and students

The outcome of the field study and suggestions from the open seminar are summarized below.

[Efforts to develop general skills]

- Many schools cherish Japanese language.

(felicitous exchange of language in class between teachers and students and among students, class management and development that construct knowledge with sensible use of language, school culture of "talk thoroughly," clever correspondence correction and precise comments, student speech contests as a school event)

- Schools consciously try to develop and utilize logical thinking ability in all subject classes.

(shared pleasure of deep thinking, school culture, presentation of a research project)

[Efforts to provide detailed instructions to make students completely understand]

- Schools provide careful instructions to have detailed classes that make students completely understand (accepting others, considerations for slow-learning students, accepting failure). It should be also noted that these schools have a good relationship among teachers.

[Emphasis on hands-on activities to make students feel the importance of learning]

- Schools put emphasis on hands-on activities that make students feel the importance of learning, and they conduct cooperative activities in which students' proactive learning is respected while they work with others.