COMPARING QUESTIONNAIRE RESULTS AND LEARNING OUTCOMES IN CLINICAL LABORATORY TRAINING PROGRAMS TO SUPPORT LEARNING IN JAPAN

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ABSTRACT: In Japan, the Ministry of Education, Culture, Sports, Science, and Technology requires every university to complete a learning behavior survey, assess the results, and disclose this information as part of the university's evaluation. This study examines the correlation between the results of the analysis conducted in a university for medical technologists and their learning outcomes, including GPA, graduation exam scores, and national exam scores. The learning behavior survey conducted in March 2020 included 345 participants studying medical technology. In total, 20 items were categorized based on seven factors. The results for the senior students were collated with their GPA scores, graduation exam scores, and national examination scores through factor analysis and multiple regression analysis using their scores and the factor scores. The results revealed that as students advance to upper grades, their efforts toward studying, such as study time, increase; however, no simple correlation exists between the increased study time and the resulting achievement. The medical technologist national exam scores were found to have a strong, positive correlation to three factors: effective use of leisure time, living environment, and observance of deadlines. The learning behavior survey analysis offers suggestions for students on the actions they must take to pass the national medical technologist exam.

KEYWORDS: *Universities; Students; Factor analysis; Surveys and Questionnaires; Regression analysis.*

1.0 INTRODUCTION

Higher education institutions in Japan include four-year universities and two-year and three-year junior colleges. Four-year universities award bachelor's degrees to university seniors, while junior colleges award associate's degrees and primarily provide vocational training. Students must graduate from a four-year university or a three-year junior college to take the national medical technologist examination. The enrollment rates for four-year universities and junior colleges were 45.1% and 54.8% in 2003 and 2017, respectively. While these rates have hardly changed since 2017, the number of four-year universities has increased from 669 in 2001 to 780 in 2017 [1].

In light of this, considering how to improve and maintain the quality of higher education is an urgent issue in university management. Since 2004, the government has required four-year universities, junior colleges, and technology colleges to be evaluated every seven years by an agency certified by the Ministry of Education, Culture, Sports, Science, and Technology. The ministry also requires that each university perform a learning behavior survey (using student questionnaires), tabulate the results, and make the results available to the public to aid high school students in choosing a university to attend.

In Japan, a national qualification is necessary to become a medical technologist. Medical technologists work at hospitals in Japan and conduct laboratory tests, such as blood tests, pathological tests, biochemical tests, microbiological tests, and tests for blood type at the time of blood transfusion. In addition, they conduct physiological function tests, such as electrocardiography, electroencephalography, and respiratory function tests. To take the national exam, candidates must graduate from a professional four-year university or a three-year college program. Currently, Japan has nearly 120 professional universities or colleges in total, and nearly 5,000 students take this national exam every year [2]. In 2020, the pass rate for the exam was 71.5%, with most universities working to increase the rate. Understanding the relationship between the national examination scores and the results of the learning behavior survey can help universities and colleges determine how best to increase the pass rate.

This study aimed to determine how students should be supported to pass the national examination of medical technologists. This was undertaken through a comparison of questionnaire results of

university students in all grades, factor analysis of the questionnaire results of fourth-year students (seniors), and multiple regression analysis of the factors and learning outcomes, including the GPA and the graduation exam scores, and the national exam scores.

2.0 METHODOLOGY

2.1 Questionnaire Target and Rating Items

The learning behavior survey using questionnaires was conducted in March 2020 (before COVID-19) at a university in Tokyo on 345 students studying medical technology: 99 first-year students (freshmen), 85 second-year students (sophomores), 90 third-year students (juniors), and 71 senior students. The results for the senior students were collated with their GPA, graduation, and national examination scores. Twenty rating items in total were utilized, and the evaluation criteria for each question are shown in Table 1.

Table 1: Results of the questionnaire graded on a 5-point Likert-type scale (mean±SD)

Item		Mean ± SD			
		Freshmen N=99	Sophomores N=85	Juniors N=90	Seniors N=71
Q1: 1: ≧8 hours, 2: ≧6 hours, 3: ≧4 hours, 4: ≧2 hours, 5: <2 hours	1: ≧8 hours, 2: ≧6 hours, 3: ≧4 hours, 4: ≧2 hours, 5: <2 hours	4.51 ± .05 a b	4.59 ± .07 a b	3.84 ± .10 c d	3.75 ± .12 c d
Q2: 1: Everyday, 2: Sometimes, 3: Only before the exam period, 4:Not study	1: Everyday, 2: Sometimes, 3: Only before the exam period, 4: Not	2.30 ± .07 a d	2.68 ± .10 b c	2.51 ± .08 c	2.26 ± .12 d
Q3: 1: Everyday, 2: Sometimes, 3: Hardly, 4: Not	1: Everyday, 2: Sometimes, 3: Hardly, 4: Not	3.70 ± .06 a b d	3.53 ± .07 a b c	1.90 ± .08 b c d	1.32 ± .07 a c d
Q4: 1: ≧5 days/week, 2: 4 days/week, 3: 3 days/week, 4: 2 days/week, 5: 1 day/week, 6: Not	1: ≧5 days/week, 2: 4 days/week, 3: 3 days/week, 4: 2 days/week, 5: 1 day/week, 6: Not	5.83 ± .04 a b	5.71 ± .08 a b	1.90 ± .08 c d	1.32 ± .07 c d
Q5: 1: Everyday, 2: Sometimes, 3: Hardly, 4: Not	1: Everyday, 2: Sometimes, 3: Hardly, 4: Not	2.45 ± .09 b	2.59 ± .11 a	2.30 ± .09 b d	2.80 ± .13 a c
Q6: 1: Greatly	1: Greatly increased, 2:	1.75 ± .05	1.85 ± .05	1.82 ± .06	1.59 ± .07

increased, 2: Increased, 3: Not changed, 4: Decreased, 5: Greatly decreased	Increased, 3: Not changed, 4: Decreased, 5: Greatly decreased	b	b	b	a c d
Q7: 1: Greatly increased, 2: Increased, 3: Not changed, 4: Decreased, 5: Greatly decreased	1: Greatly increased, 2: Increased, 3: Not changed, 4: Decreased, 5: Greatly decreased	2.18 ± .05 a b	2.06 ± .05 a b	1.76 ± .05 b c d	1.48 ± .06 a c d
Q8: 1: Greatly increased, 2: Increased, 3: Not changed, 4: Decreased, 5: Greatly decreased	1: Greatly increased, 2: Increased, 3: Not changed, 4: Decreased, 5: Greatly decreased	1.74 ± .05	1.87 ± .05 a b	1.67 ± .05 d	1.58 ± .07 d
Q9: 1: ≧5 days/week, 2: 4 days/week, 3: 3 days/week, 4: 2 days/week, 5: 1 day/week, 6: Not	1: ≧5 days/week, 2: 4 days/week, 3: 3 days/week, 4: 2 days/week, 5: 1 day/week, 6: Not	4.01 ± .15 a b	3.99 ± .15 a b	4.94 ± .11 c d	5.15 ± .13 c d
Q10: 1: ≧5 days/week, 2: 4 days/week, 3: 3 days/week, 4: 2 days/week, 5: 1 day/week, 6: Not	1: ≧5 days/week, 2: 4 days/week, 3: 3 days/week, 4: 2 days/week, 5: 1 day/week, 6: Not	5.30 ± .08 b d	4.88 ± .13 a b c	5.50 ± .11 d	5.75 ± .11 c d
Q11: 1: ≧5 days/week, 2: 4 days/week, 3: 3 days/week, 4: 2 days/week, 5: 1 day/week, 6: Not	1: ≧5 days/week, 2: 4 days/week, 3: 3 days/week, 4: 2 days/week, 5: 1 day/week, 6: Not	5.93 ± .03 d	5.59 ± .08 a c	5.82 ± .06 d	5.82 ± .09
Q12: 1: Everyday, 2: Sometimes, 3: Hardly, 4: Not	1: Everyday, 2: Sometimes, 3: Hardly, 4: Not	3.76 ± .05 a b	3.72 ± .07 a b	3.28 ± .09 c d	3.17 ± .11 c d
Q13: 1: ≧5 days/week, 2: 4 days/week, 3: 3 days/week, 4: 2 days/week, 5: 1 day/week, 6: Not	1: ≧5 days/week, 2: 4 days/week, 3: 3 days/week, 4: 2 days/week, 5: 1 day/week, 6: Not	5.92 ± .03 a d	5.46 ± .09 a c	5.74 ± .08 c d	5.70 ± .13
Q14: 1: Everyday, 2: Sometimes, 3: Hardly, 4: Not	1: Everyday, 2: Sometimes, 3: Hardly, 4: Not	3.66 ± .06 b	3.67 ± .06 b	3.62 ± .06 b	3.37 ± .09 a c d
Q15: 1: Live with parents, 2: Live alone, 3: Live at	1: Live with parents, 2: Live alone, 3: Live at dormitory, 4: Other	1.28 ± .05	1.21 ± .05 b	1.17 ± .05 b	1.38 ± .07 a d

dormitory, 4: Other					
Q16: 1: <30 min, 2: <60 min. 3: <90 min. 4: <120 min. 5: >120 min.	1: <30 min, 2: <60 min. 3: <90 min. 4: <120 min. 5: >120 min.	2.68 ± .12 b	2.68 ± .13 b	2.75 ± .11 b	2.26 ± .13 a c d
Q17: 1: Yes, 2: No	1: Yes, 2: No	1.28 ± .05 b	1.26 ± .05 b	1.24 ± .05 b	1.46 ± .06 a, b, c
Q18: 1: Yes, 2: No	1: Yes, 2: No	1.32 ± .05	1.36 ± .05	1.31 ± .05	1.37 ± .06
Q19: 1: Yes, 2: No	1: Yes, 2: No	1.02 ± .01	1.05 ± .02	1.01 ± .01 b	1.08 ± .03 a
Q20: 1: Submitted within the deadline, 2: Could not submit within the deadline, 3: No documents submitted	1: Submitted within the deadline, 2: Could not submit within the deadline, 3: No documents submitted	1.29 ± .07 b	1.42 ± .08 a b	1.19 ± .06 d	1.08 ± .04 c d

By referring to Table 1, data marked with "a" show a significant difference (P<0.05) in comparison with the data of "A junior"; data marked with "b" indicate a significant difference (P<0.05) in comparison with the data of "A senior"; data marked with "c" demonstrate a significant difference (P<0.05) in comparison with data of "A freshmen"; and data marked with "d" show a significant difference (P<0.05) in comparison with the data of "A sophomore."

2.2 Analysis

First, the questionnaire survey results were compared for each grade. Second, the factor analysis of the survey results for all the seniors was performed. Third, using the factor scores calculated from the 20 questions as independent variables, a multiple regression analysis was performed with the GPA score, graduation test results, or national exam score as the dependent variable. The relationship between the questionnaire and academic results was statistically examined. The factor analysis was performed on the learning behavior survey conducted in March 2020.

2.3 Statistical Analysis

IBM SPSS Statistics Version 22 was used for data storage, tabulation, and statistics generation. The data were also analyzed by factor and

regression analysis. The principal factor and varimax rotation methods were used to analyze the results for all 20 questionnaire survey items (listed in Table 2).

Table 2: Standardized regression weights of items on first-order factors and squared multiple correlations of predictors (principal factor method with varimax rotation)

	Factors*							h^{2*}
	F1	F2	F3	F4	F5	F6	F7	
Q1	0.82							0.75
Q2	0.74							0.63
Q3	0.62							0.46
Q4	0.54							0.55
Q5	0.37							0.29
Q6		0.90						0.84
Q7		0.83						0.77
Q8		0.76						0.60
Q9			0.77					0.70
Q10			0.62					0.48
Q11			0.61					0.67
Q12				0.72				0.53
Q13				0.63				0.55
Q14				0.50				0.45
Q15					0.83			0.75
Q16					-0.81			0.74
Q17						0.73		0.60
Q18						0.53		0.37
Q19						0.53		0.39
Q20							0.71	0.53

Note: F1: Quantity of self-study; F2: Awareness that it has been achieved; F3: Effective use of time other than study related to medical technology; F4: Collection of information; F5: Living environment; F6: Use of social media; F7: Observance of the deadline;
*h^2=communality

3.0 RESULTS

3.1 Questionnaire Survey

Table 1 presents the average value of the answers to each question. The senior students' results were significantly higher for most items than those in other grades. In other words, the higher the grade, the more enthusiastic the effort to study.

3.2 Factor Analysis of the Survey Results of Senior Students

A factor analysis was conducted on the questionnaire survey results to understand what factors affect student life. The Kaiser-Meyer-Olkin value of the scale for this analysis was 0.567, and Bartlett's test ($p < 0.00$) of sphericity was significant.

The factor analysis results are shown in Table 2. There were seven factors with a value over 1.00. One item, Q5, was excluded because its factor loading was less than 0.4. The seven factors, based on the theoretical structure, were as follows: Factor 1, the quantity of self-study (Q1 – Q4); Factor 2, awareness that it has been achieved (Q6 – Q8); Factor 3, effective use of leisure time (Q9 – Q11); Factor 4, collection of information (Q12 – Q14); Factor 5, the living environment (Q15 and Q16); Factor 6, use of social media (Q17 – Q19); and Factor 7, observance of deadlines.

3.3 Multiple Linear Regression Analysis

As shown in Table 3, Factor scores of 3, 5, and 7 had a significant ($p = 0.03$) association with the national examination score. The shorter the time spent on part-time work, club activities, and the lecture viewing system, the higher the national examination score tended to be ($p = 0.03$). However, the GPA and graduation exam scores were not related to these factors ($p > 0.05$; data not shown).

4.0 DISCUSSION

In this study, the results of the learning behavior survey completed by university medical technology students were collated with learning outcomes, such as GPA, graduation exam, and national examination

scores. The questionnaires consisted of 20 questions related to students' learning behavior. According to the results, the seniors spent the most time studying and felt that their knowledge had increased compared with the other students. Previous reports suggested that Japanese university students' average time studying at home for university lectures was 4.8, 5.4, 5.0, and 2.9 hours per week for freshmen, sophomores, juniors, and seniors, respectively [3].

Table 3: Results of the multiple regression analysis with the national examination score as the dependent variable

		Non-standardization coefficient			Standardization coefficient
		B	Standard error	p-value	β
F1	Quantity of self-study	1.53	1.54	0.32	0.13
F2	Awareness that it has been achieved	-1.73	1.48	0.25	0.15
F3	Effective use of leisure time	-3.51	1.52	0.03*	-0.29
F4	Collection of information	-1.54	1.68	0.36	-0.12
F5	Living environment	-3.55	1.58	0.03*	-0.28
F6	Use of social media	-1.11	1.70	0.52	-0.08
F7	Observance of deadline	4.15	1.90	0.03*	0.270

Note: *A significant effect on the national exam score

However, research shows that senior students spend more time studying on average [3]. Since they prioritize studying for the medical technologist national exam over research activities, study time tends to be longer as students' grade levels increase. Study time for freshman and sophomores varies greatly depending on the program of study. For example, 41% of freshmen and sophomore students in medical, dentistry, and pharmacy programs study for less than 5 hours/week, while 53.9% of freshmen and sophomore students in health-related fields such as nursing, medical technology, radiology, and nutrition, study for less than 5 hours/week. However, in Japan, the study time of students in social science and humanities programs tends to be the shortest: in these programs, over 80% and 66.3% of freshmen and sophomore students, respectively, study for less than 5 hours/week.

Further, students in health-related programs also tend to spend more time on graduation research than those in the social sciences and the humanities.

Using the questionnaire results of the senior students, factor analysis on the questions and correlation analysis using the factors and the academic performance, including GPA, graduation exam scores, and national examination scores, were performed to determine how to improve the learning effects at universities. It was confirmed that three of the seven extracted factors—effective use of leisure time, living environment, and compliance with promises (Factor 7)—were associated with national exam scores. Still, GPA scores and graduation exam scores were not associated with any factors. In particular, the length of study time did not directly affect the grades (Factor 1). Based on these results, how students use time effectively affects whether they pass the national exam, which affects the university's overall score.

5.0 CONCLUSION

The results in this study suggest that as students progress through the grades, they expend more effort on studying, such as increasing study time. Still, there was no simple correlation between increased study time and the final results. The national exam score for medical technologists was strongly correlated with three factors: effective use of leisure time, living environment of students, and observance of deadlines. The survey analysis results are expected to improve the passing rate of the national exam for medical technologists.

6.0 REFERENCES

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