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IMPACT OF INFORMATION LITERACY AND LEARNER CHARACTERISTICS ON LEARNING BEHAVIOR OF JAPANESE STUDENTS IN ONLINE COURSES

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Abstract

This paper investigated the effects of information literacy on learning behavior, and measured various indices of learner characteristics in fully online and hybrid courses at a Japanese university. In fully online courses, some factor scores for information literacy were found to be significantly higher in face-to-face than hybrid courses. The information literacy scores of masters students were also found to be significantly higher than bachelor students. Results of causal analyses indicate that operational skills (component of information literacy) affect the online learning experience of bachelor students, while for masters students, attitudes affect learning habits in online learning experiences. This paper also examined the role of information literacy in fully online and hybrid courses.

KEY WORDS: Online learning, learner characteristics, information literacy, fully online course, hybrid learning.

INTRODUCTION

There is an increasing and widespread use of online technologies for teaching and learning among universities around the world. Currently, the hybrid course format, which is a combination of online modules and traditional face-to-face sessions, is a popular way of integrating online technologies in the classroom. At the same time, many universities have started offering online courses and programs for academic credit. Credit courses that are fully online have advantages that benefit both students and professors, but challenges for the successful use of hybrid and fully online courses still exist. Moreover, factors like information literacy and student (learner) characteristics could influence how students perform and succeed in e-learning courses.

This study surveyed learner characteristics, information literacy and learning performance in hybrid or fully online credit courses, to test the hypothesis that learner characteristics affect their learning behavior and performance and to address the issue of improving online learning in university teaching. In this study, learner characteristics included motivation, personality, and thinking styles. The authors have been conducting studies on learner characteristics and learning performance since 2006 through analyses of relationships and path diagrams. Results from these previous studies suggest that learner's information

literacy level, which involves proficiency in information and communication technology (ICT) and information management, may also affect student-learning performance.

Specifically, this paper will address the following objectives:

- To examine the impact of information literacy on learning performance (e.g., course completion)
- To study the effects of information literacy on students' online learning experience
- To investigate correlations between information literacy and the characteristics of learners in online courses
- To identify and examine plausible causal paths to learning performance from these characteristics.

METHOD

SURVEY GROUP

Three credit courses, which were offered in spring term 2007, were selected for this survey project. The course title of the first two courses was "Information Society and Careers", a 2-unit bachelor-level class for university freshmen, with one course offered as a fully online course and the other, as hybrid course. Students could choose to attend either course, in accordance to their preference. For freshmen, this is one of the first courses they take upon entering the university. The third course was "Advanced Information Industries", a 2-unit master's class for students in their first year of graduate work. Most masters students have had some experience with hybrid courses during their bachelor years.

The same professor at a Japanese national university taught the three courses. The hybrid courses consisted of regular 15-week face-to-face sessions, supplemented with e-learning components in the form of online modules and tests. Students attended the face-to-face class and were also able to access the online content outside of class. The e-learning components were originally designed for a fully online course. The modules include video clips of the instructor and the lecture for that session, plus the presentation slides which were used in the face-to-face lecture. Most tests were conducted in the multiple-choice format. Learners can assess their responses and view their individual scores after completing the test. They are given as many opportunities as needed to retry and answer each question until they are satisfied with their own scores. This in turn motivated them to learn the course content well, using the accompanying video clips and presentation slides.

To encourage maximum participation in e-learning, students in the hybrid courses were given the opportunity to earn extra points. Their test scores on online modules counted towards their final grades in the course. Also, a student can make up for a class absence by taking and passing the online test that corresponded to the face-to-face class session that was missed. This encouraged the students to do the online modules and tests because missing a regular face-to-face class session often affected the students' final test scores and the evaluation of their learning experience. Most students are concerned about their performance and final grades. Thus, in these hybrid courses, online modules were counted as learning activities for the course and online test scores were also part of the grading system used for evaluating student final performance in the course. But more importantly, the online learning materials were designed to encourage students to maximize their learning. This means that the online modules for this course can serve as key learning tools for students.

SURVEY INSTRUMENTS

To extract learner characteristics among Japanese students, five constructs were surveyed, using the same constructs and questionnaires used in studies conducted in 2006 and 2007 [Nakayama et al., 2006, 2007a, 2007b]. These constructs were: motivation, personality, thinking styles, information literacy and self-assessment of online learning experience. Surveys on motivation, personality, and thinking styles were given only once, and that was at the beginning of the term. Surveys on information literacy and self assessment of online learning experience were given twice: first at the beginning of the term, and then again, at the end of the term.

There were 33 bachelor students enrolled in the fully online course, and 24 of these students completed the course. Twenty-two (22) of the 33 students completed the motivation, personality and

thinking style surveys. Twenty-four (24) of the 33 students completed the information literacy survey at the beginning of the term, and 10 out of these 24 students also completed the information literacy survey at the end of the term. There were 40 bachelor students enrolled in the hybrid course and all 40 of them completed the course. Thirty-seven (37) out of the 40 bachelor hybrid students completed all surveys (beginning and end of term). For the masters hybrid course, 81 students were enrolled, 78 completed the course, and 53 participated in all surveys.

Motivation

The motivation test inventory was developed by Kaufman and Agars [2005], and provided scores for "Intrinsic Motivation" and "Extrinsic Motivation" [Kaufman 2004].

Personality

For the second construct (personality), the International Personality Item Pool (IPIP) inventory was used. Goldberg [1999] lists five personality factors and for this construct, there were five component scores: "Extraversion", "Agreeableness", "Conscientiousness", "Neuroticism" and "Openness to Experience".

Thinking styles

Sternberg's functions of Thinking Styles had three components: "Legislative Style", "Executive Style" and "Judicial Style" [Sternberg, 1997; Matsumura & Hiruma, 2000]. Student scores for thinking styles were measured using this survey.

Information literacy

Information literacy is made up of various abilities, such as operational skills in information communication technology and knowledge of information science. Fujii [2007] defined and developed inventories for measuring information literacy. For this construct, the survey consisted of 32 question items, and 8 factors were extracted: interest and motivation, fundamental operation ability, information collecting ability, mathematical thinking ability, information control ability, applied operation ability, attitude, and knowledge and understanding. The total mean of factor scores was used to indicate each student's information literacy level. This inventory was originally developed to measure information literacy among high school students across international countries. It can also be used to measure the information literacy level of university students [Fujii 2007].

Learning experience

The fifth instrument that was used to measure students' online learning experience consisted of a 10-item Likert-type questionnaire. This questionnaire was administered twice: during the second week of the term and at the end of the course. This survey instrument has been used previously by the authors to measure learner's attitude, and has been analyzed for its validity. As in previous studies, three factors were extracted from this instrument: Factor 1 (F1): overall evaluation of e-learning experience, Factor 2 (F2): learning habits, and, Factor 3 (F3): learning strategies [Nakayama et al, 2006, 2007a, 2007b].

LEARNING PERFORMANCE

The students' final grade for the course was based on various learning activities, which included their final test scores, their learning attitude (as indicated by the number of class days attended), and their online course learning experience with modules and tests. Three indices were identified and used as indicators of learning performance: the number of days attended (NDA), the number of completed modules (NCM), and the online test scores (OTS). In particular, the number of days attended (NDA) is considered by most Japanese university students as a key factor that affects their final grade. Therefore, most students are very particular about their total class attendance. In the surveyed courses, both the number of completed modules (NCM) and the online test scores (OTS) were taken into account for NDA as mentioned earlier, and the participants had to pay attention to all indices: NDA, NCM and OTS. Also each student's final grade for the course (GRD) was analyzed. However, since most students passed the course, the deviation was quite small.

CULTURAL CHARACTERISTICS OF JAPANESE STUDENTS

The issue of cultural differences is often taken into consideration because a person's performance is often influenced by one's cultural background and country of origin. In this paper, all subjects are Japanese, so on the outset, and there are limitations, which should be taken into consideration regarding the generalizability of the results of the study. Moreover, being able to identify common Japanese characteristics can still pose difficult challenges. During the development of the survey instruments for this study, even the results of the survey depended on and were limited by the pilot group's characteristics. Therefore results of this survey are to be considered as a case report. For personality measures, while the authors were able to use a Japanese version of IPIP, Japanese psychologists agree that there is still a need for personality inventories designed specifically for Japanese subjects [Wada, 1996; Murakami & Murakami, 2001].

A motivation study by Itoh [1995] noted the following as typical Japanese characteristic: most Japanese put emphasis on effort as competence, so many carry the belief that effort provides good results and that effort is a virtue. Therefore the number of school days attended by a student can be considered and evaluated, for example, as an index of that student's effort for learning. Our previous survey showed that conscientiousness sometimes plays a major role as a factor that affects learning. [Nakayama et al., 2006, 2007a, 2007b].

Matumura & Hiruma [2000] surveyed Japanese university students using Sternberg's thinking style inventories, and they suggest that there are significant differences between groups. Those groups are categorized by gender (male vs. female) and areas of discipline (science, humanities and arts). In Japanese universities, individual aptitude is often associated with a student's choice of major discipline (science and technology vs. humanities). Japanese people believe that university students in specific major disciplines often possess common or typical learner characteristics. There is also common belief that students in science and technology areas have high levels of information literacy because information literacy is closely related to the computer science field, and that these students will find it easier to learn with online learning materials. Therefore, students' discipline area was also considered in this survey.

RESULTS

INFORMATION LITERACY AND LEARNER CHARACTERISTICS

Data that was collected from 37 bachelor students (hybrid) and 53 masters students (hybrid) who participated and completed the surveys given at the beginning and the end of the term was used for the following analysis. Responses from fully online bachelor students were excluded due to the small number (n=10) who completed both surveys (beginning and end of term).

For information literacy, eight (8) factor scores were calculated accordingly, using factor analysis (Fujii 2007). To determine the impact of information literacy on learner characteristics, correlation analysis was conducted between information literacy scores and the scores for motivation, personality, and thinking styles. The average of these eight (8) factor scores for information literacy was defined as total score. Correlation coefficients for students who participated in all surveys (except fully online students) are summarized in Table 1, with significant coefficients printed in boldface. Results indicate significant correlation coefficients ($p<0.05$) between information literacy and three personality constructs (conscientiousness, neuroticism, and openness to experience), and between information literacy and all thinking styles (legislative, executive and judicial), although in the case of coefficients between total of information literacy and constructs, the significant coefficients were small, mostly between 0.22 and 0.40. No significant relationship was found with motivation scores. The coefficients were relatively small for operational ability (fundamental and applied operational ability, IL-2 and IL-6 in Table 1).

It is interesting to note that some factor scores for information literacy were found in this study to correlate with scores of personality and thinking styles. Since results indicated that the coefficient for conscientiousness was the highest among all coefficients between information literacy and the constructs, then conscientiousness as a learner characteristic could have an effect on students' information literacy. In previous studies [Nakayama et al., 2006, 2007a, 2007b], it was also reported that there are significant correlation coefficients on conscientiousness in Japanese students' behaviors and this is consistent with

findings reported in Table 1. This continues to support the assumption that conscientiousness could be a key factor in online learning.

TABLE 1
CORRELATION COEFFICIENTS MATRIX BETWEEN INFORMATION LITERACY AND THREE METRICS

	IL-1	IL-2	IL-3	IL-4	IL-5	IL-6	IL-7	IL-8	total
Intrinsic motivation	0.14	0.08	0.07	-0.14	0.15	-0.04	0.09	0.07	0.08
Extrinsic motivation	**0.22**	0.08	0.05	0.07	0.18	0.03	0.17	0.07	0.18
Extraversion	0.07	-0.72	0.06	0.11	**0.27**	-0.13	0.08	-0.09	0.06
Agreeableness	0.05	0.02	0.05	0.05	0.11	-0.11	**0.27**	-0.07	0.07
Conscientiousness	0.18	0.13	**0.27**	**0.28**	**0.54**	-0.11	**0.37**	**0.27**	**0.40**
Neuroticism	0.08	0.12	0.19	**0.32**	0.12	0.17	**0.22**	-0.02	**0.26**
Openness to Experience	0.16	0.04	**0.39**	0.17	**0.21**	-0.01	0.09	**0.21**	**0.26**
Legislative style	0.16	0.18	**0.36**	**0.25**	0.19	0.08	0.04	**0.22**	**0.31**
Executive style	**0.24**	**0.24**	-0.06	**0.27**	0.02	0.05	0.09	0.17	**0.22**
Judicial style	**0.25**	0.14	**0.44**	**0.28**	**0.21**	0.05	0.15	**0.28**	**0.37**

Information literacy (IL) -1:interest and motivation, 2:fundamental operation ability, 3:information collecting ability, 4:mathematical thinking ability, 5:information control ability, 6:applied operation ability, 7:attitude, 8:knowledge and understanding

INFORMATION LITERACY AND COURSE COMPLETION

At beginning of the term, 24 out of the 33 bachelor students who were enrolled in the fully online course participated in the information literacy survey. Students in this course had to learn everything online, so they had to be highly competent in information literacy. There were interesting information literacy abilities that emerged among learners who chose to attend the fully online course instead of the hybrid course. Using the scores from the information literacy survey given at the beginning of the course, the abilities of the 24 fully online participants were compared with bachelor students in the hybrid course (N=37). Comparison results for the two groups are given in Figure 1.

Five out of eight factor scores for information literacy in the fully online group were higher than in the hybrid course. There were significant differences in mathematical thinking ability, applied operation ability, knowledge and understanding ($p<0.05$), and interest and motivation ($p<0.10$). Factor score for information control ability in the hybrid course was significantly higher than the fully online group. This suggests an increased likelihood among bachelor students who have gained some confidence in their use of information technology to take a fully online course rather than a hybrid course.

One interesting result found among students in the fully online course is that only 24 out of 33 students completed and earned credit for that course, while in the hybrid courses, 40 out of 40 bachelor students and 78 out of 81 masters students completed the hybrid course. Another interesting result is the difference in learner characteristics between "completers" (students who completed the course) and "non-completers" (students who did not complete the course). The scores for learner characteristics were compared between these two groups. Comparison results suggest that the score on Conscientiousness for completers is higher than for non-completers ($p<0.10$). Also, there is no significant difference in scores between completers in fully online course and hybrid course at the end of term. Completers' scores increased as they progressed through the course. This suggests that the quality of their learning experience underwent a positive change during the course.

FIGURE 1
COMPARISON OF INFORMATION LITERACY SCORES BETWEEN STUDENTS IN FULLY ONLINE AND HYBRID COURSES AT THE BEGINNING OF THE TERM

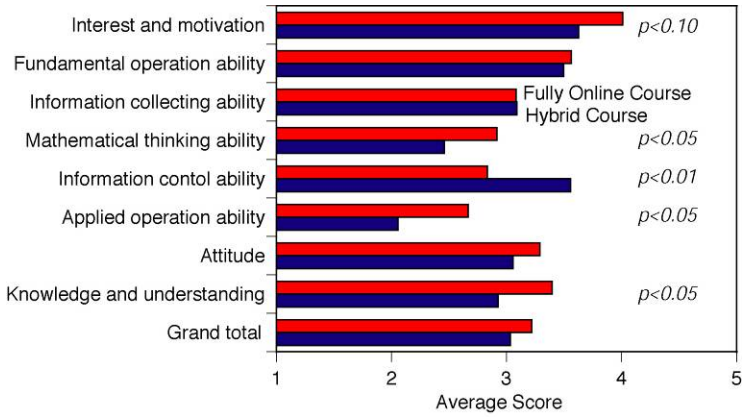
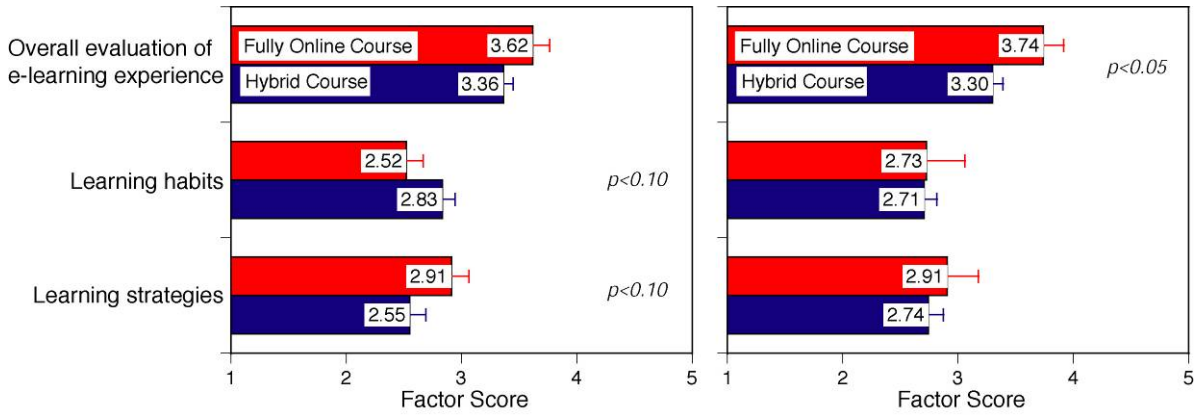


FIGURE 2
COMPARISON OF LEARNING EXPERIENCE SCORES BETWEEN STUDENTS IN FULLY ONLINE AND IN HYBRID COURSE AT THE BEGINNING (A: LEFT SIDE) AND END OF TERM (B: RIGHT SIDE)



Differences in students' learning experience in hybrid versus fully online courses were identified using three factor scores -- F1: overall evaluation of e-learning experience, F2: learning habits, and, F3: learning strategies. These were compared between completers in fully online course and in hybrid course, both at the beginning (n=24 for online; n=37 for hybrid) and the end (n=10 for online; n=37 for hybrid) of the term. Results are summarized in Figure 2(a) for beginning of the term and Figure 2(b) for end of the term. In the fully online course, 24 out of the 33 registered bachelor students took the first survey at the beginning of the term, and only ten (10) out of these 24 students also participated in the second survey at end of the term. It is a given that the scores at the beginning of the term will include both completers and non-completers, and the scores at the end of term will include only 10 completers. There was no difference in the factor score for "overall evaluation of e-learning experience" at the beginning of the term. This can be attributed to the fact that this is the students' first experience in e-learning. There are differences in scores for Factors 2 and 3 between fully online and hybrid courses ($p<0.10$), as shown in Figure 2(a). For students in the fully online course, the score for learning habits is lower, and the score for learning strategies is higher than the ones for the hybrid course.

According to Figure 2(b), completers evaluated the fully online course materials more positively than those who used hybrid course online materials ($p<0.05$). Also, there are no significant differences in scores for Factors 2 and 3. These results suggest that non-completers in fully online course possess less sufficient learning habits and only a few learning strategies, a trend found among bachelor students whose learning experience did not change throughout course.

INFORMATION LITERACY AND LEARNING EXPERIENCE

When comparing scores between bachelor (n=37) and masters (n=53) students in hybrid courses at beginning of the term, results show significant differences in their information literacy abilities, as indicated in Figure 3. Scores for masters students are significantly higher than bachelor students in the following: fundamental operation ability, mathematical thinking ability, applied operation ability, knowledge and understanding, and overall information literacy level (significance level at $p<0.01$). This suggests that masters students have more advanced abilities in information literacy than bachelor students. Bachelor students did gain some fundamental skills throughout the term, thus their score for fundamental operation ability significantly increased at the end of term ($p<0.01$). Masters students' scores did not change during the course.

FIGURE 3
COMPARISON OF INFORMATION LITERACY BETWEEN BACHELOR AND MASTERS STUDENTS IN HYBRID COURSE AT THE BEGINNING OF THE TERM

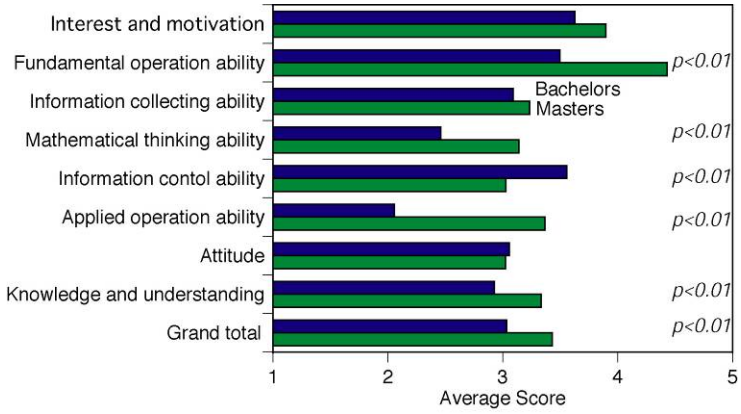
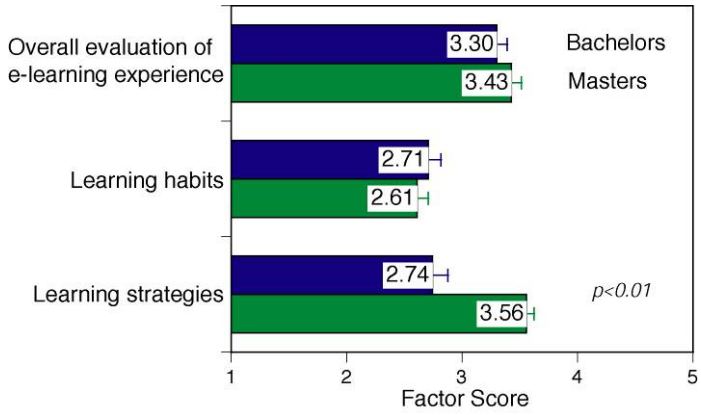


FIGURE 4
COMPARISON OF LEARNING EXPERIENCE SCORES BETWEEN BACHELOR AND MASTERS STUDENTS IN HYBRID COURSE AT THE END OF THE TERM



In analyzing the students' evaluation of their learning experience in a hybrid course at the end of the term, three factor scores from the same number of bachelor and masters students were compared (see Figure 4). Factor 1 scores (overall evaluation of e-learning experience) for both bachelor and masters students are above the midpoint. On the other hand, the evaluation score for Factor 2, learning habits, is less than 3. For Factor 3, there is significant difference in scores for learning strategies and this is consistent with results from previous studies by the authors [Nakayama et al., 2006, 2007a, 2007b] which indicated that masters students are already familiar with skills needed for university courses and university studies.

To determine the relationship between information literacy at beginning of the term and online learning experience at the end of the term, correlation analysis was conducted. It was hypothesized that the development of information literacy abilities could be related to or can be affected by one's online learning experience. In examining the relationship between information literacy and online learning experience as shown in Table 2, there exists some significant correlation relationships, especially for Factor 2: learning habits, and for overall information literacy in the hybrid course (bachelors: r=0.46; masters: r=0.47), as well as the fully online course (r=0.64).

For the hybrid course, the information literacy level among bachelor students significantly correlates with the three factors for online experience. Additionally, factors for learner characteristics significantly correlate with the three online experience factors among masters students.

TABLE 2
CROSS CORRELATION MATRIX BETWEEN INFORMATION LITERACY AT BEGINNING OF THE TERM AND FACTOR SCORES OF ONLINE LEARNING EXPERIENCE AT THE END OF THE TERM

	Bachelors			Masters		
Information literacy	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
Interest and motivation	**0.55**	0.20	0.26	0.02	**0.27**	0.09
Fundamental operation	0.30	0.19	0.21	0.05	0.10	**0.37**
Information collecting	0.23	0.25	**0.42**	0.13	**0.54**	0.30
Mathematical thinking	0.27	**0.63**	**0.37**	0.09	0.26	-0.13
Information control	0.10	0.15	0.04	0.07	0.21	0.10
Applied operation	**0.34**	**0.33**	**0.44**	-0.10	0.14	-0.01
Attitude	0.16	0.05	0.00	0.05	0.22	0.01
Knowledge and understanding	0.26	**0.40**	0.13	-0.14	**0.37**	0.23
Grand total	**0.47**	**0.46**	**0.41**	0.04	**0.47**	0.20

Factor 1:overall evaluation of e-learning experience, Factor 2:learning habits,
Factor 3:learning strategies

INFORMATION LITERACY AND LEARNING PERFORMANCE

Bachelor students' scores on information literacy did not affect their learning performance, because those scores were mostly low. Scores for fundamental operational ability for masters students significantly correlate with the number of days attended (NDA) (r=0.41), the number of completed modules (NCM) (r=0.29), and the online test scores (OTS) (r=0.46). Based on their final grades, masters students were divided into two groups -- high and low. Scores for interest and motivation in information literacy for the high group are significantly higher than the ones for the low group ($p<0.05$). The results suggest that some degree of information literacy affects learning performance in the masters group. Overall, the

results suggest that information literacy affects learners behavior and learning performance in both fully online and hybrid courses.

SECONDARY FACTOR ANALYSIS

According to results, which were given in the previous section, learner characteristics correlate with information literacy, and information literacy also correlates with learning experience and learning performance. Nakayama et al. [2006, 2007a, 2007b] tried to explain those relationships using causal analysis. The hypothesis is that learner characteristics affect learning experience and learning performance, and that information literacy could also be affected by learner characteristics.

For this analysis, the first step was to reduce the number of variables for learner characteristics and information literacy. To carry this out, secondary factor analysis was conducted for the10 variables (2 for motivation, 5 for personality, 3 for thinking styles, for a total of 10). This resulted in extracting five (5) secondary factors [Nakayama et al., 2006]. The first factor “OLJ” consisted of “Openness to Experience", "Legislative Style" and "Judicial Style". The second factor “EAE” consisted of "Extraversion", "Agreeableness" and "Executive Style", which includes a factor of "positive emotionality" as "Extraversion" and "Agreeableness" [Five-Factor model, 2001]. The two motivation scores were summarized as "MOTIV", the third factor. The remaining two factors were the original “Conscientiousness” and "Neuroticism".

Secondary factor analysis was also conducted on the ten (10) factor scores for information literacy for all responses at beginning of the term, and as a result, two secondary factors were extracted using Promax rotation. The total contribution ratio is 0.34 (variance explained by each factor eliminating other factors). The factor pattern is shown in Table 3. The first secondary factor (IL-SF1) consists of “operational confidence and knowledge understanding”; the second one (IL-SF2) consists of “attitude issues”.

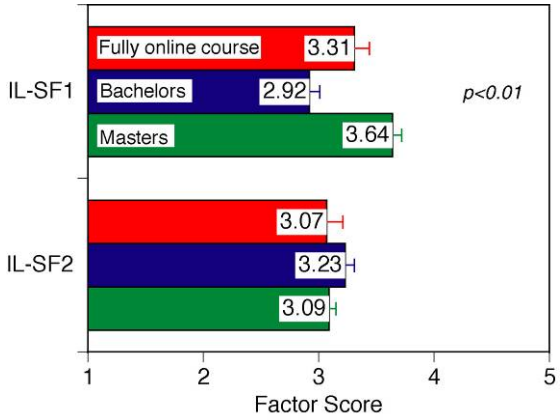
TABLE 3
FACTOR PATTERN OF SECONDARY FACTOR ANALYSIS FOR ALL PARTICIPANTS AT BEGINNING OF THE TERM

Information literacy	IL-SF1	IL-SF2
Interest and motivation	0.57	0.17
Fundamental operation	0.77	-0.15
Mathematical thinking	0.46	-0.09
Applied operation	0.75	-0.11
Knowledge and understanding	0.51	0.32
Information collecting	0.33	0.46
Information control	-0.16	0.54
Attitude	-0.06	0.56
Contribution	1.82	0.87
Contribution ratio	0.23	0.11
Axis correlation IL-SF1	1.00	-
IL-SF2	-0.35	1.00

There are some differences in information literacy among learners, i.e., between bachelor students who enrolled the fully online course or the hybrid course, and master students. There were originally 8 factors in information literacy, and there were some differences found among learners. The scores of the secondary factors are compared in Figure 5. In this analysis, all average scores were extracted at the beginning of the term, so the averages include non-completers. For the first secondary factor (IL-SF1) which consists of “operational confidence and knowledge understanding”, there were significant differences among the three groups ($F_{2,111}=19.7$, $p<0.01$), with scores increasing significantly among

bachelor students in the hybrid course to masters students. There is no significant difference in the other secondary factor (IL-SF2) which consists of attitude issues (F2,111)=0.8, p=0.47).

FIGURE 5
COMPARISON OF THE SECONDARY FACTOR SCORES OF INFORMATION LITERACY AMONG THREE LEARNING STYLES AT BEGINNING OF THE TERM (IL-SF1: OPERATIONAL CONFIDENCE AND KNOWLEDGE UNDERSTANDING; IL-SF2: ATTITUDE ISSUES)



Also, there were no significant differences in the remaining secondary factors, which were extracted using the above procedure. There was, however, some correlation relationship among them, so further analysis was done to determine those causal relationships.

CAUSAL RELATIONSHIP

To select significant variables revealing the relationship between metrics, a preliminary correlation analysis was conducted through trial and error. A causal model was created in accordance to the hypothesis and significant correlations. Using the structural equation modeling (SEM) technique [Toyoda, 1992], a causal path diagram emerged for hybrid learning among bachelors and masters students. Here, a hypothesis was made, based on the following causal relationship: learner's personality affects information literacy and learning experience, and that all learner characteristics affect online test scores (OTS) and other learning performance. To examine this hypothesis, the causal relationship was determined as follows.

The resulting path diagram is illustrated in Figure 6, and coefficients for each path are noted for bachelor and masters students. This figure suggests that three characteristics (OLJ, CONSC, NEURO) affect both information literacy secondary factors (IL-SF1 AND IL-SF2). The first factor, IL-SF1, affects all three learning experience factors (e-learning evaluation, learning strategies, and learning habits) but the second factor (IL-SF2) affects only "learning habit". When comparing path coefficients between bachelors and masters students, the IL-SF1 for bachelor students affects more strongly the three factors for learning experience than masters students. On the other hand, IL-SF2 for masters students has a strong effect only on learning habits. This suggests that operational skills in information literacy among bachelors affect mainly their learning experience, while among masters students, information literacy attitude affects their learning habits.

As indicated by the difference in the first group of secondary factor scores for information literacy (IL-SF1) in Figure 5, learner characteristics and information literacy also affect the students' learning experience in fully online course. However, it is difficult to consider a causal path diagram for fully online course, due to small samples and insufficient data on learning performance. Here, the data for completers and non-completers in fully online course were merged and analyzed to obtain the difference in the causal relationship among learning styles.

FIGURE 6
CAUSAL RELATIONSHIP FROM LEARNER'S CHARACTERISTICS TO LEARNING PERFORMANCE FOR BACHELOR AND MASTER STUDENTS

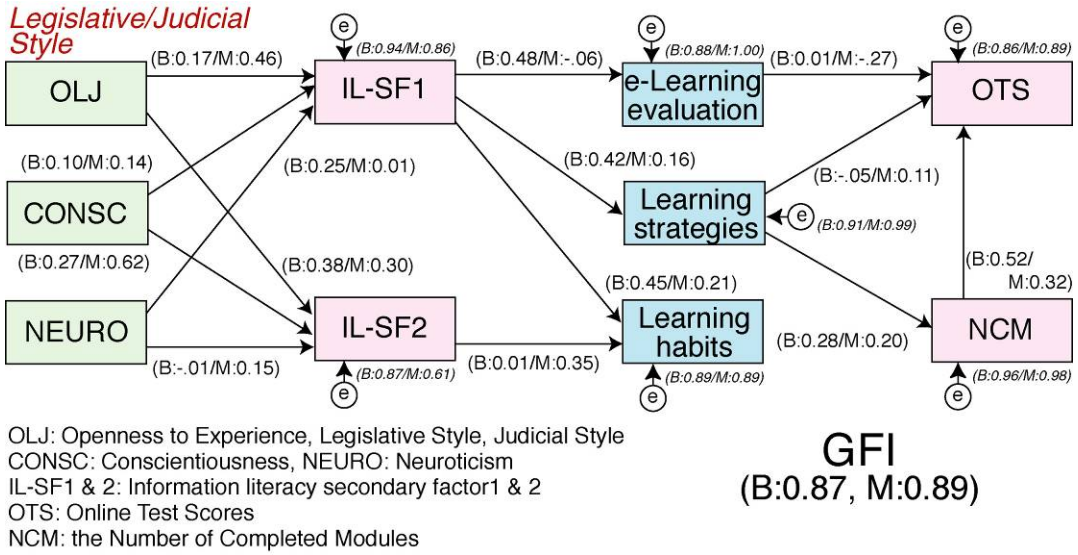
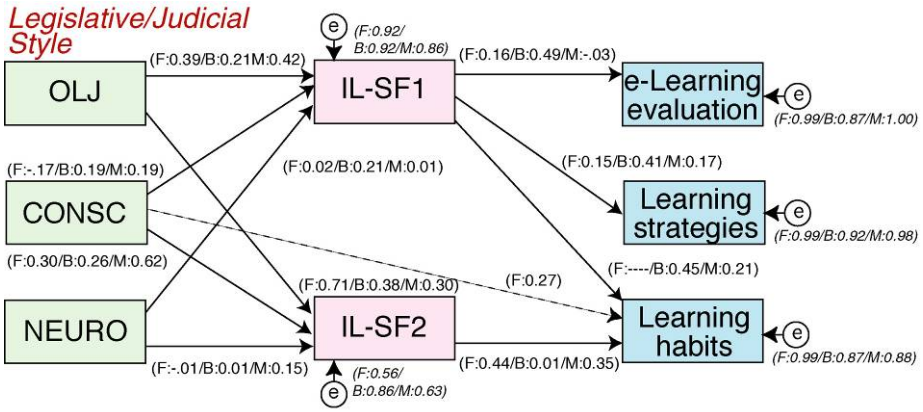


FIGURE 7
CAUSAL RELATIONSHIP FROM LEARNERS CHARACTERISTICS TO LEARNING EXPERIENCE AMONG THREE LEARNING STYLES (FULLY ONLINE COURSE, AND BACHELORS AND MASTERS IN HYBRID COURSE)



The data from 22 participants in the fully online course were included and analyzed, as well as the data from the other two learner groups of bachelor and master students in hybrid course. For participants in the fully online course who did not complete the second survey at the end of the term, their scores for learning experience were estimated using their scores from the first survey at the beginning of the term.

Data on learning performances were omitted in the analysis. Common possible paths were created, and the result of causal paths was illustrated in Figure 7. All GFIs are significant. The path coefficients were displayed as "(Fully Online / Bachelors / Masters)", the coefficients for bachelor and masters students were almost same as the values in Figure 6.

According to the path coefficients in fully online course, thinking style (OLJ) was one of the learner characteristics that affect two information literacy secondary factors (i.e., path coefficients for IL-SF1:0.39, IL-SF2:0.71), while “attitude issues” in information literacy (IL-SF2) affects “learning habits”. In particular, the path coefficient (0.71) from OLJ to IL-SF2 is the highest although the sample size is less than the sizes of the other two groups. Conscientiousness also affects both IL-SF2 (0.30) and "learning habits" (0.27), while IL-SF2 strongly affects "learning habits" (0.44). A path from IL-SF1 to "learning habits" was replaced with a direct path from "CONSC" to "learning habits" in the fully online course.

Although learners in the fully online course had high factor scores for the first group of secondary factors on information literacy (i.e., IL-SF1: “operational confidence and knowledge understanding”), and although more than half of them were non-completers, their personality, particularly their thinking styles, affected strongly their information literacy and learning habits. It appears that they have sufficient capability to learn with online modules. This trend may be significant for completers in the fully online course since there was no significant causal diagram for non-completers.

Non-completers therefore chose the fully online course rather than the hybrid course. The reason why most of them have been non-completers is not clear. Providing these learners with some form of support may help them complete the course. This type of support, however, should be designed and developed, while taking into consideration these results.

These findings suggest the kind of role that information literacy plays in different aspects of online learning among bachelor and masters students. Attitude issues in information literacy, in particular, were found to affect the learning habits of experienced online learners. These roles should be considered in the instructional design of online learning.

CONCLUSION

This paper investigated the impact of information literacy on learning behavior, and measured various indices of learners enrolled in fully online and hybrid courses in a Japanese university. The characteristics of bachelor students in a fully online course were determined using these indices and then compared with students in hybrid courses.

Information literacy (which consists of 8 factors) was found to correlate with personality factors and with thinking styles, and was also found to affect learning experience, particularly learning habits. When analyzing the information literacy abilities of students who took the fully online course, there were factor scores for information literacy that were significantly higher than in the hybrid course. This difference was found to affect student scores for learning experience, specifically learning strategies. The information literacy scores for masters students were significantly higher than among bachelors, with masters students having more advance abilities in information literacy. These points should be considered when designing and developing a fully online course.

Causal analysis was conducted using Structural Equation Modeling (SEM), and results indicate that operational skills as an information literacy factor affects the online learning experience of bachelor students while for masters students, attitude affected the learning habit factor in their online learning experience. This suggests that the maturity of learners and their information literacy level affect learning behavior. When causal analysis was extended to include the participants in the fully online course, the role that information literacy played in different aspects became evident.

The detailed analyses of the impact of information literacy on learning performance and how to create the appropriate support methodologies will be the subject of further studies. In particular, the long-term effects of e-learning on students who took this course should be examined quantitatively.

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ENDNOTES

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