IIAI Open Conference Publication Series
IIAI Letters on Institutional Research
Vol. 001, LIR016
DOI: https://doi.org/10.52731/lir.v001.016

Applicability of Existing Computer Literacy Education to Data Science Education

Takaaki Arahira [*], Yoshimitsu Hashizume [†]

Abstract

In accordance with the AI Strategy 2019 issued by the Cabinet Office, Kyushu Institute of Information Sciences has established and is operating the KIIS Mathematical and Data Science and AI Education Program at the literacy level and the applied basic level. In particular, the literacy level can be completed by all students, and is recommended for all students to acquire the basic data science knowledge necessary after employment. In this paper, we took up the subject of "Exercise of Information Literacy," which is positioned as an introductory course for data science education, and examined the possibility of its application to data science education for existing courses, using the report assignments in the lectures and the results of questionnaires. The results show that, in both departments, the final survey displayed higher marks than the initial survey, indicating that each student was able to master the lecture content and basic skills during the lecture. This brought about a certain level of educational effects in both humanities and sciences. Differences in data science backgrounds exist between humanities and science students, and it is important to fully take these into account in educational practices.

Keywords: mathematical, data science, AI, data science education

1 Introduction

In recent years, the development of computers has made it possible for companies to collect significant amounts of data. It has become necessary to process and judge such big data appropriately. In addition, the development of Artificial Intelligence (AI) is also coinciding with a major turning point in information literacy education at educational institutions. In other words, the ability to cope with and apply data science and AI is expected to become indispensable in the Society 5.0 of the future. “ Society 5.0 was proposed in the 5th Science and Technology Basic Plan as a future society that Japan should aspire to. It follows the hunting society (Society 1.0), agricultural society (Society 2.0), industrial society (Society 3.0), and information society (Society 4.0). The one of definition is “A human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space.””[1]

The Cabinet Office has formulated the AI Strategy 2019 with the aim of making AI permeate all people, industries, regions, and governments to overcome the challenges we face and pave the way for the future [2]. Based on this strategy, it has become a

[*] Kyushu Institute of Information Sciences, Dazaifu, Japan
[†] National Institute of Technology, Tokuyama College, Shunan, Japan

requirement to provide data science literacy education to all university students, both for humanities and sciences faculties. Various efforts have been made by universities to develop curricula and teaching materials for introducing data science education. Here, data science is "an academic discipline that processes and analyzes all types of data, not just big data, to extract useful information (value) from it." In particular, it deals with information science, statistics, algorithms, and other methods for handling data in a cross-sectional manner.

In 2017 and 2019, Shiga University established Japan's first Faculty of Data Science and Graduate School of Data Science, respectively. The curriculum in the Faculty of Data Science at Shiga University is based on five core areas: "problem-based learning", "data engineering", "data analysis", "value creation", and "investigation" [3]. In particular, in the introductory exercise of data science offered in the first year of undergraduate school, students experience the whole process of data analysis, "problem posing -data collection - analysis -presentation," at an early stage, so that they can acquire the basics of this discipline. In addition, the National institute of technology (KOSEN), Sasebo college conducts "Data Science Engineering" as a lecture as an introduction to data science education and provides data science education through the use of Excel as a tool for data analysis, as well as using official statistical data [4].

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) started a certification system for data science literacy levels in fiscal year 2021. In the first year, there were 78 accredited schools nationwide. There are several reasons why only about 10% of the universities in Japan applied for the certification: first, one year's the educational program operation achievement was required; second, all departments of university, including humanities departments, had to offer the course; and third, some universities decided that it would be difficult to implement data science education. In order to realize literacy education of data science for all university students, it is necessary to lower these difficulties.

In accordance with the AI Strategy 2019 issued by the Cabinet Office, the Kyushu Institute of Information Sciences (KIIS) has established a literacy level and an applied basic level as the KIIS Mathematical and Data Science and AI education program [5]. The literacy level is available to all students. It is also recommended for all learners because it enables them to acquire the basic data science background necessary after employment. In addition, the courses required for completion of the literacy level include courses that can be taken immediately after enrollment. One of them is "Information literacy exercise ". This subject is a course to educate students on computer literacy that had been offered before the implementation of the data science education program. Since the implementation of the Data Science Education Program, we have incorporated an introduction to data science education, such as the collection, analysis, and application of data, in this subject. Then, we have modified the subject content so that students can learn how to use computers and simultaneously learn about data science.

If the introduction of data science education into computer literacy education, which is already implemented in many universities, proves to be an effective means, it may lead to lowering the difficulty for implementing data science education on a university-wide basis. KIIS is a single faculty of more concerned with the humanities, with two departments, the Department of Management and Information Sciences and the Department of Information Networks. The purpose of this paper is to examine the possibility of applying the existing computer literacy education to data science education.

2 Materials and Method

2.1 Overview of traditional information literacy exercise

Information literacy exercise is a compulsory course offered in the first semester of the first year of undergraduate study. This subject aims at teaching basic skills mainly in typing techniques, basic computer operations, word processing software, spreadsheet software, and presentation software.

2.2 Contents of Data Science Education Introduced

The content of the data science education introduced at this time is "to experience how to collect, analyze, and apply real data". First, for data collection, we used the typing practice conducted in every lecture. We set aside about five minutes at the beginning of each class for typing practice and asked each student to record the number of keys typed per minute, as well as their typing speed. After completing the 15 lectures, the students were asked to visualize the data by tabulating and graphing them using spreadsheet software, which was learned in the computer literacy education. As a final report, the students were asked to write a report on their self-analysis and future tasks and goals based on the visualized data using word processing software.

2.3 Survey Contents

In this paper, based on the evaluation of data science education and the possibility of introducing data science education into computer literacy education, the following three points are examined.

First, as an indicator of the degree to which data science education was conveyed to students, we checked whether or not the five items shown in Table 1 were mentioned in the collected final reports. Then, we calculated the percentage of students who touched upon the items in each department (Management and Information Sciences: 18 students, Information Networks: 25 students).

Second, as an indicator to check whether the computer literacy education was not neglected, we conducted a questionnaire in eight items as shown in Table 3 to check the degree to which the students acquired the achievement objectives described in the syllabus in the first and fifteenth lectures. Each response to the questionnaire was scored on a scale of 0 to 10 (Management and Information Sciences: 18 students, Information Networks: 25 students).

Third, we examined the usefulness of the educational content that combines computer literacy education and data science literacy education as an introductory course for data science education. Employing the results of the questionnaire in 2021 (Information Networks: 25 students) and those in 2019 (Information Networks: 36 students) [6] as the same course before the implementation of our educational program, comparison and verification were conducted. The comparison and validation here were conducted for the Department of Information Networks.

Table 1: Faculty evaluation items for typing report assignments.

1	The table was used in typing report.
2	The figure was used in typing report.
3	The typing history was adequately explained by sentences.
4	The self-analysis and discussion were stated by using the typing history.
5	The future issues and prospects based on the typing history were described.

Table 2: Percentage of students who stated in the report assignment evaluation items. "Man Info" and "Info Net" mean students of "Department of Management and Information Sciences" and "the Department of Information Networks", respectively.

Item(Table 1)	1	2	3	4	5
Man Info(%)	93.8	75.0	68.8	43.8	25.0
Info Net(%)	88.0	68.0	80.0	56.0	72.0

Table 3: Questionnaire items for students in the first and fifteenth lectures.

1	How familiar are you with computers?
2	Can you type without looking at the keyboard?
3	How fast can you type?
4	How good are you at Word?
5	How good are you at Excel?
6	How good are you at Power point?
7	How familiar are you with information morality and security?
8	How familiar are you with our privacy practices?

3 Results and Discussion

Figure 1 shows a graph comparing the number of hits in the typing results. The values were higher in the final session than in the first one. There was no significant difference in this result among the departments. Therefore, it can be concluded that there is no significant difference in the quality of the students and the content of the lectures among the departments. Table 2 shows the percentage of students who fulfilled the descriptions in Table 1 for the report assignment on typing. The percentage of students who summarized their typing history in a table was more than 85% in both departments. On the other hand, only about 70% of the students in both departments used graphs to visualize their typing history. In both departments, there was a polarization between students who described both tables and graphs, as well as those who carefully summarized one or the other. Regarding the students who described the table and graph, more than 80% of the students in both departments described the table rather than the graph. The percentage of students who adequately described their typing history in writing was higher in the Department of Information Networks. Although a higher percentage of students in the Department of

Management and Information Sciences performed visualization of tables and graphs, they were insufficient in discursively explaining the facts. On the other hand, students in the Department of Information Networks gave appropriate explanations of the visualized tables and graphs in writing. Furthermore, in both items 4 and 5, the students in the Department of Information Networks were more able to analyze and apply factual data, such as typing history. On the other hand, students in the Department of Management and Information Sciences were not as proficient in analysis and application. From the descriptions in the report assignment and the results in Table 2, it can be considered that many students in the Department of Management and Information Sciences think that only visualizing the obtained data in tables and graphs is the way to explain them. On the other hand, in the Department of Information Network, many students try to supplement data visualization with written explanations. Given that there is no difference in the lectures among the departments supported by Fig. 1, it is thought that the difference between the Department of Management and Information Sciences, where the Department of Management and Information Sciences is a group of humanities students and the Department of Information Networks is a group of science students, is the reason behind said difference. The following measures can be taken to counter this discrepancy. In the case of humanities students, for example, visualized tables and graphs should be presented in advance, and students might have to be given time to explain to each other the facts and considerations that can be extracted from them. For science students, for example, the solution might be to present raw data and have them think about how to visualize the data in a way that is easy for a third party to understand, and then have them discuss the visualized data among themselves. In other words, by incorporating practical training instead of classroom lectures, both students may acquire the ability to devise ways to visualize and explain data appropriately. Furthermore, by slightly changing the starting point of the discussion between the humanities and the sciences, we may be able to enhance the educational effect.

Figure 2 shows the graphs of the results of the initial and final questionnaires in the Department of Management and Information Sciences and the Department of Information Networking. In both departments, the results of the final questionnaire scored higher than those of the initial questionnaire. Therefore, it was suggested that each student was able to master the lecture content and basic skills during the lecture. In particular, when we assume the certification of literacy level, it is necessary for students to acquire basic knowledge and skills in various fields, regardless of belonging to humanities or sciences related departments, and establish courses that provide a certain level of educational effect.

Figure 3 shows the results of the questionnaire before and after the implementation of our educational program in the Department of Information Networks. The results of the questionnaire in 2021 showed higher scores than those in 2019. It is possible that the use of the content learned with familiar examples may have resulted in the improvement of the quality of computer literacy education. Therefore, the "Information Literacy Exercise," which is an introductory course for data science education, did not show any differences in lectures among departments even when data science education was introduced, suggesting that a certain level of educational effect was obtained. However, there were differences among departments in data collection, visualization, analysis, and application. Therefore, it is important to maintain the current lecture content and standard as well as addressing the students' characteristics. This is the way to train students and equip them with a certain level of data science literacy level based on AI Strategy 2019.

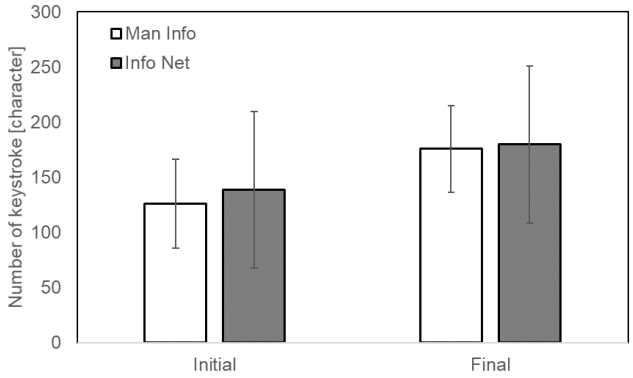
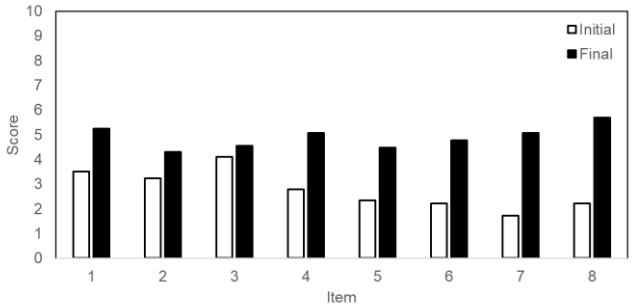
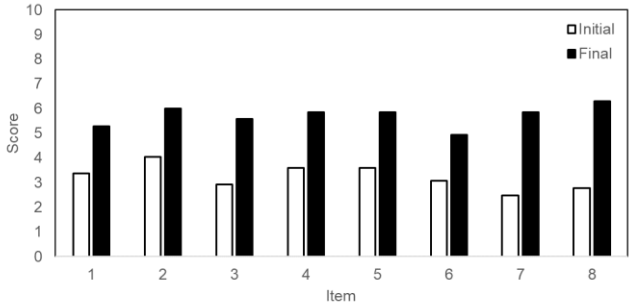


Figure 1: Average number of keystrokes for each department in the first and fifteenth lectures. Error bars indicate their standard deviations. “Man Info” and “Info Net” mean students of “Department of Management and Information Sciences” and “the Department of Information Networks”, respectively.



(a) Department of Management and Information Sciences.



(b) Department of Information Networks.

Figure 2: Initial and final questionnaire results of table 3 for each department. White and black show the results of the initial and final, respectively.

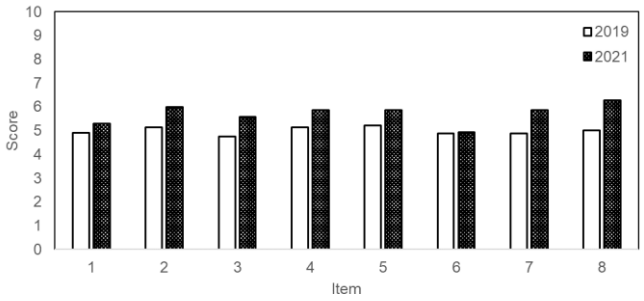


Figure 3: Final questionnaire results of table 3 for students of the Department of Information Networks in 2019 and 2021.

4 Conclusion

In this paper, we took up the subject of "Information Literacy Exercise," which is positioned as an introductory course for data science education, and examined the possibility of its application to data science education for existing subjects, using the report assignments in the lecture and the results of a questionnaire survey. The results are as follows.

(1) From the reports using typing speed data, it was found that humanities students tended to think that only visualizing the obtained data in tables and graphs was the way to explain the data, whereas science students tended to supplement data visualization with written explanations.

(2) The results of the questionnaire showed that, in both departments, the results of the final questionnaire showed higher scores than those of the initial questionnaire. This indicates that the students were able to master the lecture contents, which included the teaching of basic skills of computer literacy, which brought about a certain level of educational effects regardless of the type of department the students were from (humanities or sciences).

(3) The results of the questionnaire in 2021, after the introduction of the educational program, showed higher scores than the results of the questionnaire in 2019, before the introduction of the educational program. Therefore, the educational effectiveness of the subject was proved.

(4) There is a difference in the data science backgrounds of humanities and sciences students, and it is important to take this into account when implementing educational practices.

5 Future Work

In order to provide a certain level of data science education to both humanities and sciences students at KIIS, we will give lectures that include content to help develop the ability to explain data for humanities students and content to help develop the ability to visualize data for science students, respectively. In addition, we will continue to provide lectures that incorporate project based learning elements in computer literacy education.

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