IIAI Open Conference Publication Series
IIAI Letters on Institutional Research
Vol.004, LIR317
DOI: https://doi.org/10.52731/lir.v004.317

Integrating Tableau into a First-Year Information Literacy Course: A Practical Approach to Enhancing Data Science Education

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Abstract

In the face of rapid technological innovation and the increasing importance of data science skills across all fields, higher education institutions must adapt their curricula to equip students with the tools and knowledge required to thrive in a data-driven world. This paper discusses the integration of Tableau, a business intelligence tool for data visualization, into a first-year information literacy course at Hokuriku University as a practical approach to enhancing data science education. The university launched the "Data Science and AI Education Program" in 2022, which combines traditional information literacy topics with hands-on learning using Tableau, engaging students with real-world datasets from campus stores and cafeterias. The implementation and practice of the program are discussed, highlighting the use of Tableau as a gateway to introduce fundamental data science concepts and problem-solving skills. Although the integration of Tableau in university courses is still relatively rare, this paper contributes to the growing evidence of its educational value. Future studies will delve into the program's effectiveness through student surveys and other data, aiming to contribute to the ongoing discourse on best practices in data science education in the era of accelerating technological innovation.

Keywords: Data science education, Tableau, Data visualization, Technological innovation, Real-world data

1 Introduction

The rapid pace of technological innovation and adoption in recent years has been astounding. As Patrick Wagner vividly illustrates, it took a mere 19 days for the mobile game Pokémon Go to amass 50 million users, with people globally "running around the streets blind as moles and absorbed by their phone, crossing red lights and besieging landmarks worldwide on the look for the strongest monsters" [1]. In stark contrast, when Count Ferdinand von Zeppelin laid the foundation for modern air travel by founding the first airline in 1909, it took 64 years to reach the same milestone of 50 million passengers [1]. The speed at which the masses embrace innovations apparently has little correlation with their ultimate impact on society. Rather, the increasing

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interconnectedness of our world drives the rapid diffusion of new technologies (see Figure 1).

Figure 1: Time taken by innovations to reach 50 million users (in years) [1]

The case of ChatGPT, an artificial intelligence (AI)-powered conversational model, is even more remarkable: it achieved an astonishing 100 million users within just one month of its launch in November 2022 [2]. This unprecedented adoption rate highlights the exponential acceleration of innovation diffusion in the modern era, as groundbreaking technologies can now spread globally in a matter of days or weeks. This phenomenon of accelerating innovation adoption has profound implications for higher education. As students mature in a world where transformative technologies can emerge and proliferate at breakneck speeds, universities must adapt their curricula and pedagogical approaches to equip graduates with the skills needed to thrive in this fast-paced, constantly evolving landscape. This includes not only technical proficiency in emerging fields such as data science and AI but also the critical thinking, problem-solving, and lifelong learning skills that will enable students to navigate the uncharted waters of future technological disruptions.

Moreover, higher education institutions themselves must embrace innovation to remain relevant and effective under these rapid changes. This may involve incorporating new technologies into the classroom, developing novel teaching and learning methodologies, and forging partnerships with the industry to ensure that educational offerings are aligned with the modern workforce's requirements. By proactively engaging with the forces of technological change, universities can position themselves as catalysts for innovation and leaders in the global knowledge economy.

Globally, the discussion on utilizing big data began around 2012, and concurrently, deep learning started to demonstrate performances surpassing that of traditional machine learning [2]. This marked the beginning of the AI boom. Developing and increasing data science and AI talents has become a national issue.

In Japan, the first national AI strategy was established in 2019, which set a goal to prepare

600,000 individuals annually with basic literacy in mathematics, data science, and AI [3]. This number corresponds to the annual number of university entrants in Japan, approximately 600,000. This literacy was positioned as essential for all students, regardless of their field of study, implying that every student, whether in the arts or sciences, should possess these skills. This includes statistical concepts, data-driven thinking, fundamental problem-solving, information technology literacy, and ethics in data use. In response to this national goal, the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) in Japan initiated the Approved Program for Mathematics, Data Science, and AI Smart Higher Education (MDASH) [4]. Starting from 2021, the certification for literacy level was initiated, and from 2022, the certification for advanced literacy level began [5]. Over the three years leading up to the 2023 fiscal year, 300 universities, junior colleges, and technical colleges provided certification at the literacy level and 200 at the advanced literacy level [6].

Hokuriku University began considering the application of the MDASH Program in 2021 [7] and launched the "Hokuriku University Data Science & AI Education Program" in 2022 [8] once various conditions were met. This paper discusses the implementation and practice of this program. Section 2 describes the materials and methods used in the program. Section 3 presents the practices in the information literacy course, which is a subject in the program. Finally, section 4 elucidates future challenges.

2 Materials and Methods

A feature of the Data Science and AI Education Program at Hokuriku University is the adoption of Tableau Desktop, a business intelligence (BI) tool for visual analysis mainly used in business companies, in the first-year information literacy course. Because this course is mandatory, more than 500 first-year students from four faculties have been studying Tableau every year since the program began in 2022.

There are still few cases of Tableau being introduced in university courses. Hoelscher and Mortimer developed a case study that used Tableau to analyze accounting data and implemented it in their classes at a public university in the Midwest. Their results showed that students found Tableau to be more user-friendly than Excel for visualization. Their study suggested that Tableau could be an effective tool for teaching data visualization in accounting classes [9]. Further, Batt et al. [10] developed a Tableau tutorial that analyzed the gender wage gap data, as Tableau is not used in economics education.

In Japan, Taisho University has been using Tableau in its data science courses since 2020 [11]. Since 2021, Tableau has been used in courses for first- and second-year students in all six faculties. In the classes, students work on problem-solving exercises using real data provided by a local government and several companies [11]. Since 2022, Hokuriku University has been offering a blended information literacy course for all first-year students [8]. The course combines traditional information literacy topics with newly introduced data science content using Tableau [12]. Tableau Version 2023.1 was used in 2023 courses. For hands-on materials, we received four 30-minute videos from Salesforce Japan that teach the fundamental functions of Tableau using the built-in Sample Superstore data [13]. Since the 2019-20 academic year, Hokuriku University has mandated that students bring their laptop personal computers (PCs) [14], and some faculties also allow the use of MacBooks. Accordingly, the university has created supplementary videos to address the differences in Tableau operations between Windows and Mac, which are

provided to the students. As shown in Figure 2, many students watched the videos on the LMS using their smartphones while operating Tableau on their laptop computers.

With the increasing capabilities of modern laptops and the availability of high-functionality, user-friendly business tools via academic licenses, as well as the abundance of open data and machine learning models, this is the appropriate time for universities to embrace BYOD as a means to provide hands-on data science education. The limitations of computer labs, with their restricted number of devices and time constraints, can significantly hinder the potential benefits of such programs.

One important aspect of data science education is the use of real-world data [15]. This engages students by motivating them to uncover hidden truths in the real world, leading them to immerse themselves enthusiastically in their assignments or projects. Hokuriku University collaborated with the companies operating campus stores and cafeterias, providing students with sales data of the stores and cafeterias from 2022 and 2023, respectively. They solicited proposals in class to increase sales.

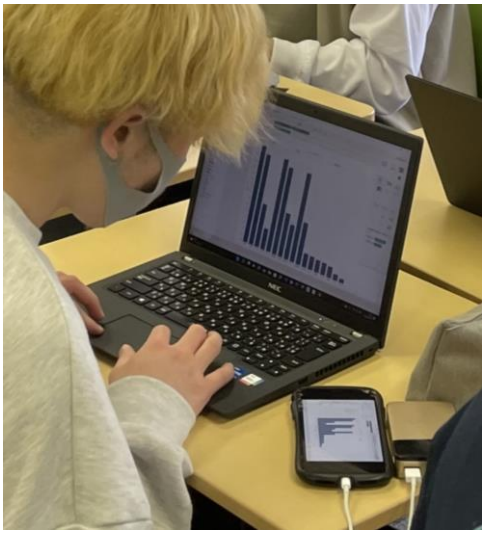

Figure 2: A scene of students watching the videos from Salesforce Japan [16]

3 Practice

3.1 Information Literacy Course Structure

In 2022, we revamped the existing information literacy course as part of the “Data Science and AI Education Program” at Hokuriku University. The new course was launched with 479 first-year students from 9 classes across 5 departments in 4 faculties. Each class is taught by one instructor, with one student assistant who helps with student exercises. The selection of student assistants is based on their performance in the previous year’s information literacy course and their interest in data science. They receive training on using Tableau and effectively supporting student learning prior to the commencement of this course.

The purpose of the course is to help students acquire skills related to PC operation necessary for studying at universities and working in society. In addition, it is aimed at facilitating the learning of the process of utilizing and analyzing information on PCs and the Internet. In this course,

students strive to understand basic concepts and operational methods related to PCs, software, and the Internet. The course comprises 15 weekly 90-minute sessions from April to July. Each session is divided into an information literacy section and a data science section. The information literacy section was reduced by two-thirds from the original information literacy course, and the freed-up time was used to teach data science. Table 1 presents the content of the 15-week course.

Table 1: Information Literacy Course Content

		Information Literacy Section (60 min)		Data Science Section (30 min)	Apps & Services Used
Unit 1 -Getting Started-	Week 01	Introduction	Basic PC Skills and Typing		Teams
	Week 02	Online Communication	PC Settings and Email		Teams and Gmail
	Week 03	Short Essay	Formal Email and Writing a Short Essay	Video Lecture: "Everyoen is Data People"	Word, Printing on Campus
	Week 04	Collaborative Presentation	Fieldwork	Tableau Exercise I	PowerPoint
Unit 2 -Understanding the Computer-	Week 05	How a PC Works	Setting Up PC and Cloud Drive	Tableau Exercise II	Google Drive
	Week 06	Information Ethics & Information Security		Tableau Exercise III	Windows Defender
	Week 07	Introduction to AI	Experiencing AI	Tableau Exercise IV	Bard and Teachable Machine
Unit 3 -Information Gathering and Analysis-	Week 08	Web Survey	Short Questionnaire	Video Lecture: "How to Analyze Supermarket Sales"	Google Forms
	Week 09	Freshman Public Opinion Survey I	Creating a Web Survey Form	Tableau Analysis Competition I	Google Forms
	Week 10	Freshman Public Opinion Survey II	Analysis of Survey Data	Tableau Analysis Competition II	Excel
	Week 11	Freshman Public Opinion Survey III	Creating a presentation		PowerPoint
Unit 4 -Data Analysis and Report Writing-	Week 12	Typing Data Analysis I	Analysing Typing Data	Tableau Analysis Competition Award Ceremony	Excel
	Week 13	Typing Data Analysis II	Analysing Typing Data		Excel and Tableau
	Week 14	Writing a Term Paper	Writing a Data Analysis Report		Word
	Week 15	Using a Proofreading Tool	Peer Review, Final Typing Test		Word

https://hokuriku-unv.hokuriku-u.ac.jp/up/faces/up/km/Kms00802A.jsp

3.2 Information Literacy Section

The information literacy section was compressed from a 90-minute class offered in 2020 in two faculties and three faculties in 2021 to a 60-minute class. The first half of this section covers the content of a traditional introductory information course in Japan, where students learn about online communication and the basic use of Office applications. In this course, first-year students first learn how to use communication tools such as Email and Chat during weeks 1–3. Then, they learn how to co-edit using Microsoft 365 Apps such as PowerPoint on Teams in week 4.

During weeks 5–7, students learn the basics of PC architecture, information ethics, information security, and AI.

In the latter part of the information literacy course, we cover two data science-related topics. First, we conduct a web survey within the class and analyze the collected responses using Excel, learning about cross-tabulation and statistical testing with data analysis tools. The results are then compiled into a PowerPoint presentation. From week 11 to 15, students analyze the data of their

typing test scores collected throughout the course. Students learn to create various charts in Excel, including boxplots, histograms, and scatterplots. They then use these charts to analyze data and summarize their findings in a term paper. This is the final assignment for the course. Table 2 shows the common rubric for grading the Term Paper.

Table 2: Rubric of the Final Term Paper

	4 points	3 points	2 points	1 points
Comparison with the school year average	The graph has been correctly created, and a comparison between the school year average and one's own score has been articulated with numerical evidence.	The graph is not complete, or the comparison between the school year average and one's own score is insufficient.	The graph is substantially incorrect or the comparison between the school year average and one's own score is nearly nonexistent.	Either the graph is absent, or the text does not convey a coherent meaning.
Comparison between genders	A test for the difference in means has been conducted, the table has been accurately inserted, and the interpretation has been correctly explained in the text.	The test for the difference in means has been conducted, and the table is correctly inserted, but the explanation in the interpretative text is inadequate.	The test for the difference in means is incorrect, or the text interpreting the data is erroneous.	Even with the presence of headings, the test for the difference in means has not been conducted, or the text lacks clear meaning.
Original analysis (Excel or Tableau)	The analysis method learned in class has been applied to data not covered in class, analyzed correctly, and the results are appropriately represented in figures or tables, with the interpretative text being accurate.	The analysis method learned in class has been used to analyze data not covered during the session, and while figures or tables are provided, the explanation in the interpretative text is lacking.	Although the analysis method learned in class has been applied, the results and interpretative text are incorrect.	Despite the presence of headings, no original analysis has been performed.
Report formatting	The title, department name, headings, figure/table captions, and the main text are presented in the specified font and format.	Up to two errors are present in the title, department name, headings, figure/table captions, or the main body of text.	Only about one aspect adheres to the correct specified font and format.	The specified font and format have not been adhered to at all.
Text	There are no typos or omissions, subject-verb agreement is maintained, paragraphs begin with an indentation, and the text is readable and exceeds 1500 characters.	There are a few errors, such as typos or omissions, but the document is over 1500 characters in length and is readable without significant issues.	There are several typos or omissions, but the text is over 1500 characters and is otherwise readable.	The text does not meet the minimum requirement of 1500 characters.

The overall grading criteria for the course are shown in Table 3. The total score for the course is 100 points. The weekly mini assignments are counted only for submission and total 40 points. There are four assignments graded by the instructor based on a common rubric: the Tableau analysis competition submission in Week 10, the PowerPoint in Week 11, the Excel in Week 13, and the Term Paper. These four assignments account for a total of 50 points.

Table 3: Grading Criteria

Points	Main Category	Subcategory
40	Submission of Mini Assignments in each session	Submission of screenshots, sending emails, responding to surveys, etc.
30	Evaluation of Task Sets based on a rubric	Week 10: Tableau Analysis Competition Week 11: Freshman Public Opinion Survey PowerPoint Week 13: Excel Analysis of Typing Data
20	Evaluation of the Term Paper based on a rubric	Week 15: Term Paper of Typing Data Analysis
10	Final Typing Test Score	Week 15: An additional 1 point for every 10 points above 100.

3.3 Data Science Section

From week 3 to 12 (excluding week 11), 30-minute data science sections are conducted using Tableau Desktop, a BI tool for visual analysis. Students use a free academic license provided by the instructor in advance.

First, students watch a video titled "Everyone is Data People" by Mr. Yutaka Sato, who was the Tableau Country Manager at the time. From this video, the students learn about the explosive growth of data worldwide and the ongoing competition for data utilization, which motivates them for the upcoming data science section.

From week 4 to 7, the section comprises hands-on sessions where students watch prerecorded videos and practice Tableau operations in the classroom. This allows all first-year students from four different faculties to acquire the basic operation skills of Tableau.

After completing these hands-on sessions, students participate in a Tableau analysis competition where they freely choose one of the three datasets provided by the university and compete in visualization analysis. In the 2023-24 academic year, three datasets were provided:

- Complete sales data from the campus cafeteria for four years (2019–2022).
- An anonymized subset of the actual results data from the student survey conducted in 2022.
- Data on the population transition by age group in each of the 47 prefectures of Japan for the past 100 years.

The first two datasets were provided to encourage students to become more interested in analysis by analyzing their university. In the 2023-24 academic year, the instructor selected one outstanding student from each of the 10 classes. One of them is shown in Figure 3. From the works

of these 10 students, Salesforce Japan, a partner company, selected three winners of the Tableau Award—the highest award—and presented them with prizes and comments.

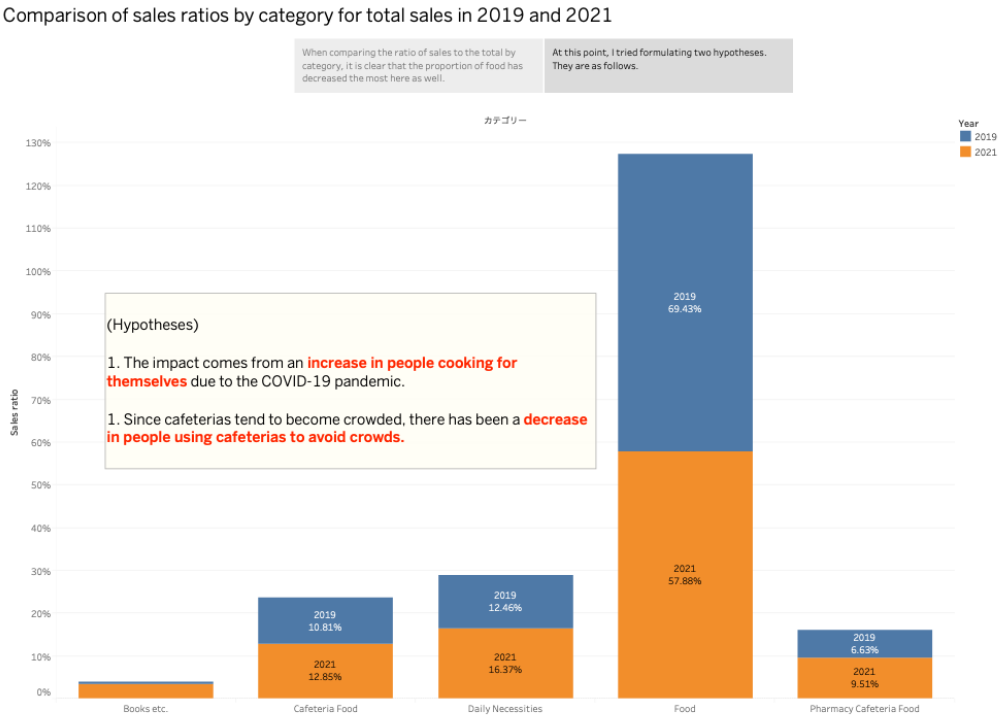

Figure 3: An Example of the Tableau Story of Excellent Students

As a result of the efforts described so far, the pass rates for information literacy in each faculty and department are high, exceeding 90% in all cases except for the Faculty of Economics and Management in 2023, as shown in Table 4.

Table 4: Results of Information Literacy Courses

Faculty and Departments	Year	Number of Registered Students	Number of Passing Students	Pass Ratio
Faculty of Pharmaceutical Sciences	2022	72	67	93.1%
	2023	63	62	98.4%
Faculty of Economics and Management	2022	219	209	95.4%
	2023	279	233	83.5%
Faculty of International Communication	2022	65	60	92.3%
	2023	50	48	96.0%
Faculty of International Communication Department of Psycho-Social Studies	2022	58	57	98.3%
	2023	52	47	90.4%
Faculty of Health and Medical Sciences Department of Medical Technology	2022	68	68	100.0%
	2023	61	61	100.0%
Faculty of Health and Medical Sciences Department of Physical Therapy	2023	62	62	100.0%

4 Discussion

In this paper, we have discussed the implementation and practice of the "Data Science and AI Education Program" at Hokuriku University (Figure 4). The program, launched in 2022, aims to equip all first-year students, regardless of their field of study, with essential skills in data science and AI. A key feature of the program is the introduction of Tableau, a BI tool for visual analysis, into the mandatory information literacy course. This has enabled over 500 first-year students from four faculties to gain hands-on experience with data analysis using real-world datasets.

Figure 4 Home page of Hokuriku University Data Science & AI Education Program (Japanese) [8]

The rapid acceleration of technological innovation, particularly in computer-related services, underscores the importance of such educational initiatives. As illustrated in Figure 1. However, this trend is even more pronounced in the realm of computer-related services. It took several years for services like Netflix, Kickstarter, and Airbnb to reach one million users, while more recent offerings like Spotify, Instagram, and ChatGPT have achieved this milestone in a matter of months or even days [17].

This lightning-fast pace of adoption highlights the need for educational programs that can keep pace with the rapidly evolving technological landscape. In Japan, where there is a clear divide between the humanities and sciences, it is particularly challenging for students in the humanities to acquire the necessary skills in mathematics and data science. However, the ability to understand and work with data is becoming increasingly crucial across all fields, as demonstrated by the image. Therefore, it is essential that all students, regardless of their specialization, have the opportunity to learn these skills.

The "Data Science and AI Education Program" at Hokuriku University aims to address this challenge by providing a hands-on, accessible introduction to data science through the use of Tableau. This paper focuses on the implementation and practice of the program, while future studies will delve into its effectiveness by analyzing student surveys and other data. By examining the impact of this innovative approach, we hope to contribute to the ongoing discourse on how to best prepare students for the data-driven world of the future.

Notably, the introduction of Tableau in university courses is still a relatively rare occurrence. However, as the examples from accounting and economics education demonstrate, there is

growing evidence of its educational value. At Hokuriku University, we have seen how Tableau can spark students' interest in data analysis and motivate them to engage with real-world problems. By providing students with the opportunity to work with their own university's data, such as sales figures from campus stores and cafeterias, we have created a more meaningful and engaging learning experience.

Of course, the goal of the program is not simply to teach students how to use Tableau. Rather, it is to use Tableau as a gateway to introduce students to the fundamental concepts of data science, statistical thinking, and problem-solving skills. To this end, the program has been designed to integrate the information literacy course with an introductory statistics course, providing students with a comprehensive and systematic understanding of data science.

Another key factor is the utilization of e-learning materials and partnerships with industry leaders. Many companies and universities now offer online courses and educational resources for data science, facilitating the integration of high-quality, standardized content into curricula with consideration for copyright. The Japan Inter-University Consortium for Mathematics, Data Science, and AI Education provides online materials, educational data, and problem-based learning case studies [18].

From a future perspective, it is important to apply the data literacy acquired in the information literacy course to other courses as well. Universities can foster a truly data-driven educational environment by encouraging students and faculty alike to apply their acquired data skills across subjects, seminars, and research projects. This could involve rotating instructors for the introductory data science courses, allowing more faculty members to gain hands-on experience with the latest data tools and techniques, ultimately serving as a form of practical faculty development.

As the speed of technological innovation continues to accelerate, driven by advances in AI and other fields, universities must remain agile and responsive to the changing needs of society. By sharing the lessons learned from innovative initiatives such as the "Data Science and AI Education Program" at Hokuriku University, we hope to contribute to the ongoing efforts of higher education institutions worldwide to adapt their curricula and teaching methods to the demands of the 21st century. We believe that through a combination of hands-on learning, real-world applications, and interdisciplinary collaboration, it is possible to equip students with the skills and knowledge they need to thrive in the data-driven future.

Acknowledgment

This work was supported by Hokuriku University Special Research Grant 2023 in Fundamental Research Area and JSPS KAKENHI Grant Number JP23K02558.

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