Trends in Data Utilization in Japanese High School IT Education: Analysis of 468 Presentations From 17 Zenkojoken National Conferences

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Abstract
This paper examines how data utilization has emerged and evolved within Japanese high school Informatics education, based on an analysis of 468 presentations delivered at 17 annual conferences of the National High School Informatics Education Research Association (Zenkojoken). After reviewing the historical context of Informatics education in Japan, the study categorizes the presentations into five areas—Problem-solving in the Information Society, Communication and Information Design, Computers and Programming, Information Networks and Data Utilization, and Other Topics—reflecting the structure of the new high school curriculum guidelines. The primary focus is on the growing emphasis on data utilization skills, including data collection, analysis, and interpretation. Through a detailed examination of lesson plans, teaching strategies, and classroom outcomes, this paper highlights trends such as the increasing use of personal and local data to enhance student engagement and the incorporation of interdisciplinary approaches to amplify real-world relevance. The findings indicate that data literacy is not only becoming a vital skill set for students in a rapidly evolving digital society but also serving as a catalyst for innovative teaching practices. Implications for curriculum design and teacher training are discussed, and future perspectives for expanding data utilization activities in collaboration with other subject areas are outlined.

Keywords: Data Utilization, Informatics Education, High School Curriculum, Zenkojoken, Japan

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Introduction

Informatics education has progressively gained importance worldwide, as digital tools and technologies shape various aspects of daily life (Jones, 2023). In Japan, efforts to integrate Informatics into the high school curriculum have been driven by the national objective of developing citizens who can actively participate in a rapidly evolving information society (Ministry of Education, Culture, Sports, Science, and Technology [MEXT], 2018). Since 2003, Informatics has been a mandatory subject in Japanese high schools, aimed at cultivating essential computer skills, problem-solving abilities, and a deeper understanding of how technology can be leveraged to address societal challenges.

To support and advance this field, the National High School Informatics Education Research Association—commonly referred to as Zenkojoken—was established in 2008 (National High School Informatics Education Research Association [Zenkojoken], 2008-2024). Zenkojoken serves as a platform for educators, researchers, and policy makers to share best practices, teaching methodologies, and classroom innovations in Informatics education. Over the course of its 17 annual conferences, Zenkojoken has accumulated a substantial body of knowledge, as evidenced by the 468 presentations that form the basis of the study presented in this paper.

A noteworthy development in the recent revision of Japan's high school curriculum (implemented starting 2018) is the creation of two new subjects, Informatics I and Informatics II. These new courses revolve around four core fields: (1) Problem-solving in the Information Society, (2) Communication and Information Design, (3) Computers and Programming, and (4) Information Networks and Data Utilization. Together, these fields aim to ensure that all students are equipped with fundamental IT literacy, technical competencies, and the ability to apply these skills in creatively and socially beneficial ways.

Among these four core fields, the domain of "Information Networks and Data Utilization" stands out due to the rapid expansion of data-driven technologies in various industries (Domino Data Lab, 2023). With the increasing importance of data analysis, visualization, and informed decision-making, educators have recognized the need to cultivate "data literacy" as a critical component of 21st-century skills. The role of Zenkojoken conferences in disseminating effective teaching strategies within this area has grown considerably, particularly in the wake of widespread digital transformation and the availability of diverse data sets—from personal smartphone usage to broader societal trends.

This paper seeks to illuminate the trends in data utilization within Japanese high school IT education by systematically analyzing the content of 468 presentations from 17 Zenkojoken conferences. First, the historical context of Informatics education in Japan is presented. Next, the paper describes how these presentations were classified according to the five categories reflecting the core curriculum fields, with a special emphasis on the emerging category of "Data Utilization." Drawing upon this classification, the paper outlines the key instructional methods, classroom activities, and student outcomes that were identified in the presentations. Special attention is given to a case study of a high school lesson focusing on smartphone usage data, demonstrating how personal data can effectively engage students in learning.

Lastly, the paper explores the implications for future curriculum development and teacher training, arguing that data literacy and interdisciplinary connections can propel Informatics education forward in Japan and beyond. By examining how data utilization has been operationalized in classroom settings, this paper contributes to a growing body of literature

on best practices in Informatics education and offers insights for policy makers, practitioners, and researchers interested in fostering a data-literate generation.

Background of Informatics Education in Japan

Early Developments (2003 Onwards)

In 2003, Japan took a pioneering step by making Informatics education mandatory in high schools (MEXT, 2003). At that time, three subjects—Informatics A, Informatics B, and Informatics C—were introduced. Each of these subjects focused on a distinct dimension of Informatics, collectively seeking to ensure that students would graduate with:

(1) **Basic Computer Skills (Informatics A)**
Students learn fundamental skills such as word processing, spreadsheet manipulation, and essential networking knowledge. This subset of Informatics emphasizes foundational computer literacy for all students.

(2) **Algorithms and Logical Thinking (Informatics B)**
Students delve into problem-solving techniques with an emphasis on algorithmic thinking. Early programming exercises typically involve educational programming languages like Scratch, though some schools also incorporate Python or other text-based languages.

(3) **Real-World Applications (Informatics C)**
This subject encourages students to use IT tools to address and potentially solve real or simulated social and organizational problems. Activities may include analyzing data related to community issues, planning technology-based solutions, or designing web-based applications.

This tripartite structure laid the groundwork for subsequent reforms, as educators and policy makers continued to refine the curriculum to keep pace with technological advancements.

Role of Zenkojoken

Zenkojoken, the National High School Informatics Education Research Association, was launched in 2008, serving as a professional network for teachers seeking to improve and share effective methods in Informatics education. Over the years, Zenkojoken's annual conferences have become a cornerstone of professional development, featuring:

- Presentations of classroom-based research and best practices
- Workshops on emerging technologies and teaching tools
- Peer-reviewed sessions to maintain high-quality discussions

Throughout its evolution, Zenkojoken has maintained a teacher-driven focus, enabling educators to discuss the practical challenges they face in the classroom and collectively brainstorm solutions. Many teachers have credited Zenkojoken with helping them stay informed about curriculum changes and innovative approaches in the field.

Curriculum Revision and the Four Fields

In 2018, Japan's Ministry of Education, Culture, Sports, Science, and Technology (MEXT) revised the high school curriculum, resulting in two new Informatics subjects—Informatics I and Informatics II—that align more closely with the demands of a digital society. Central to these revisions is the division of content into four key fields:

(1) **Problem-Solving in the Information Society**
Emphasizes recognizing and defining social or personal problems, deciding which data are necessary for analysis, and using digital tools for solution development.
(2) **Communication and Information Design**
Focuses on effectively conveying information through thoughtful design, including the creation of infographics, data visualizations, or interactive media.
(3) **Computers and Programming**
Provides in-depth knowledge of how computers operate, including hardware and software fundamentals, as well as hands-on programming practice to develop logical thinking.
(4) **Information Networks and Data Utilization**
Teaches the architecture of networks and cultivates data literacy skills—gathering, analyzing, and making data-driven decisions, with a particular emphasis on connecting such skills to societal needs.

Within these fields, educators aim to strike a balance between theoretical knowledge and practical application, ensuring that students develop robust digital competencies along with critical thinking abilities. By framing the curriculum in this way, the new guidelines recognize the increasingly interdisciplinary nature of Informatics, which intersects fields like mathematics, social studies, and even the arts.

Methodology

Data Collection

The primary data for this study consist of 468 presentations delivered at the 17 annual Zenkojoken conferences. Each presentation was documented in a conference proceedings booklet or online repository provided by Zenkojoken. While the presentations varied in format—ranging from short oral reports to extended workshops—each contained descriptive information regarding the pedagogical approach, objectives, and outcomes of the teaching practices or research findings.

Data Classification

For this paper's analysis, each presentation was classified according to one of five categories:

1. Problem-solving in the Information Society
2. Communication and Information Design
3. Computers and Programming
4. Information Networks and Data Utilization
5. Other Topics

Two researchers—including the author—independently read through the abstracts or summaries, assigning each presentation to the category that most closely matched the primary content. Cases in which a single presentation overlapped multiple fields were initially categorized according to the presenters' stated main goal or emphasis, as well as the most frequently mentioned competencies or learning objectives. Presentations deemed difficult to categorize, or whose content was tangential to the four fields, were placed in the "Other Topics" category. Afterward, any discrepancies in classification were resolved through discussion until consensus was reached.

Analysis of "Data Utilization"

Within the "Information Networks and Data Utilization" category, a further layer of analysis was performed to capture the nuances of how data were being introduced and taught. Specifically, presentations that focused on collecting, interpreting, and drawing conclusions from data formed the core of the final sample for this paper. Examples included lessons on creating scatter plots, calculating statistical measures like mean or variance, and designing interventions based on data insights.

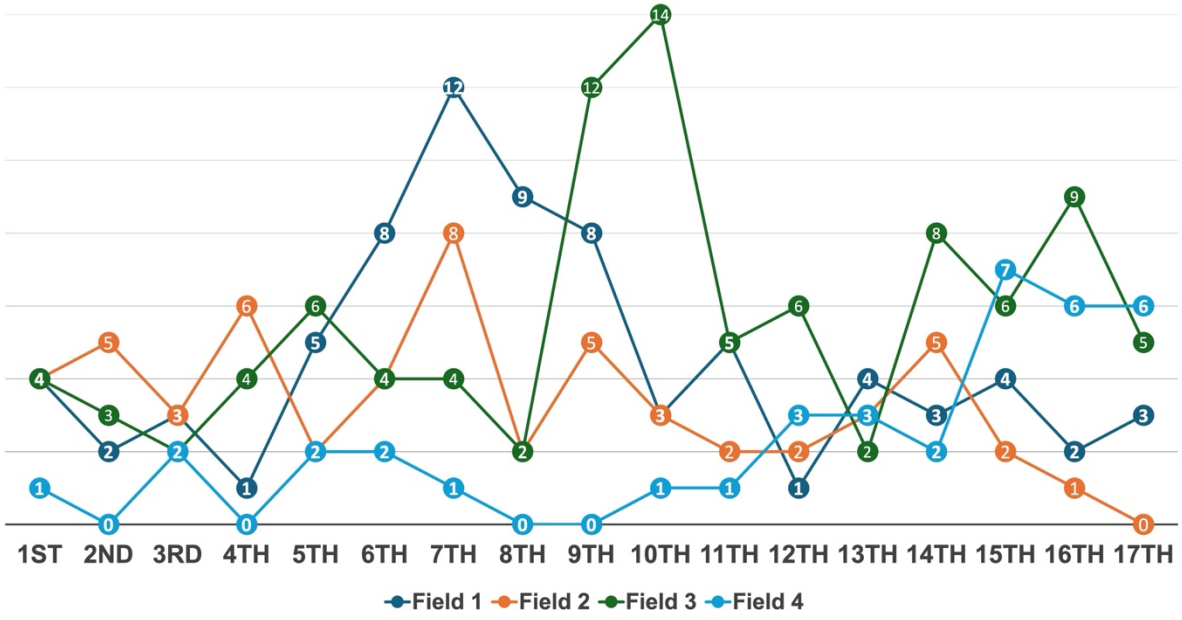
Additionally, qualitative reviews of sample lesson plans, worksheets, and anecdotal student feedback were used to identify recurring teaching strategies, challenges, and reported outcomes. This approach allowed for a deeper understanding of best practices and innovative approaches to teaching data literacy in the high school context.

Results

Overall Distribution of Presentations

Figure 1 provides an overview of how the 468 presentations were distributed across the four categories. As expected, the largest groups were Computers and Programming and Problem-solving in the Information Society, reflecting long-standing curricular objectives and teachers' familiarity with those areas. However, the category of Information Networks and Data Utilization has exhibited a notable increase over the past decade, indicating a growing recognition of the importance of data literacy in today's digital ecosystem.

Figure 1: Number of Presentations at Each Conference in Each of the Four Fields



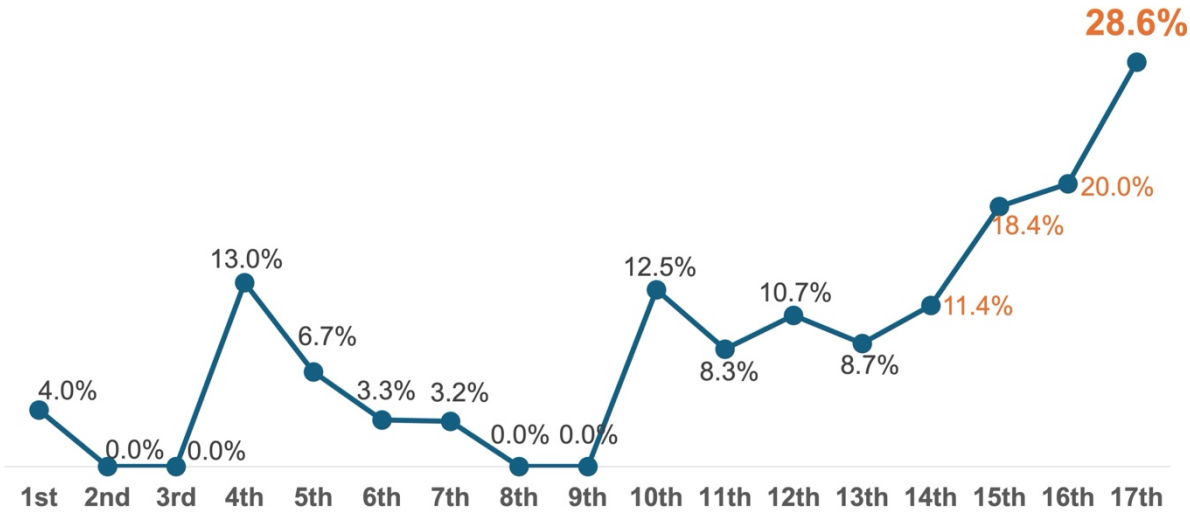
Rising Focus on Data Utilization

A deeper examination of the "Information Networks and Data Utilization" category reveals that a significant proportion of these presentations—particularly those delivered in the past

four years (as shown in Figure 2)—emphasize data-related topics. This aligns with broader societal trends that prioritize data-driven decision-making. Teachers are increasingly designing lessons that allow students to:

(1) **Collect data from personal or community sources**: For instance, students may track their daily screen time, conduct surveys in their local community, or obtain open datasets from government websites.
(2) **Analyze data using tools like spreadsheets or statistical software**: Many educators introduce basic statistical operations, such as calculating averages and correlation coefficients, or use visualizations like histograms, bar charts, and scatter plots to help students interpret data.
(3) **Propose interventions or solutions based on their findings**: After analyzing data, students are often encouraged to brainstorm practical steps or potential applications relevant to the topic at hand (e.g., improving health-related habits, addressing local environmental issues, or optimizing business processes).

Figure 2: Percentage of Oral Presentations in the Field of "Data Utilization"



Discussion

Case Study: Smartphone Usage Analysis

A highlighted example within this body of presentations is a teaching practice conducted by the author (Inagaki, 2020), which explores the concept of data utilization through a lesson on smartphone usage. Students were asked to record and analyze their personal smartphone usage over a one-week period, focusing on metrics such as total daily usage time and the frequency of specific app categories (e.g., social media, games, educational apps).

Lesson Details 1

- **Data Recording**: Students tracked their smartphone usage manually or used built-in monitoring apps, collecting data on both weekdays and weekends.
- **Basic Statistics**: They entered the raw data into spreadsheets and generated frequency tables and histograms. This helped them visualize how usage varied across the entire class and facilitated initial observations about extreme values or interesting patterns.

- **Interpretation**: The teacher introduced measures such as mean and variance, explaining how these statistics help summarize large data sets and highlight variability.

Lesson Details 2

- **Forming Hypotheses**: Students formulated questions such as "Do females spend more total time on social media apps than males?" or "Does usage spike during certain hours of the day?"
- **Data Visualization and Correlation**: They created scatter plots to explore relationships among factors such as time of day, types of apps used, and user demographic profiles. Students also computed simple correlation coefficients, interpreting the results with caution and reflecting on potential confounding variables.
- **Group Presentations**: The lesson concluded with student presentations discussing their findings, limitations of the data, and any proposed strategies for healthier or more productive smartphone usage.

Impact on Student Learning

Exam results and student feedback consistently pointed to increased engagement when lessons were grounded in personal or familiar data. Students remarked that analyzing their own smartphone habits made abstract statistical concepts more tangible and motivated them to delve deeper into topics like variance, correlation, and data visualization tools. The high degree of personal relevance appeared to reinforce conceptual understanding, as reflected in better performance on final exams covering data analysis questions.

Beyond academic achievement, anecdotal reports suggested that students began making more informed decisions about their digital habits. Some reduced unnecessary screen time, while others refined their app usage schedules for better time management. In this sense, the lesson not only meets curricular objectives but also fosters life skills that extend beyond the classroom.

Expanding Data Utilization: Interdisciplinary Connections

One critical observation emerging from the analyzed presentations is the potential for Data Utilization to act as a bridge between Informatics and other disciplines. Cross-curricular collaborations can magnify the real-world relevance of data analysis, as evidenced by several examples from Zenkojoken presentations:

(1) Social Studies: Students used publicly available data to examine local demographic changes or environmental challenges. They learned to propose solutions or policy recommendations based on their findings. This type of project underscores the social impact of data literacy and encourages civic engagement.

(2) Science: In science classes, data analysis is fundamental to understanding experiments and scientific phenomena. Linking data utilization concepts—such as hypothesis testing and correlation analysis—with actual laboratory work helps students see the connectivity between theory and practice.

(3) Mathematics: Mathematics courses provide the foundational tools for statistical analysis, such as probability distributions, standard deviations, and regression models. Collaboration with Informatics teachers can make these concepts more concrete and relatable, allowing students to witness direct applications of mathematical theories.

(4) **Arts and Design**: Although less common, some teachers have integrated data visualization techniques into art or design projects, encouraging students to find creative ways to represent complex data sets. This approach not only makes the data more accessible but also nurtures students' sense of aesthetic presentation and storytelling through graphical means.

Such interdisciplinary projects demonstrate that data literacy resonates across different subject areas and fosters deeper, more meaningful learning experiences. When students encounter data analysis in multiple contexts, they develop robust, transferable skills that will serve them in higher education and in their future careers.

Conclusion

This paper has examined the evolving role of data utilization in Japanese high school Informatics education, drawing on a large corpus of presentations from 17 Zenkojoken conferences. Several key insights have emerged:

(1) **Growing Emphasis**: Over the past decade, there has been a significant increase in presentations related to data-driven activities, reflecting both technological shifts in society and the expanding recognition of data literacy as a crucial educational objective.
(2) **Effective Pedagogical Strategies**: Classrooms that incorporate personal or community-centered data collection—and the subsequent analysis of such data—tend to achieve stronger student engagement. This approach renders abstract statistical concepts more tangible and fosters the practical application of data literacy skills.
(3) **Interdisciplinary Potential**: Expanding data utilization beyond standalone Informatics courses amplifies its relevance and provides students with a more holistic learning experience. Collaborations with subjects like Social Studies, Science, Mathematics, and even the Arts illustrate how data analysis can deepen students' understanding of complex societal and scientific questions.
(4) **Future Outlook**: As Informatics education in Japan continues to evolve under the revised curriculum guidelines, the focus on data utilization is likely to intensify. Ongoing professional development, particularly through platforms such as Zenkojoken, will be crucial for supporting teachers in adopting innovative methods, designing robust lesson plans, and staying abreast of rapidly changing technologies.

Ultimately, the shift toward data utilization in high school education aligns with a broader international trend: the need to equip young people with the competencies required to thrive in a data-rich world. By enabling students to gather, process, and interpret data in meaningful ways, educators help cultivate informed citizens who can make evidence-based decisions and contribute to societal progress.

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