I IIAI Open Conference Publication Series
IIAI Letters on Institutional Research
Vol.004, LIR323
DOI: https://doi.org/10.52731/lir.v004.323

Beyond Silos: Eduinformatics as a Catalyst for Dissolving Faculty and Staff Boundaries in Higher Education

Kunihiko Takamatsu [*], Sayaka Matsumoto [*], Naruhiko Shiratori [†], Ikuhiro Noda [‡], Shintaro Tajiri [§], Kenya Bannaka [‡], Yasuhiro Kozaki [**], Hibiki Ito [††], Shotaro Imai [*], Yasuo Nakata [‡], Masao Mori [*]

Abstract

This paper introduces eduinformatics as an innovative approach to bridge the longstanding divide between faculty and staff within institutions of higher education. By integrating education and information technology, eduinformatics fosters a collaborative environment that transcends traditional siloed structures, strengthening communication and cooperation. We explore the historical context of disciplinary boundaries in Japanese higher education, highlighting the shift towards interdisciplinary studies. Through a conceptual framework and practical applications of eduinformatics, we examine its potential to transform educational practices by facilitating data-driven decision-making and improving student learning outcomes. The paper discusses the significance of eduinformatics in promoting a more holistic and interdisciplinary approach to learning and teaching in higher education.

Keywords: Eduinformatics, Higher Education, Interdisciplinary Studies

1 Introduction

An article titled "University of Tokyo to launch new program with 50% foreign students" was published in The Japan Times on February 19, 2024[1]. The article mentioned that The University of Tokyo plans to launch the "College of Design" in fall 2027. This innovative five-year program, offering both Bachelor's and Master's degrees, is designed to tackle global issues like climate change through an interdisciplinary curriculum. Aiming for an enrollment of around 100 students each year, the program requires half of its students are from international backgrounds, ensuring a diverse learning environment with courses across various disciplines.

In related coverage, Japan Broadcasting Corporation (NHK) reported on the same development under the title "University of Tokyo to start interdisciplinary 5-year program," highlighting the program's interdisciplinary focus and its comprehensive five-year structure aimed at integrating Bachelor's and Master's degrees[2].

[*] Tokyo Institute of Technology, Tokyo, Japan
[†] Tokyo City University, Tokyo, Japan
[‡] Kobe Tokiwa University, Kobe, Japan
[§] Hokuriku University, Kanazawa, Japan
[**] Osaka Kyoiku University, Osaka, Japan
[††] University of Helsinki, Helsinki, Finland

While international coverage, as reported by The Japan Times, emphasized the aspect of a 50% foreign student enrollment, Japanese news, represented by NHK, focused more on the interdisciplinary nature and the comprehensive five-year span of the University of Tokyo's new program. This difference highlights the varied angles from which local and international media approach the same story, reflecting different audience interests or editorial policies.

In the NHK news coverage, the term "interdisciplinary" is defined through the program's structure, which spans four undergraduate years and one graduate year, allowing students to explore fields across both the humanities and sciences. This includes studying critical areas such as climate change, medicine, and education, highlighting the program's broad educational scope and its aim to foster versatile knowledge and skills.

In Japan, academic fields are traditionally defined as humanities or sciences, reflecting a distinct boundary between the two. However, the approach seen in NHK's coverage of the University of Tokyo's new program suggests a departure from this convention. In contrast, such rigid boundaries between disciplines are not as pronounced or observed in international contexts, indicating a more integrated or holistic approach to higher education abroad. These contrasting approaches shed light on varying educational philosophies and their implications for interdisciplinary studies.

In the latter section of the Imperial University Ordinance of March 2, 1886 (Imperial Ordinance No. 3), specified in Article 10, the ordinance organizes university faculties into law, medicine, engineering, humanities, and sciences, with a further subdivision within the Faculty of Law into jurisprudence and politics[3]. This articulation serves to underscore the clear distinction maintained between the humanities and sciences, reflecting an institutional effort to categorize academic disciplines within Japanese higher education from an early stage.

Prof. Oki. details the historical division between arts and sciences in Japan. Without delving into specifics, according to Prof. Oki, the split can be traced back to 1918, when Imperial Ordinance No. 389, within the Secondary Education Act, explicitly separated higher education into "humanities" and "sciences" in Article 8 of the Second Higher School Order. This marked a clear distinction between all fields into these two categories[4].

This enduring division between humanities and sciences, highlighted by NHK news, is being challenged by the establishment of new faculties aimed at integrating these traditionally separate fields. There remains, however, a recognized existence of stereotypical views among students regarding the sciences and humanities[5].

This move towards interdisciplinary studies represents a significant shift in educational philosophy, signifying a broader trend towards a more holistic approach to learning that crosses conventional academic boundaries. In the study [5], the authors examine the development of university students' stereotypical perceptions, proving that such views are not inherent but evolve through the process of self-identification within the sciences or humanities. This evolution reflects students' ongoing efforts to define their academic and professional identities. The research suggests that stereotypical views are the result of individual experiences and perceptions, indicating a complex formation process influenced by personal and educational experiences.

The evidence shows that the categorization of academic disciplines into arts and sciences in Japan has origins extending back to the establishment of universities in 1886, with significant

ramifications apparent by 1918 in secondary education. This distinct boundary between arts and sciences, instituted approximately 140 years ago, exerts a continuing influence on both secondary and higher education within the current educational framework.

Thus, once boundaries are established, crossing them - moving "beyond silos" - proves a formidable challenge. In this context, "silos" refer to isolated categories or compartments within an organization or system, here metaphorically applied to the strict division between academic disciplines; this division hinders interdisciplinary collaboration and innovation.

This paper explores the potential of eduinformatics as a catalyst for dissolving faculty and staff boundaries within institutions of higher education. It argues that by transcending traditional siloed organizational structures and integrating education with information technology, a more collaborative and interdisciplinary approach can be fostered. The implementation of eduinformatics may facilitate communication and cooperation between faculty and staff, possibly enhancing student learning experiences. This paper presents a conceptual framework for eduinformatics, examines its practical applications, and discusses its potential for transforming higher education institutions.

2 Eduinformatics

In 2018, our research collective unveiled a groundbreaking interdisciplinary domain termed eduinformatics , as documented in [6] . This innovative arena is a confluence of the disciplines of informatics and education. Its primary aim is to address emerging challenges in educational domains using informatics, which offers advanced methodological approaches that significantly boost problem-solving skills [7] (Refer to Figure 1).

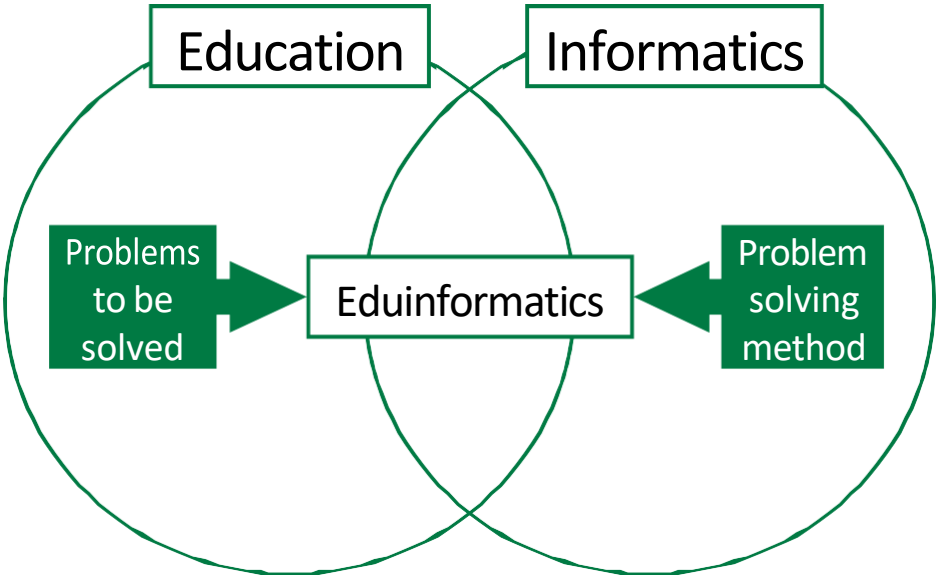

Figure 1: The concept of Eduinformatics from [6].

The original concept of eduinformatics combines Humanities and Sciences (Figure 2), two disciplines with distinct boundaries in Japan for nearly 140 years (Adapted from [6]). Humanities fields include education and scientific fields include institutional research, statistics, machine learning, evidence-based education, informatics, and so on. Therefore, eduinformatics applies scientific fields to education. The research suggests that eduinformatics in higher education will lead to a higher quality of education for students, as can be seen in previously published papers [7][8][9][10][11][12].

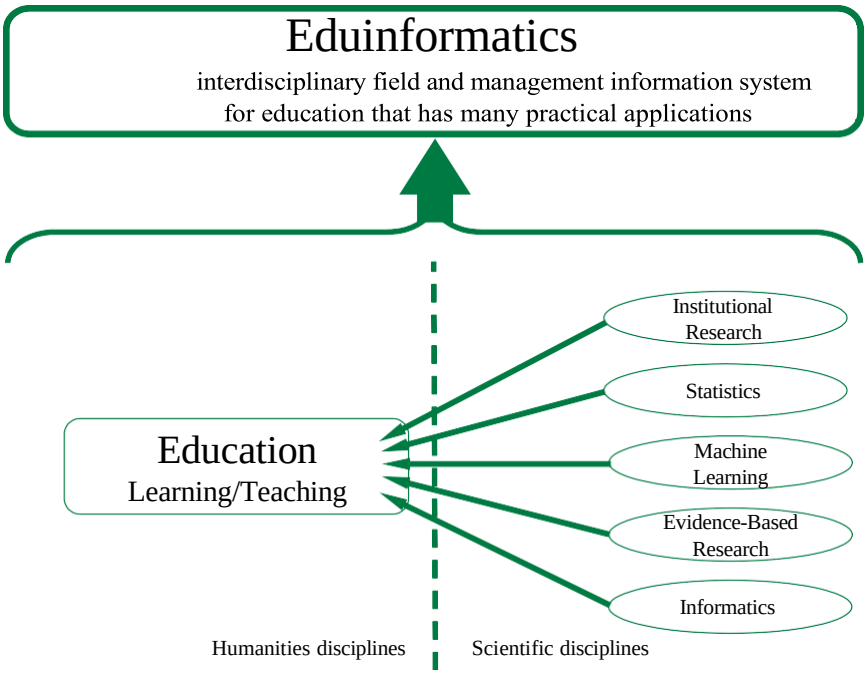

Figure 2: Concept of Eduinformatics: Eduinformatics combines Humanities and scientific discipline(Adapted [6]).

More specifically, we propose a novel concept that integrates digital transformation, institutional research, and information and communication technology based on eduinformatics, a new interdisciplinary field combining informatics and education [13] (Figure 3). By analyzing student data and developing innovative analytical methods, eduinformatics seeks to redefine higher education through the linkage of digital transformation and education. Using a Japanese university as a model, we demonstrate how eduinformatics serves as the key to connecting digital transformation, information and communication technology, and institutional research in the context of higher education, ultimately leading to the refinement and advancement of educational practices and outcomes.

3 Layers of Learning Analytics by UNESCO

The United Nations Educational, Scientific and Cultural Organization (UNESCO) proposed a three-tier framework for learning analytics in their 2012 report [14] (Figure 4). The tiers are defined as the following.

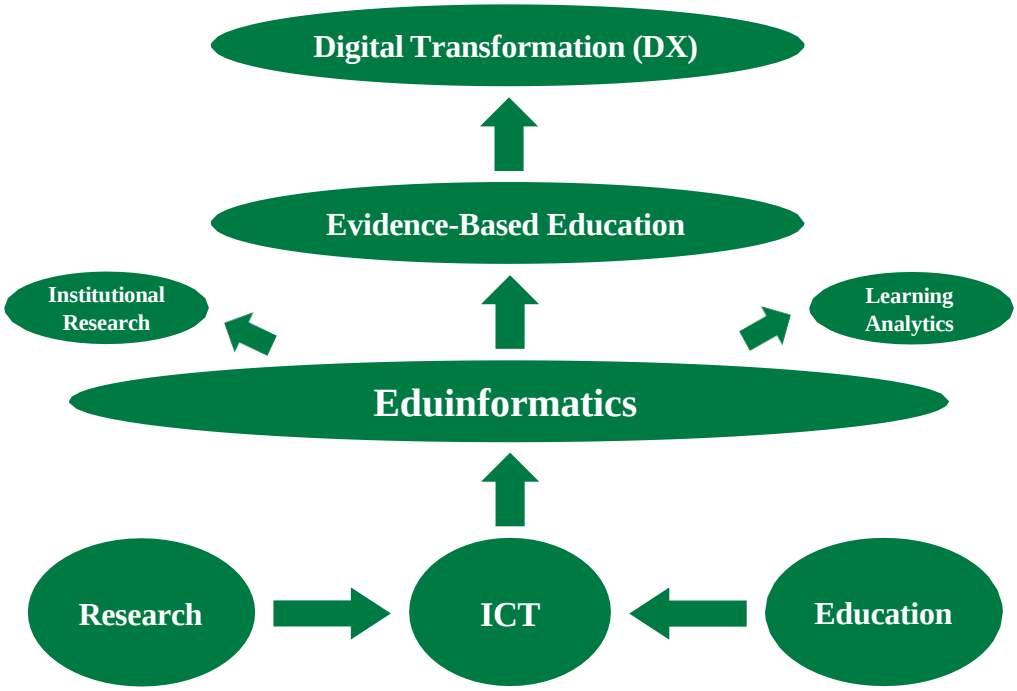

Figure 3: New concept of DX and IR based on Eduinformatics from [13]

Macro-level analytics facilitate cross-institutional analysis through surveys of current practices [15] or improved access to standardized assessment data over students' lifetimes [16]. These analytics increasingly incorporate real-time data from the meso and micro levels and could benefit from benchmarking and data integration methodologies developed in non-educational sectors. However, concerns exist about the dangers of decontextualized data and the educational paradigms they may perpetuate.

Meso-level analytics operate at the institutional level, treating educational institutions as a new Business Intelligence (BI) market sector. They leverage BI tools to integrate data silos, optimize workflows, generate dashboards, mine unstructured data, and predict customer churn and future markets. The BI imperative to optimize business processes partly motivates efforts to build institution-level "academic analytics" [17], with communities of practice forming specifically for BI within educational organizations, each with their own cultures and legacy technologies.

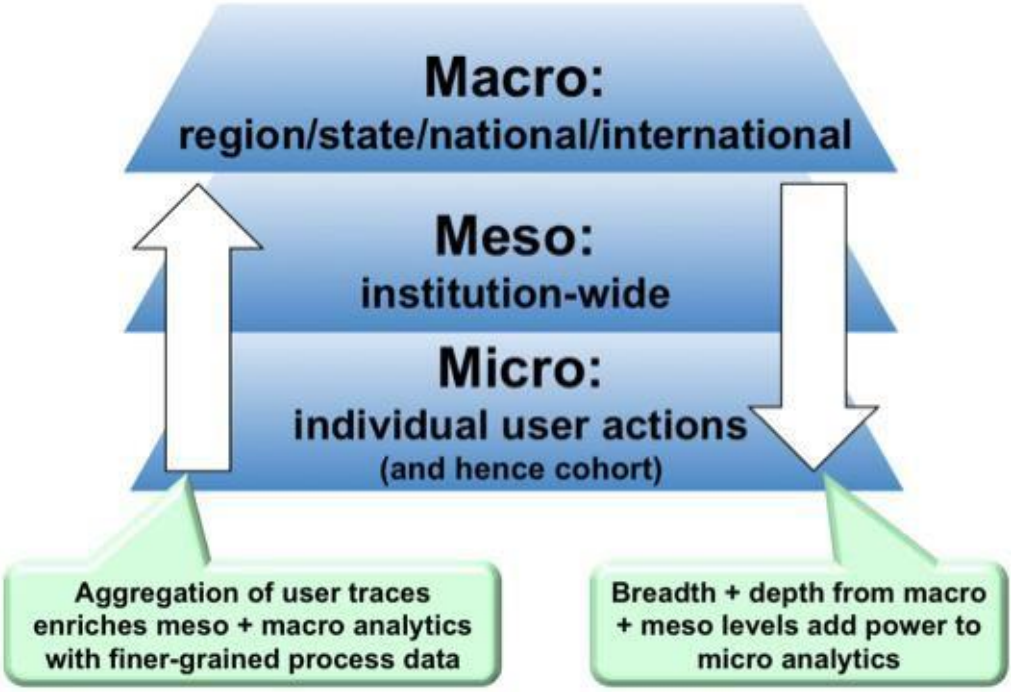

Figure 4: Layers of Learning Analytics by UNESCO IITE from [14]

Micro-level analytics support tracking and interpreting process-level data for individual learners and groups. This data is of primary interest to learners and those responsible for their success, as it provides the most detailed information, ideally in real-time. However, this data is also the most personal, potentially disclosing online activity, physical activity, library loans, purchases, and interpersonal data such as social networks.

To work with this data, researchers adapt techniques from various fields: serious gaming, automated marking, educational data mining, computer-supported collaborative learning, recommender systems, intelligent tutoring systems/adaptive hypermedia, information visualization, computational linguistics, argumentation, and social network analysis.

4 Research Question

We have previously made several proposals and conducted actual analyses in the context of Institutional Research (IR) in institutions of higher education. In our previous article titled "New Proposal to Compare Student Data in Institutional Research," we introduce novel criteria for categorizing student data [18]. We distinguish between primary data, which are not derived from linear combinations, and secondary data, which are linear combinations of primary data.

At the macro-level, we consider correct and incorrect answers to an exam question or stu-

dents' attendance and absence from a lecture as primary data. In contrast, secondary data at the macro-level include the total points in an examination or students' total attendance in and absence from a lecture. To gather secondary data at the meso-level, we analyze student records of lectures as well as grade point average, or rank, available in the annual record of the university.

This categorization offers a new perspective on student data analysis and has the potential to inform data-driven decision-making processes within universities. Distinguishing between primary and secondary data provides a more nuanced understanding of student performance and engagement and enables institutions to develop targeted strategies for student success.

In our recent paper titled "Introducing new criteria for IR, using student data compared analysis based on eduinformatics," we build upon our previous work on categorizing student data in Institutional Research (IR)[19]. We introduce "eduinformatics," a new field that combines education and informatics, as the foundation for our analysis.

Through the examination of actual educational data, we have discovered that our previous definition of secondary data as a linear combination of primary data is insufficient. We now propose that secondary data can also include nonlinear combinations of primary data. This refined understanding of the relationship between primary and secondary data allows for a more comprehensive analysis of student performance and engagement.

Furthermore, we discuss examples of the use of primary data allowing us to identify elements that were not detectable through the analysis of secondary data alone. These findings highlight potential pitfalls that IR practitioners encounter when conducting comparative analyses. The results demonstrate that using primary data in conjunction with secondary data provides a more accurate and nuanced understanding of student outcomes.

Our work emphasizes the importance of carefully considering the types of data used in IR as well as the methods employed to analyze them. Refining our criteria for data categorization and demonstrating the value of primary data analysis contributes to the development of more effective, data-driven decision-making processes in institutions of higher education.

Our previous papers have discussed the following challenge to data analysis in universities. We must consider who constructs primary and secondary data in universities. Typically, primary data at the micro-level are only obtained and stored by university faculty, while the entire set of secondary data at the meso-level is only stored by IR staff in universities. This means that faculty cannot access the complete secondary data set, and IR staff cannot access primary data.

We have drafted a research question in response:

"How does the segregation of data access between faculty and staff in universities manifest across the three tiers (macro, meso, and micro) of UNESCO's learning analytics framework?"

5 The Separation of Data Access Between Faculty and Staff

To investigate the research question about the separation of data access between faculty and staff, we proposed new matrix (Figure 5).

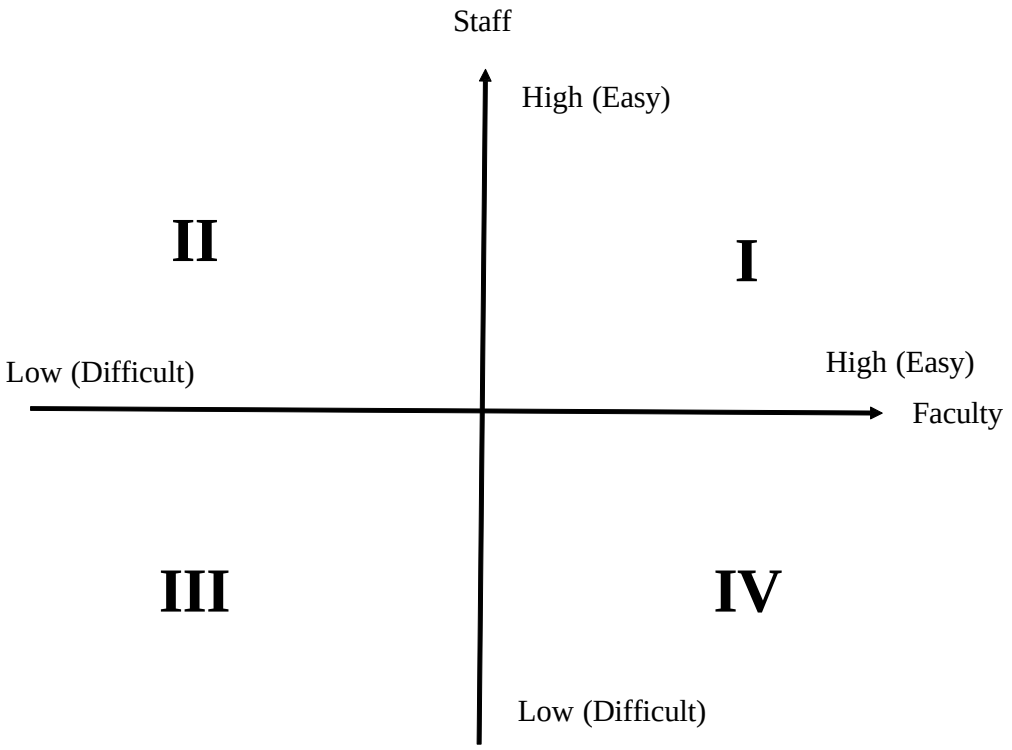

Figure 5: The Separation of Data Access Between Faculty and Staff: Challenges in Utilizing Information in Universi-ties from the Perspective of UNESCO's Three-Tier Learning Analytics Hierarchy

The first quadrant, characterized by high involvement of both faculty and staff, primarily corresponds to data analysis at the meso-level, which focuses on faculties, departments, and programs within the university. In this quadrant, faculty and staff collaborate to determine operational policies, evaluate and improve educational programs, and make decisions regarding faculty allocation and evaluation. Me-so-level data analysis utilizes data such as student enrollment status, credit acquisi-tion rates, and grade distributions to enhance the quality of education and manage the institution efficiently. However, without sufficient collaboration between faculty and staff, the results of the data analysis cannot be effectively utilized.

The second quadrant, characterized by high involvement of staff and low in-volvement of faculty, primarily corresponds to data analysis at the meso-level, which focuses on faculties, departments, and programs within the university. In this quad-rant, staff manage the meso-level data analysis and use it to improve the management of each

division and the quality of education.

Specifically, data on faculty and department budget allocation, student enrollment status, and faculty teaching activities are analyzed. However, due to the low involvement of faculty, there is a possibility that the results of the data analysis do not effectively translate to educational practices. The challenge in this quadrant is to strengthen the collaboration between staff and faculty and to more successfully link the results of data analysis to the improvement of education.

The third quadrant, characterized by low involvement of both faculty and staff, does not directly correspond to any of the three tiers (macro, meso, or micro) of data analysis in UNESCO's framework. This quadrant represents an area where data uti-lization is not sufficiently implemented within the university. Due to the passive attitude of both faculty and staff towards data collection, analysis, and utilization, evidence-based decision-making and educational improvement become challenging.

The challenge in this quadrant is to help faculty and staff recognize the importance of data utilization and to establish a system where they collaborate on data analysis. To achieve this, universities must provide training and support for data utilization, develop a mechanism for sharing the results of data analysis, and create an environment that encourages data-driven practices.

The fourth quadrant, characterized by high involvement of faculty and low involvement of staff, primarily corresponds to data analysis at the micro-level, which focuses on individual students and faculty members. In this quadrant, faculty conduct micro-level data analysis and use it to improve student learning and teaching prac-tices. Specifically, faculty analyzes data on individual student attendance, assign-ment submission, and grades use the results to provide personalized guidance to students and improve their teaching.

However, due to the staff's lack of involvement, there is a possibility that the results of the data analysis will not be clearly reflected in the university's overall educational policies. The challenge in this quadrant is to strengthen the collaboration between faculty and staff and to utilize the results of micro-level data analysis to improve the quality of education across the university.

This study revealed how separation of data access between university faculty and staff manifests in the three tiers (macro, meso, and micro) of UNESCO's learning analytics framework. The analysis of the first and second quadrants show that col-laboration between faculty and staff is crucial at the meso-level; close coordination between the two is essential to leverage the results of data analysis for improving university management and education. Furthermore, the analysis of the fourth quadrant reveal that while faculty-led data analysis is conducted at the micro-level, the results are not accurately reflected in the university's overall educational policies.

Acknowledgment

JSPS KAKENHI Grant Numbers 22H00077 support this work.

References

[1] "University of Tokyo to launch new program with 50% foreign students," *The Japan times*, 19-Feb-2024.

[2] "University of Tokyo to start interdisciplinary 5-year program," *NHK*, Feb-.

[3] MEXT, "The Imperial University Ordinance of March 2, 1886 (Imperial Ordinance No. 3) (Japanese)," 1886. [Online]. Available: https://www.mext.go.jp/b_menu/hakusho/html/others/detail/1318050.htm. [Accessed: 20-Mar-2024].

[4] MEXT, "The High School Order (Imperial Ordinance No. 389 of December 6, 1918) (Japanese)," 1918. [Online]. Available: https://www.mext.go.jp/b_menu/hakusho/html/others/detail/1318057.htm. [Accessed: 20-Mar-2024].

[5] S. OKAMOTO, "Formation Process of Stereotypical Views of the Sciences and Humanities," *J. Sci. Educ. Japan*, vol. 44, no. 1, pp. 14–29, 2020.

[6] K. Takamatsu, K. Murakami, T. Kirimura, K. Bannaka, I. Noda, L. R.-J. Wei, K. Mitsunari, M. Seki, E. Matsumoto, M. Bohgaki, A. Imanishi, M. Omori, R.Adachi, M. Yamasaki, H. Sakamoto, K. Takao, J. Asahi, T. Nakamura, et al., "'Eduinformatics': A new education field promotion," Bull. kobe Tokiwa Univ., vol. 11, pp. 27–44, 2018.

[7] K. Takamatsu, Y. Kozaki, K. Murakami, A. Sugiura, K. Bannaka, K. Mitsunari, M. Omori, and Y. Nakata, "Review of Recent Eduinformatics Research," in *IEEE/IIAI International Congress on Applied Information Technology 2019*, 2019, pp. 27–32.

[8] K. Takamatsu, I. Noda, K. Bannaka, K. Murakami, Y. Kozaki, A. Kishida, H. Kabutoya, K. Mitsunari, R. Adachi, M. Omori, and Y. Nakata, "Sustainability of Digital transformation (DX), Institutional Research (IR), and Information and Communication Technology (ICT) in Higher Education based on Eduinformatics," in *Intelligent Sustainable Systems Selected Papers of WorldS4 2022, Volume 1*, 2023, pp. 565–572.

[9] K. Takamatsu, I. Noda, K. Bannaka, K. Murakami, T. Kirimura, T. Kunisaki, R. Kozaki, S. Matsumoto, A. Kishida, H. Ito, A. Ito, S. Imai, K. Mitsunari, M. Omori, M. Mori, and Y. Nakata, "Abduction, Abstract Degree and Urgency Matrix (ABDU-M) for Flexible/Agile Higher Education Reform based on Eduinformatics," in *Intelligent Sustainable Systems Selected Papers of WorldS4 2023*, 2024, p. in press.

[10] K. Takamatsu, T. Gozu, R. Kozaki, S. Matsumoto, M. Konso, K. Nishiyama, N. Ichikawa, K. Murakami, Y. Kozaki, M. Mori, S. Imai, I. Noda, K. Bannaka, K. Mitsunari, and Y. Nakata, "Combining Key Performance Indicators and Signs of Changes in Students to improve the quality of education in Institutional Research based on Eduinformatics," *IIAI Lett. Institutional Res.*, vol. 2, pp. 1–9, 2022.

[11] I. Noda, K. Takamatsu, M. Takafuji, K. Bannaka, and Y. Nakata, "Development of learning support system in Eduinformatics Collaboration between faculty and staff to improve education and help teacher," Bull. Kobe Tokiwa Univ., vol. 13, pp. 110–118, 2020.

[12] K. Takamatsu, K. Murakami, I. Noda, K. Bannaka, Y. Nakata, Y. Kozaki, A. Kishida, H. Kabutoya, K. Mitsunari, and M. Omori, "New Proposal of University Reform by Significant Other Groups in Eduinformatics," Int. J. Institutional Res. Manag., vol. 5, no. 1, pp. 96–105, 2021.

[13] K. Takamatsu, I. Noda, K. Bannaka, K. Murakami, Y. Kozaki, K. Mitsunari, M. Omori, and Y. Nakata, "A new Concept of Digital transformation, Institutional Research,and Information and Communication Technology in Higher Education based on Eduinformatics," in Proceedings of Seventh International Congress on Information and Communication Technology, Springer Nature, 2023, pp. 233–24.

[14] UNESCO, "Learning Analytics," 2012.

[15] D. Norris, L. Baer, J. Leonard, L. Pugliese, and P. Lefrere, "Action analytics: Measuring and improving performance that matters in higher education," Educ. Rev., vol. 43, no. 1, p. 42, 2008.

[16] "DQC: Data Quality Campaign." [Online]. Available: https://dataquality campaign.org/. [Accessed: 01-Apr-2018].

[17] J. P. Campbell, P. B. DeBlois, and D. G. Oblinger, "Academic analytics: A new tool for a new era," Educ. Rev., vol. 42, no. 4, p. 40, 2007.

[18] Y. Nakata, K. Murakami, Y. Kozaki, T. Kirimura, A. Sugiura, K. Bannaka and K. Takamatsu, "New Proposal to Compare Student Data in Institutional Research," in Advanced Applied Informatics (IIAI-AAI), 2019 8th International Institute of Applied Informatics (IIAI) International Congress on. Institute of Electrical and Electronics Engineers (IEEE), 2019, pp. 404–407.

[19] K. Takamatsu, K. Murakami, Y. Kozaki, A. Kishida, K. Bannaka, K. Mitsunari, M. Omori, and Y. Nakata, "Introducing new criteria for IR, using student data compared analysis based on Eduinformatics," in Advanced Applied Informatics (IIAI-AAI), 2020 9th International Institute of Applied Informatics (IIAI) International Congress on. Institute of Electrical and Electronics Engineers (IEEE), 2020, pp. 378–384.