Eduinformatics and the Universities' Challenge for "Ri": A 100-Year Vision of Higher Education Transcending Time, Place, and Culture through *Shu-Ha-Ri*

Kunihiko Takamatsu [*], Koichi Akashi [†], Sayaka Matsumoto [*],
Ayako Hidetani [‡], Gen Akashi [§], Hibiki Ito [**], Katsuhiko Murakami [††],
Kenya Bannaka [‡‡], Ryosuke Kozaki [§§], Aoi Kishida [***],
Yasuo Nakata [‡‡], Tsunenori Inakura [*], Shotaro Imai [*], Masao Mori [*]

Abstract

This paper examines the transformation of higher education through the lens of Eduinformatics and the Japanese concept *Shu-Ha-Ri*. It analyzes the current state of universities, characterized by rigid academic divisions and external pressures, and proposes a path through interdisciplinary fusion and the introduction of absolute perspectives. The paper then envisions a future state 100 years from now that transcends constraints of time, place, and culture. It argues that a "Ri" part of universities creates new values through the fusion of Japanese cultural elements with global diversity by maximizing creativity and sensibility, and actively engages with society to solve real-world problems. The study concludes that while the path to transformation is not unimpeded, it is essential for the future relevance and impact of higher education.

Keywords: Eduinformatics, Shu-Ha-Ri, Higher Education Transformation, Future Universities, Cultural Integration in Education

1 Introduction

Higher education stands at a critical juncture, facing challenges of field divisions, external de-mands, and resource constraints [1][2]. As we contemplate the future of universities 100 years from now, we believe it is imperative to consider new frameworks for understanding and guiding this evolution. This paper employs the Japanese concept of *Shu-Ha-Ri* as a lens through which to analyze the current state of higher education and envision its future transformation, while lev-eraging the emerging field of Eduinformatics to inform this analysis and vision.
Shu-Ha-Ri is a concept deeply rooted in Japanese martial arts and traditional arts, describing the journey of learning and mastery [3]. While its exact origin is subject to various interpretations,

---

[*] Institute of Science Tokyo, Tokyo, Japan
[†] University of St Andrews, St Andrews, United Kingdom
[‡] Education by Art, Chiba, Japan
[§] Chiba Meitoku College, Chiba, Japan
[**] University of Helsinki, Helsinki, Finland
[††] The University of Tokyo, Tokyo, Japan
[‡‡] Kobe Tokiwa University, Kobe, Japan
[§§] International Pacific University, Okayama, Japan
[***] Kobe City Nishi-Kobe Medical Center, Kobe, Japan

2

K. Takamatsu, K. Akashi, S. Matsumoto, A. Hidetani, G. Akashi, H. Ito,
K. Murakami, K. Bannaka, R. Kozaki, A. Kishida, Y. Nakata, T. Inakura, S. Imai, M. Mori

it is often linked to a verse from *Rikyu Douka* (利休道歌), a collection of teachings by the renowned tea master Sen no Rikyu [3]. The verse goes: "規矩作法守り尽くして破るとも離るるとても本を忘るな", which translates to "Even when breaking the rules and deviating from the forms, do not forget the origin after having thoroughly mastered the regulations and methods". Though different perspectives exist regarding its origin, this verse encapsulates the essence of the *Shu-Ha-Ri* progression [3].

This philosophy encompasses three stages, which can be roughly translated into English as follows:

1.   "Shu" (守) - Protect, Obey: This initial stage is characterized by faithful adherence to the teachings of a master. The student diligently follows instructions, learning and internalizing the basic forms and techniques. In this stage, imitation and discipline are key, as the foundations of the art are established.

2.   "Ha" (破) - Break, Deviate: In this intermediate stage, the student begins to break away from the strict forms learned in the "Shu" stage. They start to integrate personal insights and experiences, questioning and analyzing the traditional wisdom. This stage is marked by experimentation and the development of a more nuanced understanding of the principles underlying the forms, and is a precursor to the stage of emulsifying immutable historical heritage with the adaptability to change.

3.   "Ri" (離) - Leave, Separate: This final stage represents the pinnacle of mastery. Here, the practitioner transcends the need for forms, innovating freely based on intuition and a deep, internalized understanding of the art. At this stage, the individual moves beyond conscious thought, responding fluidly and creatively to each unique situation, involving the establishment of an authentically balanced ratio of timelessness and change.
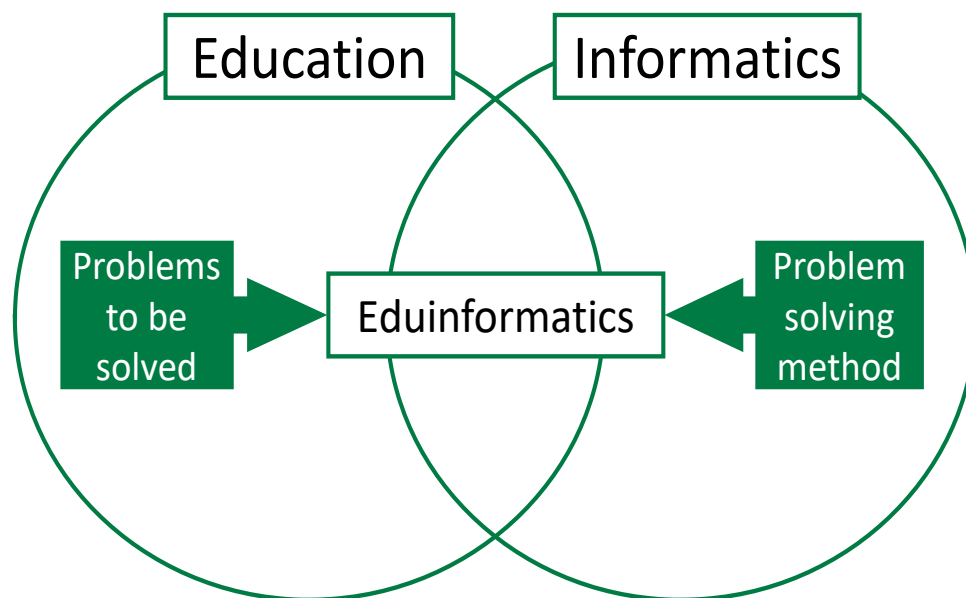
Eduinformatics is a rapidly evolving interdisciplinary field at the intersection of education and informatics, which integrates the principles of data science, machine learning, and institutional research into educational processes [4]. Its primary aim is to address emerging challenges in educational domains using informatics, which offers advanced methodological approaches that significantly boost problem-solving skills [4] (see Fig. 1). This field aims to optimize educational outcomes by applying advanced methodologies to the analysis of educational data, much like bioinformatics transformed biology [5] (see Fig. 2). In recent years, the research surrounding higher education has increasingly become evidence-based, and Eduinformatics provides powerful tools for analyzing and visualizing educational processes [5].

The form of education is evolving under the influence of the impetus of Eduinformatics. Accordingly, the role of educators is shifting from a simple transmitter of a scattered collection of knowledge to that of the holistic set of knowledge that is truly applicable in real world. This implicitly signifies the motive of learning the educational architecture from the normative education long employed in the history, such as *Shu-Ha-Ri*. By combining Eduinformatics with the *Shu-Ha-Ri* framework, rooted in mastery and learning progression, we can very likely trigger the transformation of higher education more effectively. This integration offers a structured yet flexible strategy that preserves the essential principles of education while embracing new insights and innovations from data analytics.
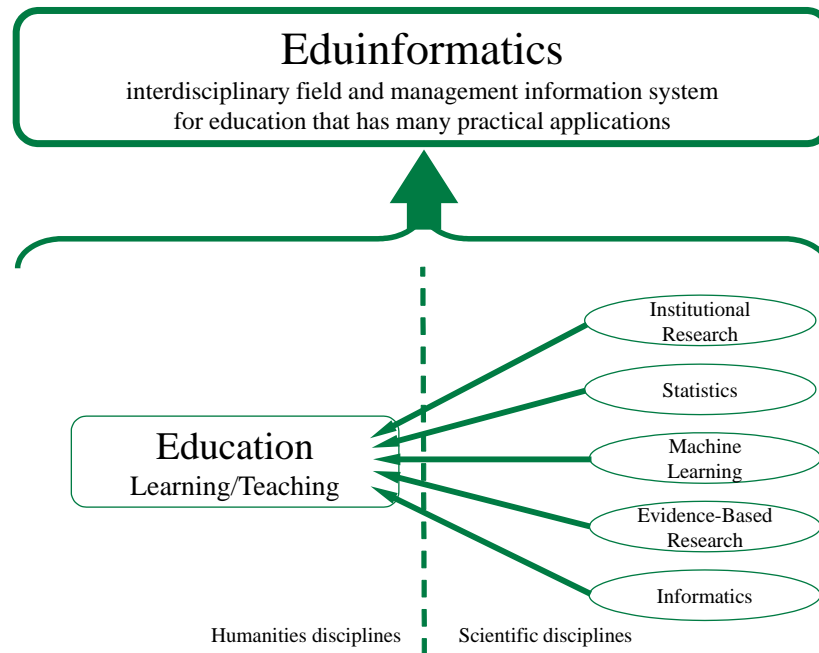
The tripartite concept can suggest that universities are currently in the "Shu" stage, where rigid academic divisions, adherence to established methodologies, and compliance with external standards are prevalent. However, to meet the challenges of a rapidly changing world and to

unlock their full potential as centers of innovation and creativity, they must progress through "Ha" to ultimately reach "Ri".

This paper aims to analyze the current state of higher education, propose strategies for progression through the "Ha" stage, and envision the characteristics of universities at the "Ri" stage, 100 years from now. By applying this Japanese concept to the global context of higher education and application of Eduinformatics, we seek to offer a fresh perspective on institutional transformation and to chart a course towards a more dynamic, creative, and impactful form of higher learning.

Figure **1**: The concept of Eduinformatics from [4].

K. Takamatsu, K. Akashi, S. Matsumoto, A. Hidetani, G. Akashi, H. Ito,
K. Murakami, K. Bannaka, R. Kozaki, A. Kishida, Y. Nakata, T. Inakura, S. Imai, M. Mori

Figure 2: Concept of Eduinformatics: Eduinformatics combines humanities and scientific dis-cipline (from [4]).

In light of these considerations, this paper attempts to address a critical question facing the future of higher education: In what ways can the integration of Eduinformatics and the *Shu-Ha-Ri* concept guide the transformation of higher education institutions over the next 100 years? Specifically, we seek to explore how this integration can create universities that transcend current constraints of time, place, and culture, while simultaneously maximizing human creativity and effectively addressing global challenges. This question is central to our investigation, as it encapsulates the core challenges and opportunities for higher education in the coming century.

By addressing this question, we hope to provide insights into the potential pathways for university evolution, the role of technology and data in shaping educational practices, and the importance of cultural integration in creating truly global institutions of learning. Moreover, this inquiry allows us to explore how traditional concepts like *Shu-Ha-Ri* can be reimagined and applied in the context of modern educational challenges, potentially offering new perspectives on long-standing issues for higher education.

2   Methods

This study adopts a conceptual analysis approach, utilizing the *Shu-Ha-Ri* framework and Eduinformatics as theoretical lenses to investigate the current state and future prospects of higher education. The analysis is grounded in a comprehensive review of ongoing trends within the relevant fields, including the growing emphasis on interdisciplinary research and education, the influence of technological advancements on teaching and learning methodologies, shifting

societal expectations of higher education institutions, and the increasing globalization of education that necessitates the cultural integration.

3 Results and Discussions

3.1 Current State ("Shu")

The current state of higher education largely represents the "Shu" stage of the *Shu-Ha-Ri* concept. Universities are characterized by thorough field divisions and knowledge systematization, with institutions organized into distinct faculties and departments, often with limited interaction between disciplines. There is a strong influence of external factors, with institutions heavily shaped by programs like the Comprehensive Support Program for University Reform and accreditation requirements.

In fact, the Organization for Economic Co-operation and Development (OECD) is promoting 21st-century education that equips students with the skills needed for future societies. Through the Programme for International Student Assessment (PISA), the OECD evaluates the literacy in reading, mathematics, and science of 15-year-old students worldwide and measures the acquisition of 21st-century skills. This assessment provides guidelines for countries to improve their education policies [6].

Additionally, the OECD Learning Framework 2030 presents a vision for future education, emphasizing the knowledge, skills, attitudes, and values necessary for students to thrive in an uncertain future. This framework advocates for interdisciplinary learning and lifelong education [7].

Furthermore, the Future of Education and Skills 2030 project, launched by the OECD in 2015, aims to support the improvement of education systems, focusing on learner-centered education, evidence-based policy-making, and the enhancement of digital skills [8].

The characteristics of 21st-century education include skill-based learning, integrative learning, and the promotion of lifelong learning. It nurtures skills such as problem-solving, critical thinking, creativity, and communication, which are applicable in real-world situations. This proffers the ability to tackle complex issues and build a sustainable society to students.

This stage is marked by a focus on maintaining and inheriting existing frameworks, where curricula and teaching methods often prioritize the transmission of established knowledge over innovation. The system is dominated by relative thinking and uniform standards, with success often measured by comparison to peers or adherence to standardized metrics. However, resource constraints, including limited funding and rigid organizational structures, further hinder innovative initiatives.

Eduinformatics analysis of current educational data reveals patterns that support this characterization. For instance, curriculum mapping data show a high degree of compartmentalization in course offerings, with limited cross-disciplinary connections. Student performance metrics often emphasize standardized test scores and grade point averages, reflecting a focus on measurable outcomes rather than creative or innovative capabilities.

6

K. Takamatsu, K. Akashi, S. Matsumoto, A. Hidetani, G. Akashi, H. Ito,
K. Murakami, K. Bannaka, R. Kozaki, A. Kishida, Y. Nakata, T. Inakura, S. Imai, M. Mori

3.2 Transition to "Ha"

The transition to the "Ha" stage in higher education involves breaking away from these rigid structures and embracing more flexible, innovative approaches. This stage is characterized by the promotion of interdisciplinary research and education, where universities begin to break down silos between academic fields, encouraging collaboration across disciplines. There is an introduction of absolute perspectives, where institutions start to pursue more universal truths or values that transcend individual field frameworks.

In this process, higher education institutions need to encourage free thinking among students and researchers and provide opportunities to challenge existing frameworks. It is important to foster the spirit of "Ha" through flexible curricula, venues for cross-disciplinary dialogue, and support for innovative research. The concept of convergence science, which aims to integrate knowledge, methods, and expertise from different disciplines to form a comprehensive synthetic framework for addressing complex scientific and societal challenges, is becoming increasingly crucial in this context.

A prime example of this trend is the recent merger of Tokyo Institute of Technology and Tokyo Medical and Dental University in Japan. On October 1st, 2024, these two prestigious institutions integrated to form a new university, Institute of Science Tokyo, with the explicit goal of realizing convergence science [9]. The fact that both universities were willing to relinquish their established names underscores the perceived importance of this interdisciplinary approach. This bold move reflects a broader shift in higher education towards dismantling traditional disciplinary barriers and creating new, integrated frameworks for knowledge creation and problem-solving.

Such developments indicate that many higher education institutions are actively embracing the "Ha" stage, recognizing the limitations of remaining in the "Shu" stage in the face of complex, multifaceted global challenges. However, it's worth noting that this trend also suggests that these institutions are not yet fully entering the "Ri" stage, where complete transcendence of disciplinary boundaries would occur. Instead, they are strategically positioning themselves at the cutting edge of the "Ha" stage, seeking to maximize the benefits of interdisciplinary collaboration and convergence while still maintaining some degree of disciplinary structure.

Many of the complex challenges facing modern society cannot be solved by a single academic discipline alone. For example, addressing issues such as climate change, infectious diseases, and social inequality requires collaboration across diverse fields including natural sciences, social sciences, and humanities. The "Ha" stage necessitates institutional and cultural transformations to promote such interdisciplinary research and education.

Moreover, the "Ha" stage involves a crucial shift from relative to absolute perspectives. A relative perspective is a view based on the context of individual academic disciplines, leading to judgments like "if A or B, then B is better". On the other hand, an absolute perspective refers to the pursuit of more universal truths or values. In the "Ha" stage, it is essential to relativize the frameworks of individual fields while addressing fundamental questions that permeate academia as a whole.

In this process, higher education institutions need to encourage free thinking among students and researchers and provide opportunities to challenge existing frameworks. It is important to foster the spirit of "Ha" through flexible curricula, venues for cross-disciplinary dialogue, and support for innovative research.

We have already proposed knowledge network models that provide insights into transcending systematic academic disciplines. In our preceding research [10][11], we analyzed the process of knowledge creation from the perspective of network theory. We represented knowledge as points (nodes) and connections between knowledge as lines (edges), explaining the growth of

knowledge in a three-stage model (propagation, mixing, and creation). In particular, the "Tag-based Knowledge Network Model" suggests the possibility of new knowledge creation by visualizing the relationships between knowledge from different fields through the use of tags. These models offer valuable perspectives for understanding interdisciplinary approaches in the "Ha" stage and the process of creating new knowledge beyond existing frameworks.

This phase emphasizes STEAM education, which incorporates Arts into Science, Technology, Engineering, and Mathematics, acknowledging creativity's importance across disciplines. STEM education is crucial for 21st-century learning [12]. In 2010, Rodger W. Bybee highlighted STEM education's significance in the renowned journal *Science* [13]. Their article, "What Is STEM Education?" explored how STEM education addresses not only science and mathematics but also technology and engineering for 21st-century citizens, promoting scientific literacy among youth.

Furthermore, the fusion of art and STEM birthed STEAM (Science, Technology, Engineering, Arts, and Mathematics) [14], enhancing creativity in younger generations. STEAM now holds its educational significance as an extension of STEM education. Researches have already been conducted on STEM/STEAM implementation in early childhood education [15][16].

Free thinking is encouraged, with students and faculty empowered to challenge existing frameworks and explore unconventional ideas. Curricula become more flexible, allowing for personalized learning paths and the integration of diverse perspectives. Universities also create enhanced dialogue platforms, providing spaces for cross-disciplinary interaction and the exchange of ideas.

Eduinformatics plays a crucial role in facilitating this transition. Learning analytics can identify patterns of interdisciplinary engagement and success, guiding the development of more integrated curricula. Adaptive learning systems, informed by real-time data analysis, can support personalized learning paths, allowing students to explore connections across disciplines more effectively.

3.3 Vision for "Ri" Universities

The "Ri" stage represents the pinnacle of transformation in higher education. Universities at this stage nurture sensibility and creativity, designing learning experiences that maximize students' inner sensible intuitions, transcending traditional academic boundaries.

Advanced educational technologies are utilized to facilitate seamless global interaction through cutting-edge online platforms and virtual reality environments [17]. These technologies not only connect learners across the globe but also provide immersive experiences that transcend physical limitations, allowing students to engage with complex concepts in novel ways.

Universities become hubs for active engagement with society, addressing real-world issues with students applying their creativity to solve complex global challenges. The role of faculty transforms from knowledge transmitters to facilitators of creativity and innovation. Eduinformatics tools support this transformation by providing real-time feedback on student engagement and learning outcomes, allowing educators to adapt their approaches dynamically.

Furthermore, at the "Ri" stage, rather than pursuing consistency or absolute truth, there is a need for an open mind that understands perspectives that include contradictions and embraces diversity. By reaching the "Ri" stage, it gets possible to create new value through abduction [18][19].

At universities aiming for the "Ri" state, the nature of education itself undergoes a significant

8

K. Takamatsu, K. Akashi, S. Matsumoto, A. Hidetani, G. Akashi, H. Ito,
K. Murakami, K. Bannaka, R. Kozaki, A. Kishida, Y. Nakata, T. Inakura, S. Imai, M. Mori

transformation. Educators no longer serve as mere transmitters of knowledge but take on the role of facilitators who stimulate and ignite students' creativity. Students, in turn, are not passive learners but active creators of knowledge, designing their own learning experiences. This transformation is closely related to the concept of Lifelong Sustainable Inquiry-based Community Learning (LSiCL) [20]. LSiCL integrates elements of lifelong learning, sustainability, inquiry-based learning, and community learning, providing an educational model adapted to the era of rapid technological innovation.

In this new educational paradigm, we move beyond the traditional binary relationship of teaching and being taught, forming a community where educators and students learn together. The LSiCL approach, based on the principles of Eduinformatics, enables data-driven educational practices, creating flexible and adaptive learning environments tailored to individual learners' needs. Moreover, this model aligns with the concepts of Society 5.0 and Industry 5.0, providing an educational foundation for realizing a human-centered society.

Such university education aiming for the "Ri" stage seeks to nurture creative problem solvers capable of addressing the complex challenges of the 21st century and cultivate the ability to continue learning throughout life. It goes beyond mere acquisition of knowledge, focusing on the creation of new knowledge and the realization of innovative ideas. This represents the actualization of education that emphasizes not just learning, but the creation of new value as well.

These institutions function as lifelong learning hubs, catering to learners of all ages and fostering intergenerational exchange and continuous personal growth. Learning becomes liberated from physical and temporal constraints, allowing for truly flexible and globalized education. Through the synthesis of diverse cultural elements and innovative approaches, universities become centers for generating new aesthetics and paradigms.

Predictive analytics plays a vital role in this vision. By analyzing vast amounts of educational data with the approaches of Eduinformatics, universities can anticipate future skills needs and societal challenges, continuously adapting their programs to remain relevant and impactful.

The emphasis on art and creativity in the "Ri" stage is particularly significant. By integrating artistic sensibilities across all disciplines, universities can foster a more holistic approach to problem-solving and innovation. This is further agreed by the emerging research on the importance of creativity in fields traditionally seen as purely analytical, such as science and engineering.

In the "Ri" stage of *Shu-Ha-Ri*, where transcendence from traditional structures occurs, the integration of arts within STEAM education represents a fusion of emotional intelligence and creativity, equipping learners with the adaptability needed to solve complex global challenges [14]. The arts provide learners with a unique lens through which they can process both personal and collective experiences, transforming them into universal expressions of empathy, mutual understanding, and resilience.

Art forms such as visual expression, music, and collaborative practices like sign language choir further foster co-creation and mutual understanding [21]. These practices dismantle polarities such as the barrier between the hearing and non-hearing, promoting inclusivity and uniting diverse communities. Such collaborative artistic activities align with the "Ri" principle of transcendence, where participants go beyond individual creative expressions to form a larger, interconnected vision. This holistic approach to education cultivates both creative innovation and compassionate problem-solving [22][23].

Moreover, arts exhibit the transformative power in an experiential fashion, represented by the forms such as the recitation of atomic bomb poetry accompanied by music. Experiences of atomic bombings have been assumed to be studied and conveyed for historical lessons, however, the norm is currently expanding so that sharing of these experiences leads to the formation of empathy, ultimately constructing a rapport in the community. This exemplifies how art can turn

collective grieves and loss into a pathway for empathy and human resilience. This aligns with the values of non-violent education, offering a creative platform to reflect on historical experiences, and ensuring lessons are learned that prevent the recurrence of tragedies [24][25][26].

Central to these transcendence and transformation are the philosophy of *wabi-sabi*— a Japanese aesthetic that finds profound beauty in impermanence and imperfection. This concept encourages reflection on the natural cycle of growth and decay, embracing simplicity and the quiet grace found in transient moments. Recognizing and admitting this mutability of any fixed practice of art, such reflective practices foster a holistic mindset, nurturing harmony with nature and cultivating innovative approaches to complex problems.

Eduinformatics enhances these artistic experiences by tailoring learning environments to individual student needs, maximizing their creative potential. This data-driven approach ensures that students thrive in a globally interconnected world, developing adaptability to address 21st-century challenges.

Incorporating these artistic elements into STEAM, particularly at the "Ri" stage, emphasizes how interdisciplinary education fosters students as both innovators and compassionate problem-solvers equipped to address the complexities of our interconnected world.

As aforementioned, the fusion of Japanese cultural elements with global perspectives offers a unique value proposition in the international higher education landscape. Japan's rich cultural heritage, including its aesthetic traditions, philosophical concepts like *wabi-sabi*, and harmonious relationship with nature, can provide fresh insights when applied to global challenges. This cultural integration can lead to innovative solutions that blend the best of Eastern and Western thoughts.

However, the path to "Ri" is not without obstacles. Universities must navigate several key challenges, including balancing academic rigor with creative freedom, developing new paradigms for assessment and quality assurance, overcoming structural inertia, supporting faculty development, investing in technological infrastructure, and carefully navigating cultural integration to avoid misunderstandings or appropriation.

Eduinformatics can help address these challenges by providing data-driven insights into the effectiveness of new educational approaches. For instance, sophisticated analytics can assist the development of more nuanced assessment methods that capture creative and interdisciplinary competencies, moving beyond traditional metrics.

Notwithstanding these challenges, the potential benefits of achieving the "Ri" state in higher education are immense. Universities at the "Ri" stage would be uniquely positioned to produce graduates capable of addressing the complex, interdisciplinary challenges of the future. They would become centers of innovation, driving social and technological progress while preserving and reinterpreting cultural heritage.

4 Conclusion

Revisiting our research question: How can the integration of Eduinformatics and the *Shu-Ha-Ri* concept guide the transformation of higher education institutions over the next 100 years to create universities that transcend current limitations of time, place, and culture while maximizing human creativity and addressing global challenges?

Our analysis suggests that the integration of Eduinformatics and *Shu-Ha-Ri* gives a powerful framework for guiding the transformation of higher education over the next century. This approach provides both a philosophical foundation and practical tools for creating universities that

K. Takamatsu, K. Akashi, S. Matsumoto, A. Hidetani, G. Akashi, H. Ito,
K. Murakami, K. Bannaka, R. Kozaki, A. Kishida, Y. Nakata, T. Inakura, S. Imai, M. Mori

transcend current limitations and maximize human potential.

The journey from "Shu" to "Ri" in higher education, supported by Eduinformatics, represents a path towards institutions that are more adaptive, creative, and globally engaged. At the "Shu" stage, Eduinformatics can help universities optimize existing structures and identify areas for improvement. During the "Ha" stage, it can facilitate the breakdown of disciplinary silos and support the development of more flexible, personalized learning experiences. Finally, at the "Ri" stage, Eduinformatics can enable truly transformative educational models that respond intuitively to individual and societal needs.

The universities of the future, embodying the spirit of "Ri", will not only be institutions of learning but catalysts for societal transformation. They will be places where the boundaries between disciplines dissolve, where creativity flourishes unfettered by conventional constraints, and where the wisdom of diverse cultures converges to address global challenges. Eduinformatics, in lockstep with the introduction to pre-existing STEM education, will play a crucial role in realizing this vision, providing the data-driven insights necessary to continuously refine and improve educational practices.

However, this transformation is not entirely free from challenges. It requires a fundamental rethinking of educational structures, assessment methods, and the role of educators. It demands a delicate balance between leveraging technological advancements and preserving the human element of education. Moreover, it calls for a careful integration of cultural perspectives to create truly global institutions of learning.

In spite of these challenges, the potential benefits are truly profound. Universities that achieve the "Ri" state will be uniquely positioned to develop individuals capable of addressing the complex, interdisciplinary challenges of the future. They will be centers of innovation that drive social and technological progress while preserving and reinterpreting cultural heritage.

In conclusion, the integration of Eduinformatics and the philosophy of *Shu-Ha-Ri* offers a promising path forward for higher education. It provides a framework for creating universities that are not just responsive to the needs of the future, but actively shape that future in positive ways. As we look ahead to the next century of higher education, this approach can guide us in creating institutions that transcend current limitations, maximize human creativity, and effectively address global challenges. The journey towards "Ri" in higher education is not just an evolution in educational practices, but a fundamental reimagining of the role of universities in society, promising a future of learning that is more creative, compassionate, and connected than ever before.

Acknowledgment

References

[1] "2024 Higher Education Trends," *Deloitte Insights*, 18-Apr-2024. [Online]. Available: https://www2.deloitte.com/us/en/insights/industry/public-sector/latest-trends-in-higher-education.html. [Accessed: 14-Oct-2024].

[2] "Top 10 Challenges in Higher Education Management and How Full Fabric Addresses Them." [Online]. Available: https://www.fullfabric.com/articles/challenges-in-higher-

education-management. [Accessed: 14-Oct-2024].

[3] Hiratsuka S., "Shu Ha Ri," *Chuzo Kogaku (J. Japan Foundry Eng.)*, vol. 86, no. 2, pp. 192–193, Feb. 2014.

[4] K. Takamatsu *et al.*, "'Eduinformatics': A new education field promotion," *Bulletin of Kobe Tokiwa University*, vol. 11, pp. 27–44, 2018.

[5] K. Takamatsu *et al.*, "Review of Recent Eduinformatics Research," in *IEEE/IIAI International Congress on Applied Information Technology 2019*, 2019, pp. 27–32.

[6] "PISA: Programme for International Student Assessment," *OECD*. [Online]. Available: https://www.oecd.org/en/about/programmes/pisa.html. [Accessed: 14-Oct-2024].

[7] "The OECD Learning Compass 2030," *OECD*. [Online]. Available: https://www.oecd.org/en/data/tools/oecd-learning-compass-2030.html. [Accessed: 14-Oct-2024].

[8] "Future of Education and Skills 2030," *OECD*. [Online]. Available: https://www.oecd.org/en/about/projects/future-of-education-and-skills-2030.html. [Accessed: 14-Oct-2024].

[9] "About Institute of Scinece Tokyo," *Science Tokyo*. [Online]. Available: https://www.isct.ac.jp/en/001/about. [Accessed: 14-Oct-2024].

[10] T. Kirimura *et al.*, "Three-step knowledge network model," *Bulletin of Kobe Tokiwa University*, vol. 9, pp. 78–86, 2016.

[11] K. Takamatsu *et al.*, "Tag-based knowledge network models," *Bulletin of Kobe Tokiwa University*, vol. 10, pp. 51–60, 2017.

[12] X. Ge, D. Ifenthaler, and J. M. Spector, *Emerging technologies for STEAM education: Full STEAM ahead*. Springer, 2015.

[13] R. W. Bybee, "What is STEM education?," *Science*, vol. 329, no. 5995. American Association for the Advancement of Science, p. 996, 2010.

[14] D. Aguilera and J. Ortiz-Revilla, "STEM vs. STEAM education and student creativity: A systematic literature review," *Education Sciences*, vol. 11, no. 7, p. 331, 2021.

[15] S. Wahyuningsih, N. E. Nurjanah, U. E. E. Rasmani, R. Hafidah, A. R. Pudyaningtyas, and M. M. Syamsuddin, "STEAM learning in early childhood education: A literature review," *International Journal of Pedagogy and Teacher Education*, vol. 4, no. 1, pp. 33–44, 2020.

[16] A. A. Akturk and H. O. Demircan, "A review of studies on STEM and STEAM education in early childhood," *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi (KEFAD)*, vol. 18, no. 2, pp. 757–776, 2017.

[17] S. M. Kosslyn and B. Nelson, Eds., *Building the intentional university*. London,

12

K. Takamatsu, K. Akashi, S. Matsumoto, A. Hidetani, G. Akashi, H. Ito,
K. Murakami, K. Bannaka, R. Kozaki, A. Kishida, Y. Nakata, T. Inakura, S. Imai, M. Mori

England: MIT Press, 2017.

[18] Y. Nakata, K. Bannaka, T. Kunisaki, T. Kirimura, and K. Takamatsu, "Abduction essential for mathematical and data science education in basic nursing education: to avoid a belief conflict between methodologies," *Bulletin of Kobe Tokiwa University*, vol. 16, pp. 52–59, 2023.

[19] K. Takamatsu *et al.*, "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.

[20] K. Takamatsu *et al.*, "Lifelong Sustainable Inquiry-based Community Learning (LSiCL) Based on Eduinformatics," in *8th World Conference on Smart Trends in Systems, Security and Sustainability (WorldS4 2024)*, 2025, p. in press.

[21] G. Akashi, "An inquiry from Music Visit Activities to Welfare Facilities and Nursery Schools: The points of contact and the spread of welfare, childcare, and art education found in the case of signing chorus by deaf children," *Chiba Meitoku Junior College Bulletin*, vol. 40, pp. 3–10, 2020.

[22] B. Juan-Morera, I. Nadal-García, and B. López-Casanova, "Systematic review of inclusive musical practices in non-formal educational contexts," *Neveléstudomány*, Dec. 2022.

[23] M. Fautley and A. Daubney, "Inclusion, music education, and what it might mean," *Br. J. Music Educ.*, vol. 35, no. 03, pp. 219–221, Nov. 2018.

[24] A. Hayakawa, "Facing the Loss of Memory: A Re-reading of Austerlitz," *Journal of the Faculty of Liberal Arts, Tsuda University*, vol. 54, pp. 29–44, 2023.

[25] Cook and A. R. K. Roy, "Can music increase empathy? Interpreting musical experience through the empathizing–systemizing (E-S) theory: Implications for autism," Frontiers in Psychology, vol. 11, Art. 1407, 2020. doi: 10.3389/fpsyg.2020.01407.

[26] C. Atherton, "Give back peace that will never end: Hibakusha poets as public intellectuals," Jun. 2015.