

A Study of Digital Transformation Human Resources Development and Data Science Education Programs at a Private Liberal Arts University

DX 人材の育成と文系大学におけるデータサイエンス教育プログラムに関する研究

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Abstract

Digital transformation is now being promoted speedily in all industries. In various fields of social, industrial, and business situations, problem-solving based on the existence of big data is emphasized. Therefore, there is an urgent need to develop human resources that have the ability of data analysis/utilization, create new value and solve problems based on this. Following the publication of the model curriculum by the Japan Inter-University Consortium, MEXT is promoting measures related to the "Certified Education Program" MDASH to enroll all students in AI/data science literacy level education. Correspondingly, the movement to introduce data science education is now spreading at many universities. However, it cannot be said that the goals of the human resources image required by the digital transformation era and the contents of the data science education curriculum suitable for the university are not always clearly recognized. Therefore, in this paper, we will discuss the essence of DX and the characteristics of human resources required in the DX era, and also describe the basic form of data science education, especially the construction of a curriculum for data science education at small private liberal arts universities such as our university. And then, we discussed the issues involved in data science education, such as the impact of information education reform in high school, the introduction of "information" in the common test for university admission, and the possibility of a fusion of data science knowledge in specialized education and how to integrate data science education with expertise education, and how we should overcome the barriers for the liberal arts students who lack mathematics foundations and IT skills in data science learning.

1. INTRODUCTION

The fourth industrial revolution driven by advanced information technological innovations such as Internet of Things (IoT), Big Data, Artificial Intelligence (AI), Machine Learning (ML), Data Science (DS), and traditional Mathematical Statistics skills, etc. is bringing significant changes to our society, economic activity and industrial structure 1). On the other hand, the digital transformation (henceforth, DX) is now being promoted speedily in all industries, and it is the advancement of digital technology and data utilization that brings us the mega shift in the

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way that society should be, including personal life, administration, industrial structure, employment, etc. But what is the essence of DX? What are the characteristics of human resources required in the DX era? And what does DX have to do with data science? Before we talk about data science education, we need to answer these questions. In various fields of social, industrial, and business situations, problem-solving based on the existence of big data is emphasized. As more data and ways of analyzing them become available, more aspects of the economy, society, and daily life will become dependent on data. Therefore, there is an urgent need to develop human resources who have the ability of data analysis/utilization, create new value and solve problems based on this, meanwhile, education on mathematics and data science has been strongly demanded. Educators, administrators, and students must begin today to consider how to best prepare for and keep pace with this data-driven era of tomorrow 2).

But unfortunately, Japan is a little behind the level of major countries in the world. The shortage of human resources in DX and AI application fields is becoming more serious, this is the current situation. To treat such a situation, the government has formulated a strategy called "AI Strategy 2019" and set a goal of about 500,000 people to nurture human resources in higher education every year. It states that "all of the university and technical college students, regardless of the humanities fields or the science fields, will acquire the literacy education with the basis on mathematics/statistics skills, data science, and AI technologies in their courses 3). Furthermore, it is also important for the liberal arts universities to develop human resources who have mathematical thinking ability and data analysis/utilization ability for handling data process and AI applications, especially the data science ability because science and engineering universities alone cannot be fully satisfied with that goal. As the main initiative for educational reform to respond to AI Strategy 2019, all people should be nurtured with the necessary abilities of basics of "Mathematical, Data Science, AI", which is known as the "reading, writing, and calculation basics" of the digital society required. From now on, more data and ways of analyzing tools become available, more aspects of the economy, society, and daily life will become dependent on data. And graduates will be active in all fields and contribute to technological innovation.

Under such a background, to encourage efforts in mathematics, data science, and AI education at each university and college of technology, the Cabinet Office, the Ministry of Education, Culture, Sports, Science and Technology (MEXT), and the Ministry of Economy, Trade, and Industry (METI) have collaborated to formulate the "Mathematical, Data Science, and AI Education Program Certification System (literacy level)", which is also known as MDASH-Literacy (Approved Program for Mathematics, Data Science and AI Smart Higher Education). Corresponding to this, the Japan Inter-University Consortium for Mathematics and Data Science Education to promote activities to spread the enhancement of mathematics and data science education within universities whole of the country, and to foster the development of human resources for pioneering a future centered on mathematics, statistics, and data science.

Meanwhile, there is also a transformation in information education of high schools. It was decided that the subject "Information I" will be compulsory in high school from 2022 and it will be introduced to the common examination for university admissions three years later. These changes have led to no choice but to reexamine the

way ICT education should be in universities.

Under such circumstances, especially there is a difference in proficiency in mathematics and IT literacy skills between each department's students at the time of admission. To provide literacy-level education of data science to all university students, it is appropriate for each university to consider countermeasures according to the actual situation of the students and to develop a good education program. As a case study, this paper will discuss the construction of building a curriculum for data science education at private universities of liberal arts, the scale close to Kansai University of International Studies (KUISs). Although a skeletal model curriculum by the Inter-University Consortium has been formulated, discussions on what kind of mathematical and data science education should be specifically provided to university students who have various proficiency levels and motivations for mathematics, etc. have just begun.

2. DX HUMAN RESOURCE DEVELOPMENT AND DATA SCIENCE EDUCATION

No doubt the biggest buzzword from 2015 till today is "Digital Transformation", a phrase that has already acquired the somewhat it goes far beyond mere change or innovation, but so-called revolution or evolution in various fields all over the world. Meanwhile, in the promotion of DX in companies in Japan, due to the IT needs expansion, there will be a supply-demand gap of 450,000 domestic IT human resources in 2030. 70% of the IT talents are mainly in the information technology-related companies. It is not easy for other user companies to hire digital human resources from outside. Therefore, efforts to develop in-house human resources are necessary for general enterprises, at the same time, there is no choice but to rely on educational institutions such as universities. Whichever it is, human resources who understand both business domain knowledge and digital technology are the ones in the field who will become a key player in realizing DX 4).

The transformation will be a top priority for most companies and organizations as exponential technological change impacts them across the board. The key point is it keeps moving and we all know Moore's Law. The law claims "technology doubles in power about every 18 to 24 months". And that is the challenge to keep up with when you are in a business, or you will be. But what exactly the digital transformation is? What is the essence of DX? And what kind of ability is required for human resources who can promote it? Unfortunately, the reality is that many people don't understand exactly the difference between "digitized" and "digital". This is the current situation. Different fields have different interpretations. For instance, about the Education DX, the president of a university maybe thinks it is a visualization of management; while the teachers may think of Education DX as online lessons, the staff employees may think DX is work from home. Similarly, in a company, the managers may think DX is agile culture and business innovation. The office workers may recognize DX is just a paperless action; while the technical department people may think it is a culmination of technologies about IoT, Clouds, AI, Machine Learning and Data Science, etc. 5). We should let students understand these because they will live and work in the DX era, where work across nearly all domains is becoming more data-driven, affecting both the available jobs and the required skills.

Generally, DX is the integration of digital technology into the whole process of a business, fundamentally changing how to operate and deliver value to customers, which is a cultural change that requires organizations to challenge their status quo continually. At the social level, digital transformation means that the penetration of ICT will change people's lives for the better in every aspect. New social and economic systems will be born with it. At the corporate level, digital transformation means a new business model based on digital resources and digital technology.

But what is the difference between the two words, “digitized” and “digital”. The key point is to figure out the differences between work efficiency and work modes. Digitization is generally about the conversion of analog information into digital. For instance, paper-media information can be converted to digital by scanning with OCR. To convert music information from the cassette tape to format of mp3 digital file; when calling a Taxi, a few years ago, you will first call the operator by phone, and the operator would then tell the taxi driver and drive to the place where the customer is. But now you can just use the application on your mobile phone. Once you take advantage of what has become digital, it can lead to improved business efficiency or added value. That is digitalization.

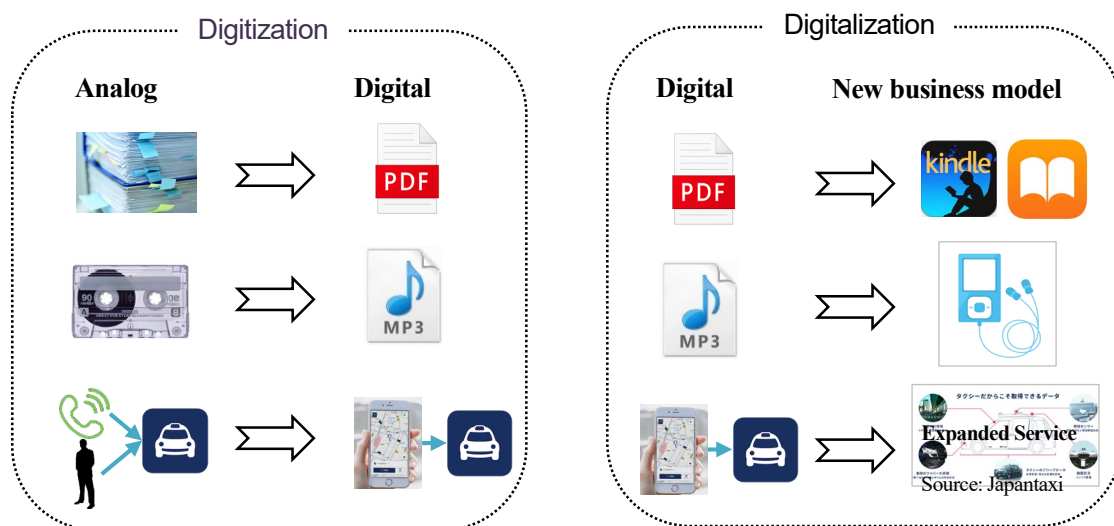


Figure 1. The Difference between digitization and digitalization

For example, as shown in Figure 1, if you convert books from paper-media information to digital, you can read the books you like anytime, anywhere as the AWS Kindle or Apple books service do. Also, when music or song is digital, you will be able to listen to songs anytime, anywhere, and in addition, you can also select the song to listen to according to your taste, and the system can deliver it to your smartphone easily. Similarly, when POS data is utilized in digital, it will be possible to optimize inventory management, automate customer service, and so on. This means a new model of business. For a company, to realize this, it requires the construction of a digital human resources development platform; and further, clarifies the relationship between the abilities that DX human resources should possess and the data science education in business. DX promotion needs the business ability to

commercialize, data science ability that can test hypotheses from data, and engineering talent in problem-solving.

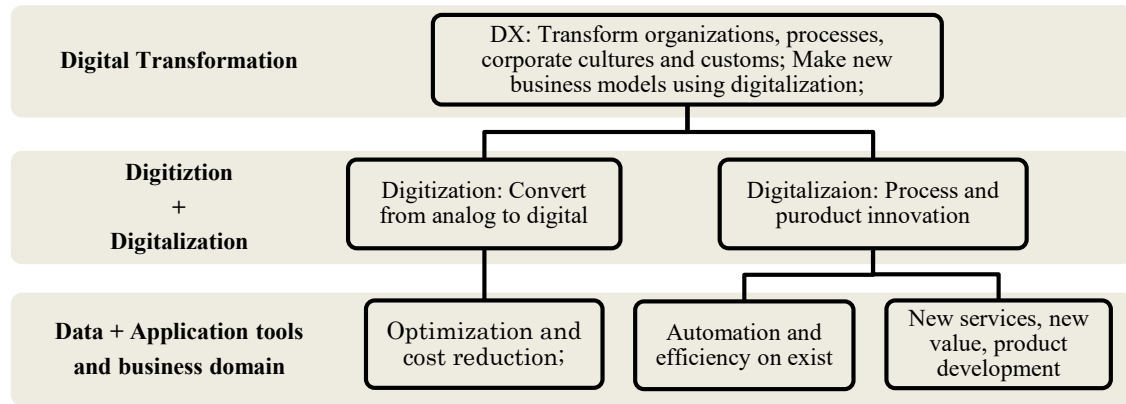


Figure 2. Relationship between digitization and digitalization in DX

Figure 2 shows a relationship between Digitization and Digitalization in business DX promotion. For a business, the “Digitized” concerns the operational excellence to convert existing business from analog to digital to get for optimization and cost reduction by using analog data and ICT tools in a specific domain. While “Digitalization” concerns the process innovation and product innovation using the datasets of a business and the application tools related to knowledge of Data Science and Machine Learning applications. The transformation enhances traditional products and customer service; it concerns to delivers a new customer value proposition and a new model for rapid business innovation. So, the talents of human resources required in the DX era include both digitization and digitalization abilities. The former is the ability to convert traditional operations from analog to digital, and the latter is the ability to innovate business processes, that is, automate and streamline existing operations, including product innovation ability to develop new services models and products.

Table 1. Definition of human resources corresponding to DX promotion

Product Manager	Leader-level human resources who lead the realization of digital business
Business Designer	Human resources responsible for planning, drafting, promotion, etc. of DX and digital business (including marketing)
Tech Lead (Engineering Manager, Architect)	Human resources who can design and implement systems related to DX and digital business
Data Scientist	Human resources who are familiar with the business and operations, and have the ability of data analyzing and create new value
Advanced Technology Engineer	Human resources responsible for advanced digital technologies such as machine learning and blockchain
UI / UX Designer	Human resources in charge of designing systems for users related to the digital business
Engineer / Programmer	Human resources responsible for system implementation, infrastructure construction, maintenance/operation, security, etc. related to digital business

An example of human resource types/definitions required for DX is claimed in DX White Paper 2021 (Part 3 Human resources in the digital age) by Information-technology Promotion Agency (IPA) 6) as shown in Table 1. The digital business here refers to businesses that utilize digital technology, such as EC, AI (artificial intelligence), IoT, and big data. These characteristics of the human resources image will help us in the development of the curriculum for our data science education program.

3. MDASH-LITERACY OUTLINE OF EDUCATION PROGRAM CERTIFICATION SYSTEM AND STANDARD CURRICULUM OF CONSORTIUM

To develop human resources who have the abilities of mathematical thinking, data analysis/utilization, and create new value and can solve problems based on this, MEXT is promoting measures related to the "Certified Education Program" MDASH-Literacy to enroll all students in higher education in literacy-level education about AI and data science national wide. Correspondingly, the movement to introduce data science education programs is now spreading at many universities, including the private liberal arts universities. By now the MDASH-Literacy recommended by MEXT has been recruited twice in March and August 2021, and a total of 78 universities and technical colleges have been certified so far. Furthermore, among the certified educational programs, those with leading and unique ideas and characteristics will be certified as the successor at the MDASH-literacy Plus educational programs. The recruitment will start from March 2022. In addition, to expand the base of digital human resources, it will focus on vocational training and education and training benefits for digital human resources development and strengthen the expansion of digital-related programs.

In connection with this effort, the inter-University Consortium for Mathematics and Data Science Education plays a central role so far to create and disseminating a standard curriculum and teaching materials that will serve as models for high education. Also, the consortium has created a "mathematical, data science, AI (literacy level)" model curriculum. The basic idea for the study objectives and curriculum implementation is as follows.

- 1) In the future digital society, to proactively acquire the basic skills to master mathematics, data science, and AI in daily life and work.
- 2) Based on the knowledge and skills related to mathematics, data science, and AI that he/she has learned, when dealing with these, they can make appropriate human-centered decisions, and enjoy the benefits of AI technology own without anxiety. Also, they can explain and utilize.

The main contents of the model curriculum consist of "introduction", "basics", "knowledge", and "elective". The introduction part is related to the utilization of data and AI in society; the basics part is about data literacy on data analyzing; the knowledge part is about issues to keep in mind when handling data/AI such as data security, data/AI ELSI; the elective part includes statistical and mathematical foundations, data structures and programming, machine learning, etc. as options 7).

According to the MEXT's open call for participants briefing materials 8), the educational program should raise the interest of students, and the content should be systematically acquired with basic knowledge and skills. And

the course subjects corresponding to five specified examination items must be satisfied with the requirements for completing the relevant educational program. The correspondence of the specified items' requirements to points of the model curriculum is shown in Table 2.

Table 2. Five examination items requirements corresponding points of the model curriculum

Item	Examination contents of items	Model curriculum correspondence
Item 1	Science, data science, and AI are deeply contributing to the ongoing social changes (Fourth Industrial Revolution, Society 5.0, data-driven society, etc.); and it is closely related to one's own life.	Introduction 1-1. Changes occurring in society 1-6. Latest trends in data / AI utilization
Item 2	The "data utilized in society" and "data utilization area" targeted by mathematics, data science, and AI are extremely wide-ranging and can be useful tools for solving problems in daily life and society.	Introduction 1-2. Data used in society 1-3. Data / AI utilization areas
Item 3	Examples of data utilization in various data utilization sites are shown in lectures. Mathematical, data science, and AI should create value by combining knowledge in various application areas (distribution, manufacturing, finance, services, infrastructure, public, healthcare, etc.).	Introduction 1-4. Technology for data / AI utilization 1-5. Data / AI utilization site
Item 4	However, mathematics, data science, and AI are not all-purpose. It is important to consider various points to keep in mind (ELSI, personal information, data ethics, AI social principles, etc.) when using it.	Knowledge 3-1. Precautions for data / AI utilization 3-2. Precautions for protecting data
Item 5	Using actual examples in society, such as exercises using actual data and actual tasks (including academic data, etc.). Basic usage of mathematics, data science, and AI such as "understanding, explaining, and handling data".	Basics 2-1. data understanding 2-2. data explaining 2-3. data handling

4. CONSIDERATION OF PROBLEMS ABOUT LIBERAL ARTS STUDENTS IN DATA SCIENCE EDUCATION

The Japan Inter-University Consortium for Mathematics and Data Science Education surely has created a "mathematical, data science, AI (literacy level)" skeletal model curriculum. However, the implementation of the concrete curriculum is left to the discretion of each university. For a private liberal arts university like our university, in the development of a data science education program, how to build a systematic curriculum model that considers the aspects on "knowledge module" of data science, "implementation approach" about the teaching method, and overcome the "study hurdles" of the liberal arts students. The study hurdles mean the disability features peculiar to liberal arts students. For instance, students at a liberal arts university are not good at mathematics and lack IT skills, and the commands for critical thinking skills, including the knowledge of data structures and introductory programming at a slightly higher level than information literacy lessons in the current university's ICT education curriculum. These issues must be taken into consideration to overcome such difficulties in implementing the

curriculum of a data science education program that is suitable for the students at a liberal arts university.

On the other hand, it is important to regard data science as a cycle of knowledge development based on data for problem-solving. As pointed out in the recommendations of the Science Council of Japan (2014) 9), in data science, Problem extraction and formulation; Data acquisition/management/processing; Exploratory data analysis; Data analysis and reasoning; Sharing and communicating results, proposals for problem-solving. To develop these abilities, a student will learn data science through hands-on practice with the latest job-ready tools and skills, including open-source tools and libraries, Python, databases, SQL, data visualization, data analysis, statistical analysis, predictive modeling, and machine learning algorithms.

5. CURRICULUM DESIGN FOR DATA SCIENCE EDUCATION AT KUISs

The importance of education on involved in mathematics and data science that transcends the boundaries of specialized fields is being strongly emphasized, from the year 2022, Kansai University of International Studies (KUISs) will offer a "Mathematical and Data Science Standard Curriculum Course" for students enrolled in 6 faculties: Sociology, Education, Business Administration, Psychology, International Communication, and Health and Medical Sciences. It has been established and is developing education to acquire the basics of mathematics and data science, regardless of the framework of liberal arts and science.

To carry out data science education program smoothly, and let the data science talent training course succeed, as a way of thinking on curriculum implementation, I think it is necessary to comprehensively develop the course of subjects cover computer and information system knowledge, mathematics/statistics related skills, domain knowledge about specialized fields, problem-solving experience. This paper proposed a conceptual diagram (see Figure 3) of a Stage-wised Refinement Model in the data science education program of implementation for a liberal arts university.

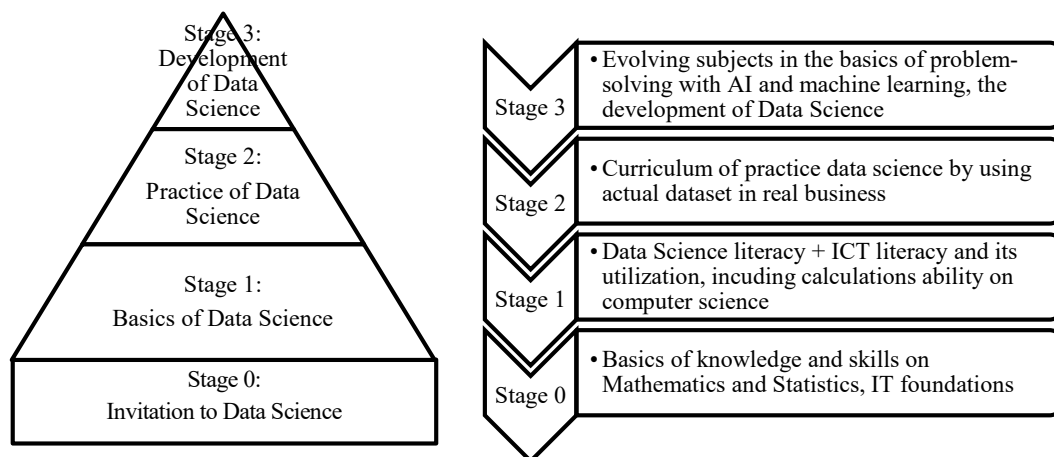


Figure 3. A Stage-wised Refinement Model in data science education program implementation

As pillars that support the data science curriculum, four subject categories have been set to be four stages as "Stage 0: Invitation to Data Science ", "Stage 1: Basics of Data Science", "Stage 2: Practice of Data Science", and "Stage 3: Development of Data Science".

At **Stage 0: Invitation to Data Science**, the contents include the basics of knowledge and skills on Mathematics and Statistics which is aimed to clear the hurdles for liberal arts students in data science study. In some cases, you may also need a remedial education on mathematics and IT foundations in junior high school and high school.

At **Stage 1: Basics of Data Science**, the contents include the data Science literacy corresponding points of introduction in the model curriculum by the Inter-University Consortium, in addition, ICT literacy skills including calculation's ability on computer science.

At **Stage 2: Practice of Data Science**, the contents include practice data science by using actual datasets in real business or simulation with a specific domain application. Learn how to handle data and databases for liberal arts students and analyze data using statistical analysis software R or entry of programming language Python.

At **Stage 3: Development of Data Science**, the contents include evolving subjects in the basics of problem-solving with AI and machine learning. Learn how to perform machine learning using actual data by using Python programming language, AI tools, etc. If possible, take it to PBL education that practices problem-solving and value creation.

Based on the above conceptual design, we develop a curriculum of subjects that includes three knowledge areas.

The subjects shown in table 3 are the subjects of the data science education program curriculum that will be performed at our university from next year, which is mainly related to three knowledge areas. Area I is about basic statistics skills, Area II is about ICT and data science basics, and Area III is for the programming techniques and the basics of IoT, big data, and AI evolving subjects in the basics of problem-solving content.

Table 3. Subjects of data science education curriculum

Knowledge Category	Subject Name	Course Period	Status	Credit	Certification Requirements of MDASH-Literacy	
Area I	Basic Statistics A	1st year (spring)	compulsory	2	Item 5	Subject C
	Basic Statistics B	2nd year (spring)	elective	2	Item 5	Subject F1
	Entry To Research	1st year (autumn)	elective	1	Item 5	Subject D
Area II	ICT literacy	1st year (spring)	compulsory	2	Item 4	Subject B
	ICT Application A	1st year (autumn)	elective	2	Item 5	Subject D
	Data Science	2nd year (spring)	compulsory	2	Item1,2 ,3	Subject A
Area III	Data Science Theory	2nd year (spring)	elective	2	option	Subject E1
	Data Science Practice Exercise	2nd year (autumn)	elective	2	option	Subject E2
	Basics Of Artificial Intelligence	2nd year (autumn)	elective	2	option	Subject F2

The work performed mainly considers two aspects. The first one is to systematize the relationships between the subjects while standardizing the contents of the subjects that are currently being implemented. The second one is going to award a "Data Science Education Curriculum Certificate" by acquiring the prescribed credits from the subject group listed in table 3.

The course of subjects including in knowledge Area I and Area II are called DS-KUIs beginner course. It is for the beginner's Data Science education program at our university. If a student has completed the prescribed 4 subjects from it with 7 credits, he/she will be reached the "Data Science Education Curriculum Beginner" level (DS-KUIs beginner). The level of DS-KUIs beginner has cleared the MEXT MDASH-Literacy which is shown above in Table 2 by the items 1 to item 5 certification requirements. Moreover, students who take an additional elective course in knowledge Area III after taking the beginner's course will be in the intermediate level of "Data Science Education Curriculum Intermediate" (DS-KUIs Intermediate). In this case, they need to complete the prescribed 6 subjects with 11 credits.

6. CONCLUSION

If we look at the perspective of high school and university connections from the field of information literacy education, we can note there is the same goal between high school and the university, regardless of humanities fields or science fields, to acquire literacy-level mathematics, data science, and AI in regular courses. However, how well it can be achieved is a problem. It is important to point out that three things will affect Data Science Education in universities going forward, first one is the impact of the reform of information education in high school, and the second one is the introduction of "information" in the common test for university admission. The third one is the possibility of a fusion of data science knowledge in specialized education and how to integrate data science education with expertise education. Of course, the problem of remedial education of mathematics basics that university students of liberal arts are not good at cannot be ignored.

Firstly, a new course of study to be implemented in high school from 2022 was announced in March 2018, to integrate reform of the information education in high schools, universities, and colleges enrollment selection to realize high school connections suitable for the new data-driven era. In the information department, it is focused on the scientific understanding of information science, and the subject of "Information I" was made a compulsory subject in high school. After that, "Information II", which deals with the advanced contents, was set up as an elective subject. In addition, the subject "Information" in the Common Test for University Admissions will be introduced. From the point of view of information education at universities or colleges, the obvious merit of imposing the information subject on the entrance examination is that it can be guaranteed that the students have a certain level of information literacy. But it causes the problem to take the opportunity to review the curriculum of information education at universities.

Secondly, how to solve the problem of the fusion of data science education with specialized education. It is necessary to have an "implementation approach" that divides the knowledge module into the stages of data science

introductory, data science development, and data science practical according to the difficulty level of knowledge and teaching progresses step by step. Particularly, in the expertise education of each faculty, how to integrate the data science knowledge with the "expertise knowledge education" is important. One of the solutions is considered effective to incorporate PBL (Project Based Learning), which deals with practical issues in collaboration with the real world, into the curriculum. The detailed discussion is omitted here and will be reported in another paper.

Finally, it is a problem for the liberal arts university students who lack mathematics basics and information technology skills, including programming skills in study data science. In the current course of study in high school, the subject "Information Science" contains a lot of content related to data science, but the subject "Society and Information" is overwhelmingly taught. When expanding data science education to all universities nationwide, the problem is that there is a great deal of variation in the content of learning up to high school. The same is true in mathematics, especially for liberal arts university students. Some people think that mathematics is sufficient for logical thinking, but it is the strength of information science that can be seen in problem-solving in the real world. Both the foundations of mathematics and the foundations of information technology skills are indispensable for the implementation of Data Science education.

Looking at the lectures of Data Science courses for the first-year students of the Faculty of Sociology and the Faculty of Psychology of our university, the basics of mathematics are exactly lacking. This is one of the obstacles that must be overcome in future Data Science Education. Otherwise, when implementing a skill set that includes content that exceeds the literacy level, such as the application items about AI and machine learning, the remedial education related to the three major categories "math basics", "calculation basics", and "statistics basics" is necessary. This issue needs to be addressed in the form of first-year education, seminars, or center programs at KUISs. As one measure to this problem, we are newly constructing basic mathematics content for data science education for college students in the liberal arts, which will be developed by on-demand learning. For instance, to develop the learning content that utilizes Python programming and corresponds to the middle and high school math knowledge modules that are indispensable for data science learning. This is a future research task in Data Science Education.

7. REFERENCES

- 1) Zhihua Zhang, The development of new information technology and necessity of data science education, Bulletin of Sanyo Women's College, No.41, pp. 1-20 (March 2020).
- 2) National Academies of Sciences, Engineering, and Medicine 2018. Data Science for Undergraduates: Opportunities and Options. Washington, DC: The National Academies Press, (2018).
- 3) Cabinet Office, AI Strategy 2019 -AI for all people, industry, regions, and governments-, Integrated Innovation Strategy Promotion Council Decision, (June 2019), https://www.kantei.go.jp/jp/singi/ai_senryaku/pdf/aistratagy2019.pdf.
- 4) Jeanne Ross, Cynthia Beath, the Digital Challenge: How to Transform Your Business in the Midst of a Crisis, MIT

Industrial Liaison Program Webinar Series, (2020).

- 5) Zhihua Zhang, ACP International Workshop and Symposium on Safety Management Beyond, Human Resources Required in Digital Transformation (DX) Era, (December 2021).
- 6) IPA Homepage, "DX White Paper 2021", <https://www.ipa.go.jp/files/000093706.pdf>.
- 7) The Japan Inter-University Consortium for Mathematics and Data Science Education, Mathematics / Data Science / AI (literacy level) Model curriculum, (April 2020),
http://www.mi.u-tokyo.ac.jp/consortium/pdf/model_literacy.pdf.
- 8) MEXT, "Mathematical/Data Science/AI Education Program (Literacy Level) Requirements", Open call for participants briefing materials, (March 2021),
https://www.mext.go.jp/content/20210305_mext_senmon01-000012801_1.pdf.
- 9) The recommendations of the Science Council of Japan, Training of Human Resources for the Big Data Era, (2014),
<https://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-22-t198-2.pdf>.
- 10) Yumi Matsuo & Kazue Tamada, Issues in data science education at liberal arts and private universities, Bulletin of Edogawa University No. 31 (March 2021) pp. 249-255.
- 11) METI, "Survey on IT Human Resources Supply and Demand", (2018),
https://www.meti.go.jp/policy/it_policy/jinzai/.
- 12) Jeanne Ross, Cynthia Beath, the Digital Challenge: How to Transform Your Business amid Crisis, MIT Industrial Liaison Program Webinar Series, (2020).
- 13) Curriculum Guidelines for Undergraduate Programs in Statistical Science, (2014),
<https://www.amstat.org/asa/files/pdfs/EDU-guidelines2014-11-15.pdf>.

抄 録

昨今、デジタルトランスフォーメーションの動向はあらゆる業界でスピーディーに推進されていて、社会、産業、ビジネスのさまざまな場面において、ビッグデータに基づく問題解決が強調されている。そのため、データ分析・活用を持ち、新しい価値を創造し、これに基づいて問題を解決する能力を持っている人材の育成が急務となっている。特に、データサイエンスや AI 技術応用分野で活躍できる人材の必要性が高まり、国立 6 大学を拠点校とする「データサイエンス教育強化拠点コンソーシアム」がリテラシーレベルのモデルカリキュラムを公表したことを受け、文科省は AI・データサイエンスリテラシーレベルの教育を全学生が履修することを目標に、MDASH「認定教育プログラム」という施策を推進している。これに順じて、多くの私立大学でデータサイエンス教育導入の動きが広がっている。

しかしながら、一方では、デジタルトランスフォーメーション時代に求められる人物像の目標や、大学にふさわしいデータサイエンス教育カリキュラムの内容が必ずしも明確に認識されているとは言えない。そこで本稿では、これらの問題を踏まえて、DX の本質と DX 時代に求められる人材の特徴について考察するとともに、データサイエンス教育カリキュラムの基本形、特に文系の小規模私立大学におけるデータサイエンス教育のカリキュラムの構築について論じる。

最後に、大学におけるデータサイエンス教育課題として、高校における情報教育改革の影響や大学入学共通テストで「情報」の導入の影響、そしてデータサイエンスの知識と専門領域教育における専門知識との融合の可能性など、大学のデータサイエンス教育に関する課題について議論する。また、数学の基礎力と IT スキルが不足している文系大学生のデータサイエンスの学習における障壁をどのように克服するか、数学基礎とプログラミングを統合するリメディアル教育についても論じる。