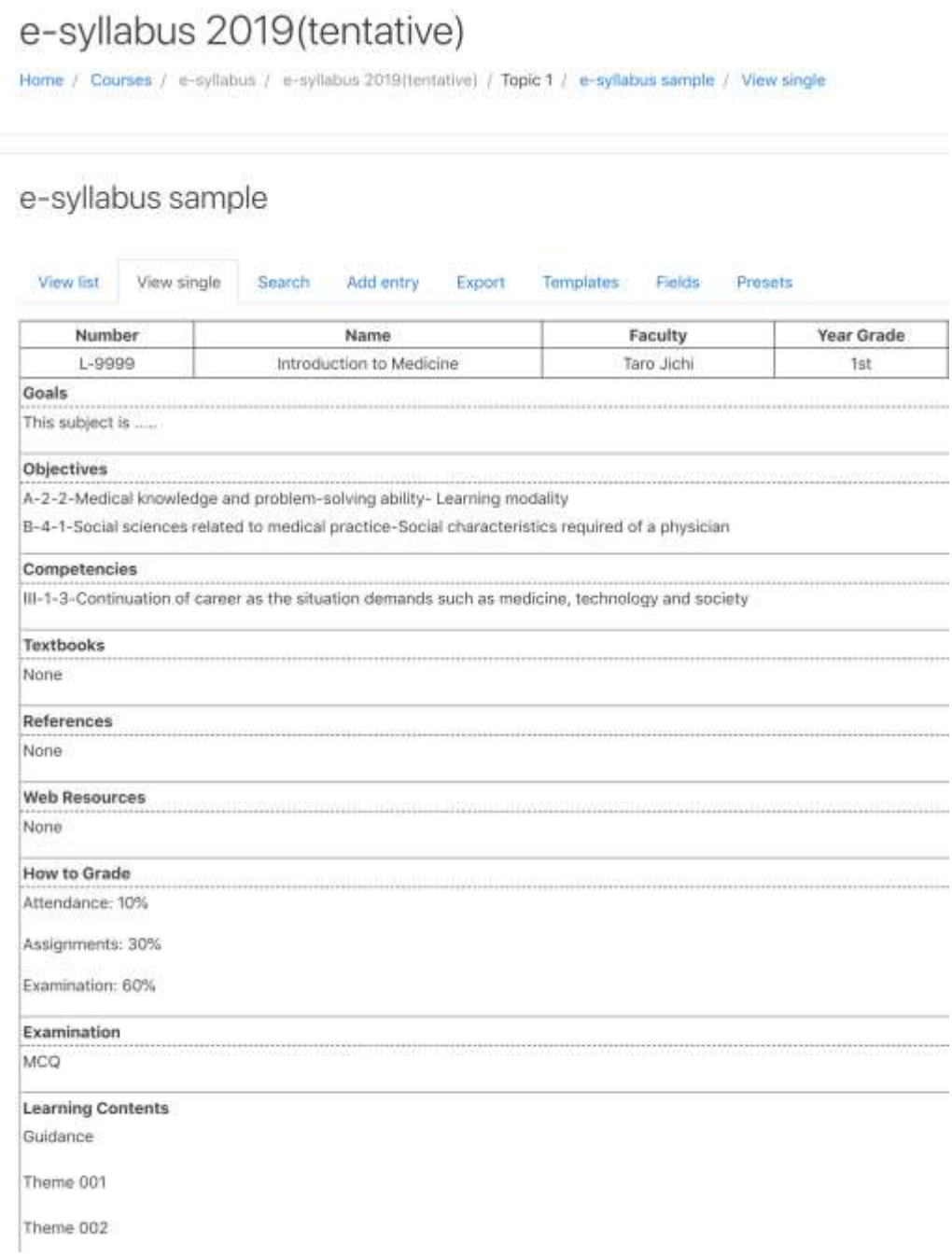

Figure 4: Sample of e-syllabus with Moodle database activity, objectives, and competencies shows the MCC and DP.

The latter is created using the feature of competencies. Moodle can have competencies as a tree-structured data. Each competency can be connected to each course or each activity. The administrator of Moodle is also able to define the stage of completion of competencies, such as "not competent" and "highly competent."

Table 7: Elements of General Information of Subjects (for Moodle e-syllabus)

Items	Contents
ID	Unique ID for this table
Subject ID Number	ID number of the subject
Goals	Free-style text on the goals of subjects
Objectives	Choices from the lists of MCC (3 to 5)
Competencies	Choices from the lists of DP (3 to 5)
Texts / References	Information about the textbooks
Grading	Grading rules and the percentage of each element, such as attendance and final examination
Contents	List of contents of each class

3 Current Working Topics of IR

There are some distinctive aspects of medical education, especially in JMU. In this section, the four main topics are described.

3.1 Enrollment Management

As mentioned before, JMU takes two or three students from each prefecture every year because of the specialty of the university. This means that the scores on the entrance examination sometimes would not function properly.

Figure 5 shows the distributions of the number of candidates who took up the entrance examination. The figure shows that there are large differences in the numbers; some prefectures have about only 20 while others have more than 100. Since the university must admit 2 to 3 students from each prefecture, there would also be score gaps among candidates. That is, some applicants who score higher in prefecture A (e.g., 85%) might not gain admission while other applicants who score lower in prefecture B (e.g., 70%) might gain admission even though they have taken the same examination.

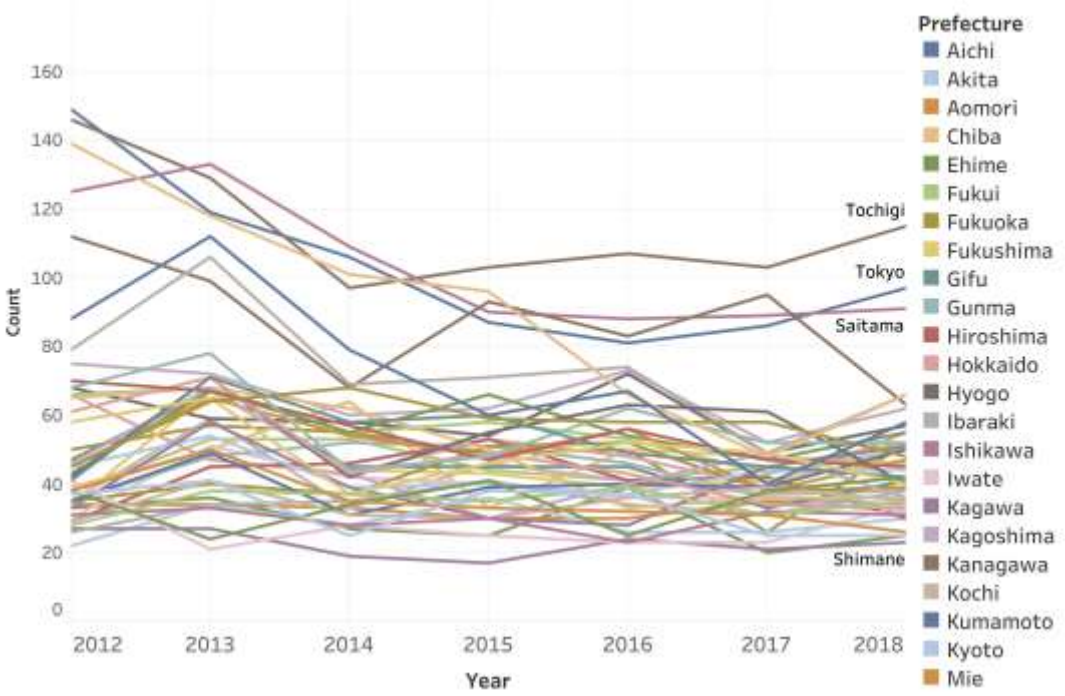

Figure 5: Distribution of the number of candidates, the color of lines shows the prefectures

Although distribution per prefecture is the special interest topic of JMU, other topics such as the distribution of sex and the length of the year spent after high school graduation sometimes hold significant meaning in certifying the equitability and fairness of the entrance examination.

3.2 Indexes for Institutional Research

The second topic is indexes for analysis. The "standard" indexes are sometimes not appropriate because of the specialty of medical education.

For example, most subjects are compulsory. Of course, there are some elective subjects such as liberal arts, but medical-specific subjects such as anatomy and clinical medicine are all mandatory. Also, there are many non-classroom lectures such as bed-side learning and PBL (Problem Based Learning). This means that the rates of unit acquisition or attendance for classroom lectures might not be suitable as indexes to consider at-risk students. In other words, new indexes should be considered for medical education.

In JMU, Moodle has been used as the LMS from 2012, especially for first-year students. There are some assignment tasks and materials for self-directed learning. Moreover, some lab courses and bed-side learnings use Moodle as a tool for assessment of attitudes and as a learning portfolio these days. For example, Figure 6 shows the sample distribution of the submission time of quizzes. This figure shows some students doing their task late night. This might have led to short-time sleep and in turn to low performance. These kinds of formative assessment data would be useful for IR, especially for enrollment management as a longitudinal data after the entrance.

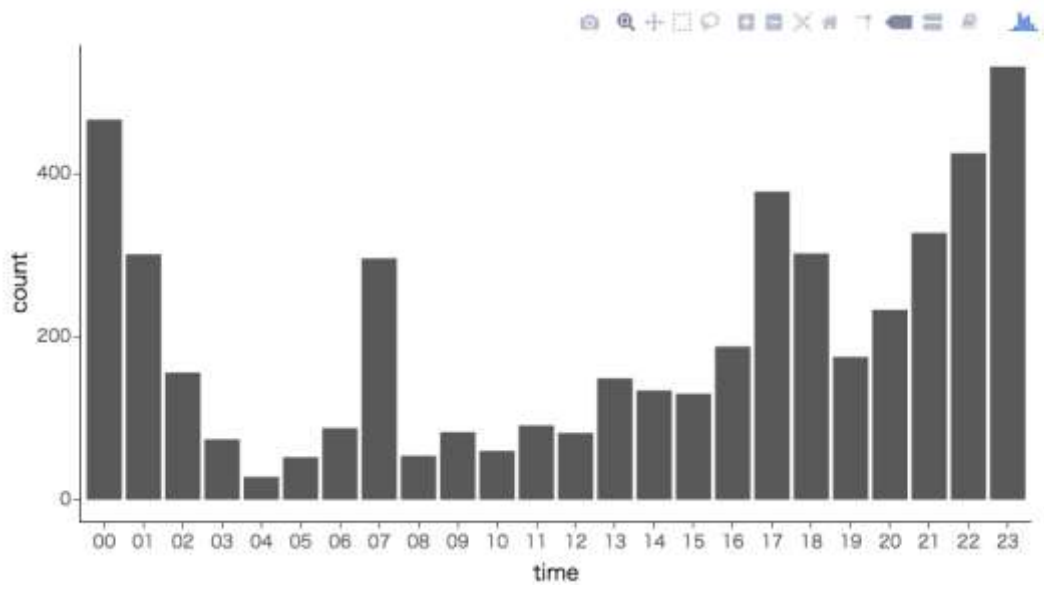

Figure 6: Distribution of submission date and time of assignments on Moodle

3.3 Learning Analytics

Previous sections mentioned about IR from the position of the faculty. However, the important role of education deals with students. Although the IR is needed for some academic management such as accreditation, some of the data are based on students' learning results. In fact, there are previous studies about learning analytics with Moodle data in medical education [12] [13]. They might be useful for analyzing and finding at-risk students [14].

If the data can be used for students and faculty as well, this will aid learning support. However, since the IR data treat some sensitive data, they are not suitable for sharing with students, and even with faculty. Thus, the summarized, visualized data sharing structure is underdeveloped in Moodle.

One example is that of viewing learning-completion status. The "objectives" of syllabus are connected to the MCC and the "competencies" are connected to DP in JMU. That is, if students clear some subjects, the related MCC and DP are also cleared to some extent. Thus, it can calculate and visualize the completion rate of MCC and diploma policies from the completion stage of the subjects.

Note that students have limited access authorization to visualized data; they should be able to access only their own data. When students access Moodle, they use their own ID and password. Thus, the new plugin is developed to check the id number and view only their data.

Furthermore, since Moodle is one of the common open source LMS [15] and is used in several universities and colleges, the methods of IR with learning analytics based on Moodle data would be shareable and useful for other medical universities and colleges.

3.4 Establishing the system for sharing visualized data

The fourth one is about sharing the results. Since educational data are personal information, the data should be handled sensitively. The raw results data of analysis by IR are on the local computer, and the faculty and staff cannot access them directly. Some graphs and anonymous data are accessible via local area network for the convenience of meetings or for committee, but they require the id and password.

Although most graphs on report files such as PDFs are static images, the dynamic graphs are useful for IR such as filtering the data and changing the scale of axes. For example, choosing specific years or terms is needed to analyze and to compare the differences between them. The typical approach to make dynamic graphs is to use business intelligence (BI) tools [16] [17]. However, many BI tools need on-premise or cloud server for sharing the results. As noted before, the data of IR include sensitive information that is not permitted to be uploaded to the cloud server. Also, these servers usually have limits on the number of accounts. This implies that sharing the results of IR via BI server with the faculty is difficult due to the limit on the number of accounts.

Moreover, data protection regulations such as EU GDPR (General Data Protection Regulation) are attracting a lot of attention these days [18]. Since the role of IR is not the assessment of students but the evaluation of the educational system, the educational data would be handled for a purpose other than the original intent. Therefore, students' consent to this must be sought to use their data as needed.

One possible idea to make the sharing system for sharing visualized data is using Moodle. In fact, some previous studies show LMS with visualization for learning analytics and assistance of self-regulated learning in medical education [19] [20]. As mentioned before, plugins of Moodle such as "Configurable Reports" and "Ad-hoc database query" are able to extract row data from the database with SQL. If some improvements are made to the plugin, it would be possible to visualize the data using some other programming languages such as Python and R, as shown in Figure 3.

Another idea is to use open data for sharing contents such as the syllabus. Many universities and colleges disclose and share their syllabus. Thus, it would be possible to share statistical data based on e-syllabus such as the curriculum mapping of DP and MCC for each subject. Since MCC is used commonly in Japanese medical education, visualized data based on MCC can be easily comparable with results of other institutions. Furthermore, this sharing style can be applied to other clinical education fields that have MCC, such as pharmacy education or nursing education.

3.5 Limitations

Despite the positive ideas emerging from the establishment of IR, this paper has its limitations too. First, this study is only a case report and mentions only a few results of actual IR data. One of the future tasks on establishing the IR of JMU is to analyze the data and find useful results for educational improvement such as for enrollment management or checking the curriculum map.

Second, the results and discussion focus only on the JMU case. Since there are another 81 medical universities and colleges in Japan, and the JMU has some specific aspects, as is noted in the

previous section, the generality of the results might be a little weak. The suggested IR system should be compared with other universities as a future task.

Furthermore, this discussion is based only on "IR for medical education" in Japan. Although sometimes IR and learning analytics are considered separately, they share some similar aspects, as noted in the previous section. They mean almost the same when discussing enrollment management and supporting system of learners [21]. Thus, both IR and learning analytics are to be used in the literature review. The different aspects of IR must also considered carefully when the results of this study are applied to other IR.

4 Conclusion

In this paper, the current situation of medical education and the needs of educational IR in Japan are described, using a case study of JMU. There are three different databases in JMU for IR data management: (1) MySQL-based IR database with general information of students, including test scores; (2) Moodle, including e-syllabus with database activity module; and (3) LRS, which is currently for storing the data from Moodle. These data can be used for several educational IR, such as certifying the equitability and fairness of the entrance examination. Some of the datasets can be used for learning analytics to support students. Future work would involve analyzing the data to find useful results and compare them to results of other universities. This would help establish indexes for IR in medical education.

Acknowledgments

This work was supported by "Jichi Medical University Young Investigator Award," "JSPS KAKENHI" (Grant Number 18K02865), and "Health, Labour and Welfare Sciences Research Grants" (Research on Medical ICT and Artificial Intelligence).

References

[1] Y. Nakamura, Y. Takamiya, M. Saito, K. Kuroko, T. Shiratsuchi, K. Oshima, Y. Ito, and S. Miyake, "A Survey of Palliative Medicine Education in Japan's Undergraduate Medical Curriculum," BMC Palliative Care, vol. 16, 2017, pp.38 doi: 10.1186/s12904-017-0212-1.

[2] Basic Medical Education: Japanese Specifications, WFME Global Standards for Quality Improvement, https://wfme.org/publications/bme-japanese-specifications-2015/?wpdmdl=834&ind=3n0ohF0VvL_14xppNexGcstTmv-_g7T3g57KgXsQYbu1Vda8LQy4hTi9ipr4bmzeNZA0INs6bClpMGlkIFjmZg (in Japanese)

[3] Basic Medical Education WFME Global Standards for Quality Improvement, the 2015 revision, https://wfme.org/publications/wfme-global-standards-for-quality-improvement-bme/?wpdmdl=831&ind=98bcn8G7oNLoIkZxyMAQG4Hdo5rerpzpM0gM4wwN4CQDTU6htsKBS943G7pJQGTB

[4] Y. Asada, "Investigation of the Current Situation of Medical Education in Japan Based on the

Results of Accreditation Based on Global Standards," Proc. 8th IIAI International Congress on Advanced Applied Informatics (IIAI-AAI), 2019, pp. 342-346.

[5] R.D. Howard, G.W. McLaughlin, and W.E. Knight, The Handbook of Institutional Research, Wiley, 2012.

[6] K. Inoue, Y. Hirayama, and M. Igarashi, "A Medical School for Rural Areas," Medical Education, vol. 31, no. 6, 1997, pp. 430-434.

[7] M. Matsumoto, K. Inoue, and E. Kajii, "Long-term Effect of the Home Prefecture Recruiting Scheme of Jichi Medical University, Japan," Rural and Remote Health, vol. 8, no. 3, 2008, pp.1-15.

[8] Y. Asada, "Trends of Institutional Research in Japanese Medical Education: A Case Study of Jichi Medical University," Proc. 7th IIAI International Congress on Advanced Applied Informatics (IIAI-AAI), 2018, pp. 490-492.

[9] Model Core Curriculum for Medical Education in Japan, AY 2016 Revision (in Japanese), http://www.mext.go.jp/component/b_menu/shingi/toushin/__icsFiles/afieldfile/2017/06/28/1383961_01.pdf

[10] Model Core Curriculum for Medical Education in Japan, AY 2016 Revision (in English), http://www.mext.go.jp/component/a_menu/education/detail/__icsFiles/afieldfile/2018/06/18/1325989_30.pdf.

[11] M. Saqr, U. Fors, M. Tedre, "How Learning Analytics Can Early Predict Under-achieving Students in a Blended Medical Education Course," Medical Teacher, vol. 39, no. 7, 2017, pp. 757-767.

[12] M. Saqr, "A Literature Review of Empirical Research on Learning Analytics in Medical Education," International Journal of Health Sciences, vol. 12, no. 2, 2018, pp. 80-85.

[13] M. Saqr, U. Fors, and M. Tedre, "How the Study of Online Collaborative Learning Can Guide Teachers and Predict Students' Performance in a Medical Course," BMC Medical Education, vol. 18, no. 1, 2018, pp. 24.

[14] N. Kondo, M. Okubo, and T. Hatanaka, "Early Detection of At-Risk Students Using Machine Learning Based on LMS Log Data," Proc. 6th IIAI International Congress on Advanced Applied Informatics (IIAI-AAI), 2017, pp. 198-201.

[15] edutechnica, LMS Data – Spring 2019 Updates, https://edutechnica.com/2019/03/17/lms-data-spring-2019-updates/

[16] L.D. McIntosh, C. Zabarovskaya, M. Uhlmansiek, "It's Just (Academic) Business: A Use Case in Improving Informatics Operations with Business Intelligence," Proc. AMIA Jt Summits Transl Sci, 2015, pp. 117-121.

[17] V.K. Ong, "Business Intelligence and Big Data Analytics for Higher Education: Cases from UK Higher Education Institutions," Information Engineering Express, vol. 2, no. 1, 2016, pp. 65-75.

[18] Home Page of EU GDPR, https://www.eugdpr.org/

[19] T. Treasure-Jones, R. Dent-Spargo, and S. Dharmaratne, "How Do Students Want Their Workplace-based Feedback Visualized in order to Support Self-regulated Learning? Initial Results & Reflections from a Co-design Study in Medical Education," Proc. European Conference on Technology Enhanced Learning (EC-TEL) 2018, http://ceur-ws.org/Vol-2193/: CEUR.

[20] T. Treasure-Jones and R. Dent-Spargo, "How Students Want to See and Use Their Workplace Learning Data: Initial Results from a Co-design Study," Proc. AMEE 2018 abstract book, 2018, pp. 725.

[21] L.D. Roberts, J.A. Howell, K. Seaman and D.C. Gibson, "Student Attitudes toward Learning Analytics in Higher Education: "The Fitbit Version of the Learning World," Frontiers in Psychology, vol.7, 2016, pp. 1959 doi: 10.3389/fpsyg.2016.01959.