AI ASSISTED ADVISING FOR GROWTH OF UNIVERSITY STUDENTS

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ABSTRACT

This paper introduces a new advising system based on datamining and AI technology to boost a rapid and steady growth of individual students. The implemented system gives students useful advices about university life, regular curriculum, and extracurricular activities to change their mindset and behaviors for learning. Especially, we believe that combination of regular curriculum and extracurricular activities is significant for university students because the both are mutually complemented to realize the CDIO cycle. Kanazawa Institute of Technology has electric archives of 15,000 graduates' e-portfolios, and we used the records to counsel each student individually. We actually implemented two kinds of advising systems: one is a datamining system for supervisors use to give advice, and the other is AI advising system that student use for themselves. We tested the efficacy of the systems, and got the positive results.

KEYWORDS

Student growth, Advice, Learning support, Datamining, AI, Standards: 9

INTRODUCTION

Providing better education for diversified students is a common challenge to higher educational institutes. We should support individual students with different experiences, background knowledge, needs and interests (Attard et al., 2010), but we just have limited educational resources. Lately AI (Artificial Intelligence) technology has highly developed, and has employed also in education field (Luckin et al., 2016). This paper introduces an AI application in education to assist advising diversified individual students in KIT (Kanazawa Institute of Technology). The advice derives from electric archives of the 15,000 graduates' records stored in KIT e-Portfolios archives, which contains 1,000,000 datasets including not only their profile but also their thoughts, activities and histories. Therefore, we can give our students individual advice about university life, regular curriculum, and extracurricular activities. We aimed our students to change their mindset and behaviors for learning. We mainly target the "middle-level" students who are have ordinary attitude for learning and middle-level achievement. We aim to give our middle-level students practical advice to change their mindset and behaviors (Regan et al., 2015) via AI based on the graduates data. We don't target "at-risk" students who will drop out of our university, even if AI can find them in early stages (Marbouti et al. 2016). AI cannot give those students good advice at present, and we believe that they really need

practical helps from human advisors. We aim to boost the rapid and steady growth of the individual students by the system (Figure 1).
We actually implemented two kinds of advising systems: one is a datamining system for supervisors called as “Advising Assist System” for human supervisors, and the other is AI advising system that students use for themselves that is called as “Self-coaching System”. Supervisors in KIT can use the Advising Assist System for individual counseling to motivate and support their students. Supervisors can also use the system to make curriculum visualization, and to extract clear portraits of some types of typical students classified by their department, achievement score, or other attributes. Students can use the Self-coaching System to search their specific targets and to motivate for themselves. We tested the efficacy of the systems, and got the positive results.

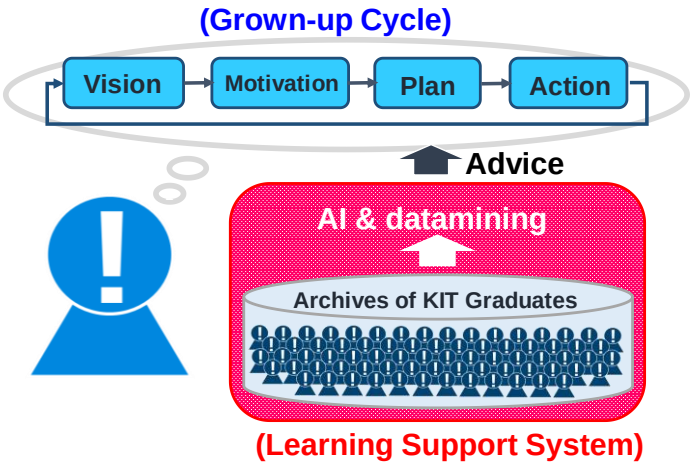

Figure 1. AI supporting coaching

KIT: KANAZAWA INSTITUTE OF TECHNOLOGY

Introduction of KIT

Kanazawa Institute of Technology was established in 1965, and currently has an enrollment of 6,500 undergraduate students and 490 graduate students. KIT provides student-centered learning environment and features Project Design Education in which students identify and solve problems in teams (Saparon et al., 2017). In the education environment, KIT students have experience of finding what people need and embodying their own engineering solution as a prototype. Through a process of experiments, validation and evaluation, they acquire the “innovation skills” that are required of personnel who will play an important role in the global society. The Project Design Education has many affinities with CDIO education (Crawley et al. 2011), so KIT became the first Japanese university to join the CDIO Initiative in 2011. KIT are promoting CDIO in both the regular curriculum and the extracurricular activities. In 2016, we launched an e-syllabus to combine more than 100 extracurricular projects and the regular curriculum for purpose of building overall competence. We believe that combination of regular curriculum and extracurricular activities is significant for our students because the both are mutually complemented to realize the CDIO cycle.

Supervisor System

KIT have a class-based supervisor system, and all of our students can consult their supervisors with no hesitation when they need help. Approximately ninety professors are currently assigned to supervise their class students and the supervisors give them advices about the university life, curriculum instruction, and extracurricular projects. At least once in a semester, every supervisor has an obligation to have face-to-face counseling with the all students individually. Supervisors of the first year students teach the compulsory curricular subject for freshmen, named “Basic Style for Study”, every week in the first and the second semesters. The supervisors give lessons on the mindset of learning and the basic academic disciplines in university to new comers. Every extracurricular project also has one or more supervisors, who are professors or other faculty staffs, to support the student members in each project.

KIT e-Portfolio systems

KIT has already developed KIT e-Portfolio Systems for student’s learning. The e-Portfolio Systems aid our students to drive a grown-up cycle of four phases, which means vision, motivation, plan and action, by recording what they think and behave. In e-Portfolio Systems, students are required to answer some open questions by inputting a certain length of sentences. At present, we are running five kinds of systems: “Basic Style for Study” Class System, “Project Design I & II” Classes System, Career Design System, Self-evaluated Reports System, and Self-evaluated Achievements System.

1) “Basic Style for Study” Class e-Portfolio System
   This is an e-portfolio system for “Basic Style for Study” class to get actively learning style and keep regular hours of private life in early stage of university life. The first year students input records of personal activities, learning activities, review of activities in the last week and plans for the next week into the system once a week during the semesters. Supervisors return feedbacks about the inputs to their students every week.
2) “Project Design I & II” Classes e-Portfolio System
   This is an e-portfolio system for both classes of “Project Design I” and “Project Design II”. All students of class record their own class activities and work products. The Project Design I class is coursed in the second semester, the Project Design II in the third semester. Both classes are compulsory curricular subjects, and they are typical embodiment classes of CDIO process.
3) Self-evaluated Reports e-Portfolio System
   This is an e-portfolio system to input self-evaluated reports for some regular curricular subjects and the extracurricular activities.
4) Career Design e-Portfolio System
   This is an e-portfolio system for making career path. Students record their past activities before entering KIT, and contemplate their future of ten years from now. From both past and future, they conceive what to do at present regarding learning academic specialties and acquiring professional skills.
5) Self-evaluated Achievements e-Portfolio System
   This is an e-portfolio system for annual records from the first grade year to the third record at the every year’s end. By the way, the fourth grade students do not need to input into the system because they write their graduate thesis as the final work product of university life. The system needs our students to write in records of this year and plans of the next year. The records of this year include goals, past activities toward the goals, achievements, and self-assessments of them. The plans of next year contain next goals, improvable points, and action plans. The number of records of the 15,000 graduates has been up to 420,000

datasets. The archive is used to help supervisors to handle their regular face-to-face counseling with individual student.

The all records of e-portfolio systems are accumulated as archives. KIT has the other archives such as university register of student fundamental profile, records of job getting activities, records of library use, and records of educational center use. For these 10 years, KIT has collected the records of the approximately 15,000 students, and has electrically stored them as numbers, symbols or text format. We utilize these archives as the basic data source for textmining and AI.

ADVISING ASSIST SYSTEM FOR HUMAN SUPERVISORS

We develop two kinds of advising systems: Advising Assist System" for human supervisors and "Self-coaching System" for student. First, we explain the "Advising Assist System" for human supervisors. Supervisors or advisory staffs operate the system to give advice to their students. Second, we will explain the "Self-coaching System" in the next section.

The assisting system for human supervisors aims to support mainly the ordinary or middle level students. We assure that high performing students successfully employ the educational environment to boost their growth, with least advice. In addition, we are sure that low-level students, who are likely to drop out, are sufficiently given generous support and help. On the contrary, middle level students are not usually self-motivated and are given much less support than low-level ones. The number of ordinary students is much bigger than the ones of high and low level students, and they have the potential to grow rapidly if they gets appropriate advices timely. This is the reason why we set students of middle level performance as target.

The Advising Assist System is essentially a functional textmining tool. The system has two subsystems: database and interface. We can use the archives of the students as mention above. The human supervisors are not only professors but also the other faculty members, for example the staffs of Student Affairs Section, who can access the archives. We use Watson Explorer as an interface between database and human supervisors, and the interface helps to find useful data from huge archive (Figure 2). Watson is a general-purpose AI system developed by IBM, and Watson Explorer is the interface system of Watson. Watson is essentially a question answering computer system capable of answering questions posed in natural language. A supervisor type in words or a phrase, for example "human-powered vehicle", then the supervisor can find some highly fitted sentences that were written by the

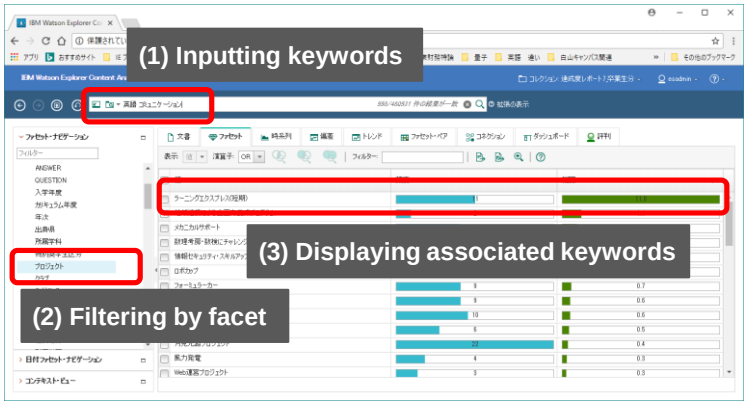

Figure 2. Interface of Advising Assist System for human supervisors

graduates who were engaged and committed in extracurricular activities or research related human-powered vehicle.

We clarify three requirements to assist human supervisors to give advice to their students. We explain them in the following subsections.

Searching related information

During individual counseling, students often inquire something with which their supervisor are not familiar. Then the system helps the supervisor in real time to let him or her know about the topic. In this section, we use two databases: university register of student fundamental profile and Self-evaluated Achievements e-Portfolio.

If a student wants to work globally in the future and the student says something about it in the counseling, the supervisor readily types in the two phases “English language” and “extracurricular activities” to find highly matched texts from the database. We actually input these phases into the Watson Explorer, the system indicated the best match topic, “Learning Express”. The Learning Express is a global and social innovation project trying to foster global human resources conducted by some higher education institutes in Southeast Asia (Learning Express, 2018). We also get some useful contexts from the archives of some graduates who participated the project when they were undergraduates. Then the advisor can give some advices to the student as follows:

- One graduate was a project participant once held in Indonesia, and he felt it is very important to take care of each own health in foreign countries.
- The other graduate studied English very hard to get high score of TOEIC (Test of English for International Communication) before going into the project, and she wanted to make her career path to work for a global company

Even if a supervisor does not know the project much or at all, the supervisor can immediately give some valuable and detailed advices to the student in the counseling.

Visualization and extracting keywords

Not all supervisors are necessarily knowledgeable about the curriculums of all departments or the extracurricular activities in KIT. Visualization of curriculum (Mima, 2006) and extracting keywords are very helpful for supervisors. Viewing visualized relationships of keywords, students also understand easily what are significant to learn. The texts from syllabus are available to make visualization such as co-occurrence network. We use the texts of brief summary and behavioral objectives in KIT e-Syllabus. In this section, we analyze and depict some examples by the free datamining software KHCoder (KHCoder, 2018). Figure 3 depicts an example the co-occurrence network of curricular subjects for the first year students in Mechanical Engineering Department. The most appeared keyword is “machinery”, but the centered keyword is “mechanical parts” that has the highest medium centeredness. This can be explained that the students learn about mechanical parts in basic dynamics of mechanism and draw them in the mechanical drafting classes. We find that the centered keywords of the second year’s curriculum is “thermal” and “mechanical property”, and the ones of the third year are “theory”, “method”, and “calculation”. The transition of centered keywords may indicate that the contents of the curricular subjects become more general and more sophisticated as student grade advanced.

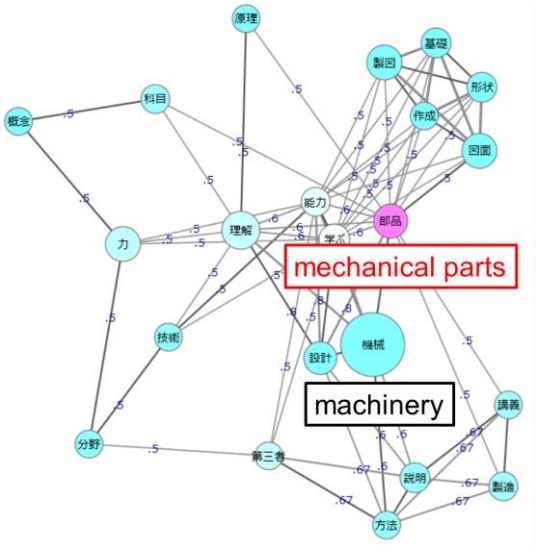

Figure 3. Co-occurrence network of syllabus

Profiling Typical Students

We can find some features of students group such as typical attributes, mindsets, behaviors and growing paths. In this section, we try to find the differences between ordinary students and excellent ones. We define ordinary student as having middle-level QPA scores and participating no extracurricular activities. We also define an excellent student as a student who has high QPA scores and gets involved extracurricular activities as well. By the way, QPA (Quality Point Average) is a system of assessing a student's performance in KIT, and very similar system to GPA (Grade Point Average). In this section, we use two databases: university register of student fundamental profile and Self-evaluated Achievements e-Portfolio. We analyze linguistic dependency parsing from predicative words to nouns.
We analyze each departments, and explain the case of students of Mechanical Engineering Department in this subsection. The ordinary students have the features as follows (Table 1):

- They worry most whether they can earn their course credits for graduation
- They tend to be satisfied as long as they have average credits of GPA
- They make an effort to keep regular hours in their life
- Some of them work part-time job for money in their spare time

On the other hand, the excellent students of Mechanical Engineering Department have the features as follows (Table 2):

- They always keep in mind to maintain their high QPA score
- They always try to finish their homework and assignments at a high quality level, and finish the tasks before deadlines.
- They are willing to keep regular hours in their life
- They often visit some learning help centers of KIT, and try to solve immediately their questions in lectures
- They dedicate much time to their extracurricular activities

The results in the tables do not seem correlative words because not every correlative pair consists of two words in English language. Nevertheless, the original correlative pair described in Japanese language are all composed of only two words. The values in the tables mean

correlation values that are calculated as the amount of uniqueness of the high frequency of the words pair as compared to other pairs (Zhu, et al., 2014).

Table 1. Correlative words from the records of ordinary students

Inquiry	Top Highest Correlation	Value	Second Highest Correlation	Value
total	earn … course credits	1.3	review … lessons	1.3
next target	be … goal	5.1	not fail … class	4.7
self-evaluation	achieve … goal	8.9	fail … class	7.3
for improvement	get … sleep time	8.0	have … task	7.4
daily practice	be satisfied … situation	12.8	be bad …situation	10.2

Table 2. Correlative words from the records of excellent students

Inquiry	Top Highest Correlation	Value	Second Highest Correlation	Value
total	participate … extracurricular activity	3.5	study further … in graduate school	2.2
next target	do both … at the same time	3.5	master … skill of technology	4.2
self-evaluation	achieve … goal	6.6	keep … high score	4.0
for improvement	manage … time	10.1	get up … early in the morning	5.5
daily practice	submit … before deadline	8.9	deliver … task	7.3

Results and Discussion

We conducted tests to verify the effectiveness of the system. Two volunteer professors who are in charge of class supervisors used the system for the individual counseling with ten students respectively in October 2017. The results and feedbacks from the two professors and the twenty students indicated that the counseling with the system did not give more improved advice than before. We think that the disappointing result is mainly caused by high counseling skill of the professors. The two professors have high skills of learning support, and they hardly need the help from the system. The students therefore felt no differences of the advice between with and without the system.

Then we conducted the second test in the preparation of KIT Stakeholder Meeting in December 2017. The KIT Stakeholder Meeting is one kind of speech contest in which students make short public speaking about their own growth toward people of local corporates and communities. Thirty students made speech in 2017, and seventeen supervisors of faculty staffs supported them. The supervisors made man-to-man discussions several times, and gave advices to brush up the students' speech. We used this opportunity, and the twenty-six students and five supervisors cooperated with our test. We carried out questionnaire surveys twice, before the first discussions and after the last ones. We found the significant differences of the students' self-evaluations that indicated the growth of capabilities and skills. We also got positive feedbacks from some supervisors.

SELF COACHING SYSTEM

An academic adviser with artificial intelligence, referred to as "Self Coaching System", has been in service in November 2017. Students can search over one million datasets in the archival records of KIT graduates from the e-portfolios databases to select a student with a similar academic background, and they can get appropriate advice based on the data taken from the record. The AI system can provide students with timely advice with regard to their

choices regarding curriculum and extracurricular activity. This system is implemented based on IBM Watson, and is applied a machine learning technique developed by IBM.

A student logins the system, then the system opens the interface window (Figure 4). The interface of the KIT has four sections: user's profiles, personality assessment, profiles of top three graduates who are very similar to the user, and statistics of the one hundred graduates who are similar to the user.

1) User's profile section displays the information including department, participating extracurricular activities, holding certifications, number of the educational centers use, number of lending books from the library, number of getting the incentive award of KIT, choice of university courses, number of earned credits, GPA score, percentage of class attendance, hometown, job after graduation, and so on. This section is available for not only displaying a user's profile but also setting search conditions in the following 3) and 4).
2) Personality assessment section depicts a pentagon radar chart of personality judged by records of user's behaviors from "Basic Style for Study" class e-Portfolio database. The radar chart has five metrics that indicate intellectual curiosity, conscientiousness, extraversion, agreeableness and neuroticism. Neuroticism in the chart means stability of emotions of a user. Each value of metrics is assessed by five grade in this system.
3) Top three similar graduates section provides three graduate icons, who are the most similar to the user, with accordance rate between the user and each of them. A user clicks the icon, and then a window of detailed profile of the graduate opens. The opened window indicate a comparison of personality assessment, and records of the graduate's Self-evaluated Achievements e-Portfolio. The records of very similar graduates will suggest a role model to the student. If a user changes values of attribute in the user's profiles section, the selected graduates will change according to the change. A student therefore can get wise to approach his or her future vision what to change or improve about them by simulating. Needless to say, we meticulously mask the detailed personal information not to identify an individual graduate.
4) Statistics of the one hundred similar graduates section depicts some pie charts about jobs and one list of certifications. The pie charts of jobs displays industries or company sizes of one hundred of graduates. The list of certifications indicates the exams they passed, so it means the recommendation list of certifications to deserve to get. This section gives useful information to make a professional career path.

(a) Opening screen (b) Layout of sections

Figure 4. Interface of Self-Coaching System

We also are developing a chatbot to give advice to our students in a style of casual conversation. The chatbot works based on Self-Coaching System and Self Advising Assist System. We are uniquely trying to give helpful advice from archive of great persons' saying via the Chatbot, and our students will have fun and get encouraged.

Results and Discussion

We conducted the trial event of experience of the Self Coaching Systems including the chatbot from August 1 to August 4, 2017, prior to starting the formal operation of the AI system in November 2017. Approximately 350 students experienced the AI systems. We conducted a questionnaire survey and interviews, and forty-four percent of 144 questionnaire respondents were proven to be satisfied with the system.

CONCLUSION

We implemented the AI assisted advising system for university students. The Advising Assist System helps human supervisors or advisory staffs to counsel individual students and motivate them. The system assist for supervisors' counseling to give advice in which individual student have an interested. The system also work to make curriculum visualization, and to extract clear portraits of some types of typical students classified by their department, achievement, educational score, and other attributes. The system is especially expected to counsel the ordinary student who has not clear target in near future. The Self-coaching System helps student to search their specific and detail targets and to motivate for themselves. The advice derives from electric archives of the 15,000 graduates' records stored in KIT e-Portfolios, which contains 1,000,000 datasets including not only their profile but also their activities and histories. We aim to boost the rapid and steady growth of the individual students by the systems.

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BIOGRAPHICAL INFORMATION

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