DEVELOPING STUDENTS' GENERIC SKILLS BASED ON OBJECTIVE EVALUATION

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ABSTRACT

We have been examining the effects of our educational improvements since 2014 at KOSEN (National Institute of Technology) Sendai College, Hirose campus. Our students are assessed annually with the PROG (Progress Report on Generic Skills), one of the standardized tests for generic skills assessment. We have previously reported on a survey analysis of GS (Generic Skills). In this paper, the GS growth characteristics of our students on this campus for the survey through 2020 are reported. In addition, the use of the results of the ongoing survey and the plan for a new pre- entrance survey and a follow-up survey after graduation will be discussed. Furthermore, we will collaborate with universities and companies to attempt to visualize the skills that are developed in different industries (fields) after graduation. In particular, the collaboration with universities will realize the potential for effective educational collaboration not only on academic performance (knowledge-based), but also on technical skills (skill-based). For collaboration with companies, on the other hand, this project will help companies to train their employees according to their needs and reduce the mismatch in career paths. From 2020, Hirose Campus will be promoting collaboration on GS research with the two universities of technology in Toyohashi and Nagaoka, both of which have a strong affinity with the KOSEN. We will report on the concept and future plans for academic improvement, including strengthening of collaboration, growth changes in students' behavioral characteristics through continuous analysis, collaboration from KOSEN to universities, and improvement of KOSEN education through feedback from universities.

KEYWORDS

INTRODUCTION AND BACKGROUND

It has been recognized for a long time that in engineering education, in addition to the learning of specialized knowledge and skills, it is important to develop GS to apply the acquired knowledge and skills in the actual world. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) has also indicated the importance of these skills, but has yet to propose specific evaluation methods using rubrics, as these are different from knowledge retention courses at https://www.meti.go.jp/english/policy/economy/human_resources/.
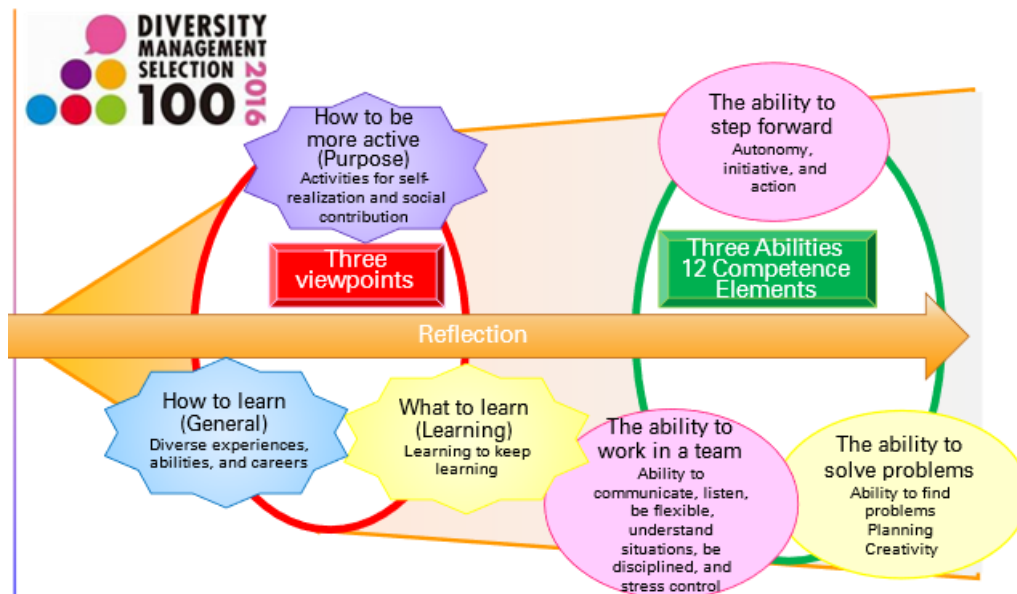

Figure 1. Improvement of generic skills for social workers

As well as GS development, portfolio education has been also emphasized by MEXT. As Zubizarreta (Learning Portfolio) and Seldin et al. (Teaching Portfolio) reported, reflection through portfolios deepens students' learning and improves teachers' teaching, thereby establishing quality assurance in education. The portfolio can be used not only to achieve short-term goals, but also to achieve long-term goals, and can be used to support students' careers.

At KOSEN Sendai College, Hirose campus, improvements of the classes and curriculum had been conducted by introducing Active Learning and PBL in 2014 and constructing the educational environment for effective GS development of students. Continuous assessments of students' generic skills had been conducted once a year using PROG, which is one of the standardized tests for generic skills assessment, in order to verify the effectiveness of our educational improvements. In 2018, we finished the 5-year continuous survey to identify GS growth characteristics from enrolment to graduation. Until 2018, the aspect of the survey was measurement, but since 2018, we have been focusing on the utilization of the results. The results of the survey to present and the utilization of the results (feedback to students and college, curriculum and class improvement based on the analysis results) have been reported at the 15th-17th CDIO International Conferences.

This paper reports on the GS growth characteristics of the most recent students on this campus, using the results of the survey through the year 2020, and introduces an overview of the utilization of the continuous survey results. Only briefing sessions based on PROG results

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were conducted for our students until last year, but a portfolio education program was started this year. By using the portfolio, students can reflect on their learning and set goals as well as record actions (club activities, qualification exams, etc.). At the beginning of the introduction of portfolio education, we did not focus on the priority of implementing a complex and complete portfolio system. We began by making sure that students understood the need for portfolios and having them fill out paper-based portfolios that were as simplified as possible. This is because paper portfolios can be viewed and recorded at any time, and we believed that this would make them more accessible to portfolio novices.

Next, we introduce our plans for a pre-entrance survey and a post-graduation follow-up survey as developments in the use of the results of our ongoing survey. In particular, an educational collaboration with universities and companies was proposed. By collaborating with universities and companies, we can evaluate and visualize the skills required for different industries, occupations, and research fields after graduation based on the same (unified) standards for the GS. As a result, enable effective educational collaboration can be achieved not only on the knowledge base of specialized fields but also on the skills base. In addition, this project will enable the construction of education that meets the needs of companies and guidance that can reduce the mismatch in the selection of companies and industries for students in career support. This will be possible by using the PROG evaluation standard to uniformly evaluate generic skills, which vary greatly from evaluator to evaluator. From 2020, we have collaborated with both Toyohashi and Nagaoka University of Technology, which have a close relationship with the KOSEN, to conduct surveys and discuss ways of collaboration. Since PROG is implemented in many KOSEN, and many students transfer to two Universities of Technology, and since PROG is implemented at the KOSEN, the goal is to develop students' humanity by linking information on humanity, which is different from grades, between the KOSEN and two Universities of Technology. In addition, by visualizing the progress of students, it will be possible to share information with universities (support for students transferring from KOSEMN, improvement of university life) and KOSEN (support for students transferring to universities, improvement of KOSEN life) and realize a cycle of mutual improvement. The concept of generic training and future plans will be introduced.

PROPOSE AND IMPLEMENT CYCLE ON CAMPUS

Implementation of student SFD(Small Faculty Development)

In the KOSEN Sendai College, students in grades 1-3 are required to take the PROG online at the same time in the computer room with the support of a few teachers. For 4th and 5th year students and advanced course students, the examination period is set (from mid-December to early December), and students take the examination at home or in the laboratory. What is GS? The school fosters not only academics but also human skills, including GS. 5-year career path (course selection, internship, lab assignment, career decision, etc.). We will guide them through the five-year process shown in Figure 2. In this guidance, the importance of GS, which is different from academic grades, was explained to acquire the ability to survive in society. However, since they do not know the details of GS, SFD will be conducted to help them analyze themselves and set goals while returning the PROG results.

Portfolio (visualization of 5 years of continuity)

Students write the results of the PROG on a sheet of paper as shown in Figure 3(a) and (b), making it part of their portfolio that includes a record of the changes in GS and self-analysis and self-development based on the results. Currently, both students and teachers have a little

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understanding of portfolios, so we are promoting paper records as part of the portfolio education for the whole school. The advantage of paper is that it can be checked and filled in at any time. Although there is a risk of lost items, we are using paper media to improve self-management skills as well. This is because if the students use digital media before they understand the necessity of the portfolio, the purpose will be to understand how to use the system, and the self-management effect of the portfolio will be weakened. As shown in Figure 3, it is possible to understand the current situation by transcribing the visualized values into a table by oneself. In many cases, students do not check the details when the data is visualized on a computer using the radar chart method. In addition, students can visualize their own changes by graphing the changes in each grade level for each skill.
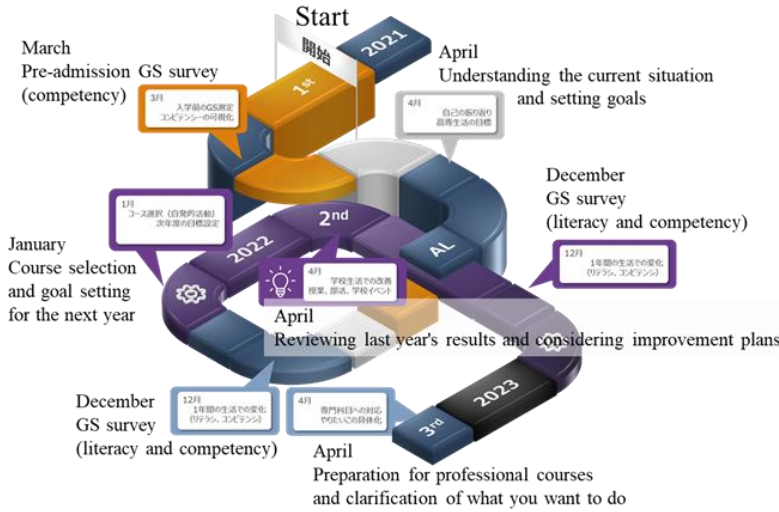

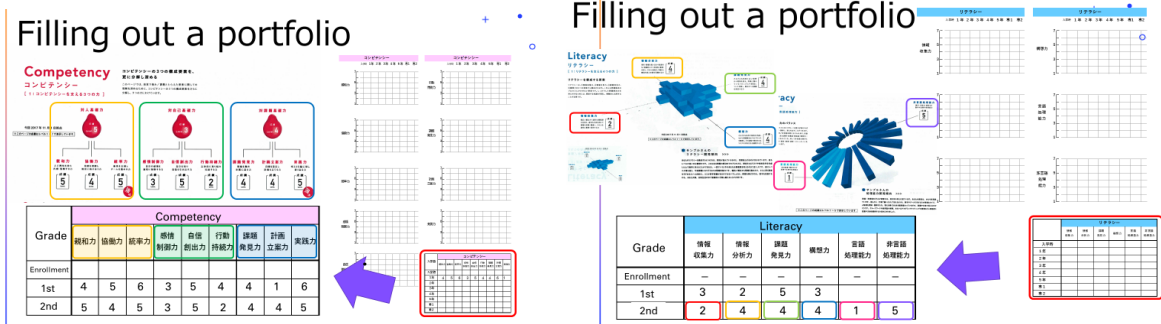Figure 2. Career path at KOSEN Sendai College Hirose campus

Figure 3. (a) Record competency results   Figure 3. (b) Record literacy results

Considering that changes in GS are also influenced by changes in awareness, such as daily activities and qualification exams, recording them is also explained in the SFD. To add information to the portfolio, class teachers need to raise awareness through repeated announcements in HR. In addition to the quantification of each skill by the PROG, goals are set for further development based on comments on strengths, and goals for improvement based on comments on weaknesses. In the following year, they will be able to check the

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changes in their growth through the PROG values and strengthen their self-affirmation by reflecting on their actions.

Promotion of portfolio

In the beginning, changes in GS were used to investigate changes in students' behavioral characteristics due to changes in learning styles (passive learning → active learning) caused by the introduction of active learning. Every year students receive the results of their GS, but unless there is an explanation about the results, no improvement cycle based on them can occur. As mentioned earlier, SFD for students was conducted to promote the use of portfolios as a cycle of improvement through continuous reflection and goal setting over five years. What kind of skills are required? What skills will be required during the 5 years of student life?
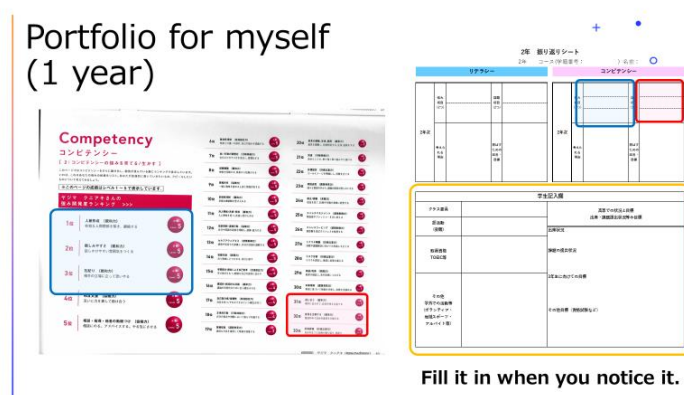

Figure 4. Career path at KOSEN Sendai College Hirose campus

Because GS is different from knowledge, a small score is not necessarily bad, but it can be made as large as they want it to be. Just as in pottery, where clay is kneaded to make a vessel, the size and shape can be changed as much as possible depending on one's goal setting and experience. As a teacher, if you are an adult and you fit into a certain field, it is very difficult to make the vessel bigger because it is already baked. As you improve one skill, the other goes down. We convey to our students that the overall strength of GS can be developed flexibly at SFD, and that the student days are very important. Currently, students take the PROG between December and January, which is the second half of the academic year. These explanations to students are given in February at the end of the academic year or around May of the new academic year. However, since students are not yet familiar with how to manage their own exams, it is necessary to devise a way to implement this at HR after each exam.
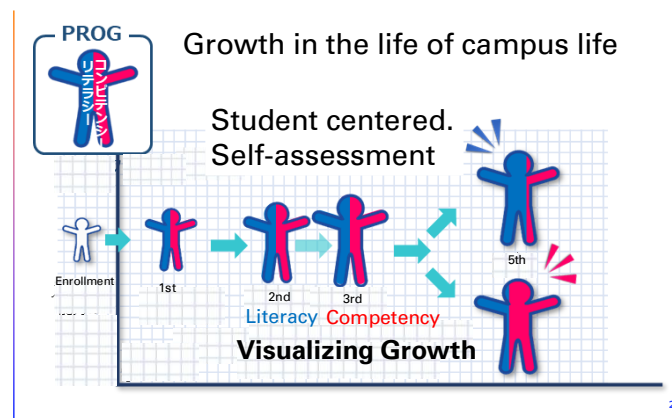
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Figure 5. Growth of various GS configurations

Example of improvement

From the continuous survey, visualizations of the changes in the growth of GS across the campus were realized. The results show us that our students have some skills that have grown a lot and other skills that have not grown much. Rather than overlooking this as a characteristic of the college, it would be effective for the college and the students if we could assist their growth even a little in the curriculum. So, we called it a curriculum supplement to share GS trend analysis with the campus and improve the curriculum so that we can determine small targets in the curriculum to assist their growth.

As an example, the basic experiments for third-year students will be shortly introduced. Until now, the curriculum has been based on a schedule in which each group conducts experiments on prepared experimental themes in order in an omnibus format during one semester. In order to improve their ability to plan and carry out the experiments, the groups were asked to create and manage their own experiment schedules within the semester. Students had a start meeting at the beginning of the experiment to confirm the contents of the implementation and their individual progress. Before the end of the experiment, a closing meeting is held to check the progress of the day, confirm the contents of the next experiment, and reschedule if necessary. In addition to the experiment textbook, the teacher provided the students with tools to manage their schedules and check their progress. The teacher is responsible for checking and managing the status of these activities. In addition, in order to improve responsibility skills, we established a system of personal management of parts boxes necessary for experiments, and parts checking at the time of rental and return. In the students' self-evaluation (direct survey), the result that the intended skills have been improved was obtained. Unfortunately, with the current amount of data, it is difficult to analyze the correlation with PROG. In the future, it will be necessary to analyze the effects of this proposal together with PROG data to confirm the effectiveness of the curriculum supplement.

Student development in cooperation with universities

The flow of recording and utilizing the changes in GS growth as a portfolio over the five years of technical college is being established as a system. This cycle is also recommended by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) as a "career passport" for elementary and junior high schools. However, the details are left up to the schools, and the

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transfer and sharing between grades and schools is still being coordinated. The school is working on a project to develop students by collaborating with universities that allow transfer after graduation from technical colleges, not only for assessment of knowledge but also for GS.

In Japan, Toyohashi University of Technology and Nagaoka University of Technology are engineering universities that have strong ties with KOSEN. These universities were originally established for students graduating from technical colleges to obtain degrees and doctorates, and they have accepted many students as third-year transfer students. At the time of transfer, students' personal information and academic records are sent to the university. There is no information on GS for students of the College of Technology who come from technical colleges across the country. In other words, while information about grades is shared, there is no information about personal development, and students themselves need to create a new environment. After transferring to the university, students are assigned to laboratories and internships, and there is no way to know the nature of the students in detail. Therefore, since a year ago, we have been asking our graduates to take the PROG exam continuously to track their growth after transferring to universities.

We are promoting the follow-up of students transferring from KOSEN to the University of Technology, but due to COIVD-19, face-to-face active learning classes have been drastically reduced, making it difficult to continue GS skill checks. Table 1 shows the change in the number of schools taking the PROG at technical colleges in each region of Japan; before COVID-19, there was an upward trend, spreading throughout KOSEN, but after COIVD-19, it has been implemented in a limited number of KOSEN. One of the reasons given is that it is a GS test, and the survey itself is not being conducted because of the face-to-face paper-based mark-sheet group examination format. In addition, it was difficult to prepare for the PROG web-based examination because of the effort required for the remote class operation. This may be a problem unique to the Japanese, but in the case of web-based PROG examinations, it is difficult to trust the spontaneity of the students and there seems to be a strong concern that a fair judgment cannot be made due to the lack of support until the completion of the examination, relaxed examination (selection of the same marks), and differences in examination environments.

Table 1. Changes in the number of PROG tested by region

Year	Hokaido	Tohoku	Hokuiriku	Knato	Tyubu	Kousinetu	Kinki	Tyugoku	Shikoku	Kyusyu	Ratio
2014	1	1	1	1	0	0	0	0	1	0	9%
2015	1	1	1	0	0	0	2	0	1	0	11%
2016	1	2	0	3	2	2	3	2	1	3	33%
2017	1	3	0	3	2	2	3	2	2	7	44%
2018	1	4	1	5	3	2	2	1	2	7	49%
2019	0	3	1	4	1	2	1	1	1	1	26%
2020	1	3	2	4	1	2	1	1	2	0	30%

Currently, as an effective method, we are conducting a survey on PROG implementation at KOSEN, informing the University of Technology of the names of KOSEN students who have taken the PROG examination, and personally linking those who have taken the PROG examination with past PROG data. For this reason, the number of students to be surveyed is small, but in order to promote future collaboration between KOSEN and the University of Technology, the project was started last year as a project of each university of technology. Currently, the KOSEN Sendai college Hirose campus and both technical colleges are working

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together on each project. In the next year, we will be planning to develop this project as a nationwide project in collaboration with the head office of the National Institute of Technology. After that, the collaboration with other universities in Japan, where a student transfer is possible, will be scheduled.

By making continuous surveys possible, students will be able to learn about changes in GS that are different from those in KOSEN due to university transfer. The university side will be able to know the nature of the students and provide more effective guidance. In addition, KOSEN will be able to know what skills need to be strengthened for university transfer. Feedback from universities will enable KOSEN to improve its education. New collaboration among students, KOSEN, and universities using GS will become possible. In order to systematically realize these goals, we are currently studying the implementation method and adjusting the information sharing. Due to the Protection of Personal Information Act, it is currently difficult to efficiently share information across institutions, so as a countermeasure, we are asking individual students for their approval and proceeding with information submission from them. However, we do not plan to provide this information to universities and technical colleges in association with personally identifiable information. We plan to use this information as a result of trend analysis for school improvement. In the future, it will be necessary to consider a system that will enable educational improvement, including changes in individuals.
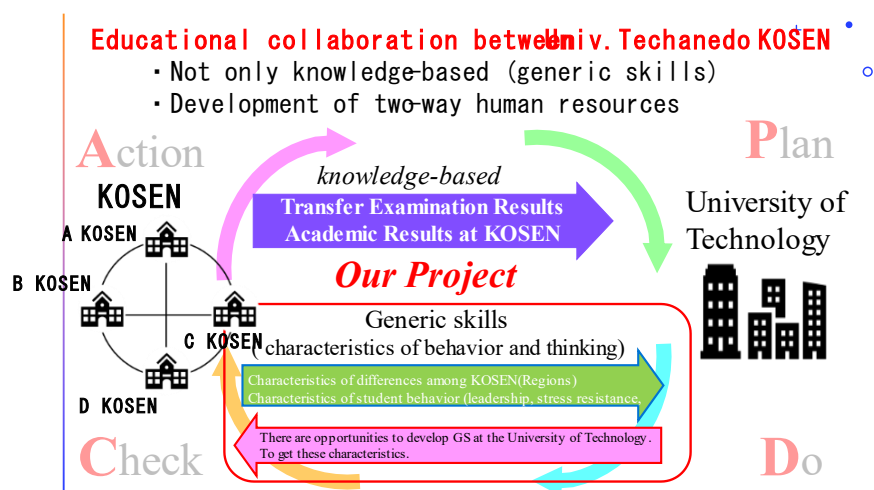

Figure 6. Growth of various GS configurations

CONCLUSION

KOSEN Sendai college is promoting the voluntary growth of GS by students using PROG with the help of portfolios. As for information sharing with universities after graduation, the current focus of student information is on grades and other indicators of knowledge retention. We reported on cross-institutional collaboration on efforts to foster students' continuous growth in human abilities by collaborating with KOSEN graduates. Within the constraints of the Personal Information Protection Law, a lot of ingenuity is needed in collaboration between KOSEN and University of Technology, coordination within and outside the institution to link PROG data, one of the GS evaluation methods, and sharing of individual student data, which is not described in detail.

Currently, the project is being promoted at the KOSEN Sendai college Hirose campus. In the second year of the project, students from other KOSEN have started to collaborate with each other, making it possible to conduct follow-up surveys and analysis: 1) changes in GS after transferring from the KOSEN (for students), 2) analysis and improvement of GS to be extended before transferring to the university (for KOSEN), 3) analysis and improvement of GS to be extended at the university (for University of Technology) and students. The cycle of improvement by the students themselves, feedback from the university to the KOSEN, and improvement of GS growth at the university will make it possible to continuously implement the cycle of improvement that has been carried out independently until now.

In the future, we plan to approach not only the University of Technology, but also the universities to which the students have transferred. We are also planning a follow-up survey of students who have found employment. By visualizing for current students what GS they need to strengthen depending on their field of employment, it will be easier for them to set specific goals for their five years at the college of technology, which will revitalize their student life.

We believe that if this project progresses significantly, it will significantly change the way student information is currently handled in educational institutions. While there is an importance of assessing the retention of knowledge, the human ability to cope with internal and external changes in social activities has a great impact. Although the importance of human resources is recognized, there are few reports on information sharing in collaboration within educational institutions. We hope that this will become a new type of student information collaboration in Japanese educational institutions.

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