A Proposal of a New Team Building Method in IT PBL: A Trial of the SENTAI-Hero-Exercise

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Abstract: In recent years, the development of digital transformation has accelerated worldwide. Therefore, the importance of practical IT human resource development is increasing day by day. Active learning has been introduced as a practical human resource development method. In Japan, practical education programs that transcend the barriers between universities and between industry and academia have been implemented since 2006, and Project Based Learning (PBL) has been widely used as a method to realize such programs. However, in Japan, the university faculty members don't have enough specialty in project management, and many of them feel difficulty in team management. Especially, IT faculty members are seemed not good at facilitation. In this study, we organize PBL from the perspective of project management and report the results of our trial of a method to smoothly implement team building, which is particularly important when launching PBL for IT faculty. This method doesn't use any tools and easy icebreaking for the start of PBL.

1 INTRODUCTION

In recent years, STEAM education has been gaining momentum worldwide in. STEAM is an educational concept that combines the initials of five words: Science, Technology, Engineering, Art, and Mathematics. In the background, there have been dramatic advances in AI and robotics-related technologies, and STEAM education cannot be separated from practical IT human resource development.

In Japan, the Cabinet Office released the "Fifth Science and Technology Basic Plan" (Cabinet Office website, 2016), which recommends further promotion of cross-disciplinary education centered on ICT, as the number of students majoring in STEAM fields is small compared to other countries from 2021, programming education will become compulsory in elementary schools, and ICT education is expected to become more widespread.

Active learning (AL) is mainly used to implement STEAM education. Especially in recent years, PBL is often used. However, there are few institutions of higher education in Japan that specialize in teaching project management, and the diffusion of know-how is insufficient. In Japan, where there is an urgent need to secure practical IT personnel, project management education for PBL teachers is an important issue. However, IT faculty members are not good at communication and facilitation. Although there are faculty members who can perform simple icebreakers, PBL requires even more intimate relationship-building. There is a need for practices that can be implemented by inexperienced faculty.

Therefore, in this study, we developed a practice that is simple to implement. This is the "Sentai-Hero-Exercise," which can be used for team building in the introduction of PBL.

2 PRACTICAL IT EDUCATION IN JAPAN

In this chapter we will introduce the overview of IT education in Japan.

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2.1 The Study Guidelines of the Ministry of Education, Culture, Sports, Science and Technology

In Japan, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) has established the "Courses of Study" to define standards for curriculum development in elementary and secondary education. The "Courses of Study" ensure that all schools throughout the country maintain a certain level of standards. Children's textbooks and timetables are based on these guidelines. The Courses of Study are revised approximately every 10 years.

As a specific educational content, the enhancement of STEAM education is clearly stated. For example, the following contents are described.

- Activities to identify problems in everyday life (mathematics)
- Observation and experimentation with a perspective (Science)
- Statistical education for collecting and analyzing necessary data and solving problems based on the trends (Mathematics)
- Enrichment of content related to natural disasters (Science)

In particular, foreign language and programming education are included in compulsory elementary school education and must be studied by all elementary school students. This is a major point of this revision and has a very significant impact on the curriculum. Regarding learning methods, the Courses of Study emphasize active learning in order to promote interactive education and independent learning. In interactive education, group work and discussion are encouraged. However, the specific teaching methods are left to the schools and teachers.

2.2 Current Status of IT Education

According to the "Policy Package on Education and Human Resource Development for the Realization of Society 5.0 (Interim Summary)" released by the Cabinet Office in December 2021, the content has been changed from the perspective of human resource development based on the assumption of an industrialized society to one that emphasizes the development of human resources for value creation and innovation creation in a human-centered manner. Furthermore, to achieve this, more emphasis will be placed on human resource development related to digital technology. This also has an impact on the mandatory programming in elementary schools mentioned in the previous section.

Regarding science and math literacy, the issue of gender disparity has been pointed out. At the end of secondary school, 39% of girls have high science and mathematics literacy, 27% of girls choose natural science and mathematics in higher education, and 16% in engineering, manufacturing, and architecture. This is the lowest percentage among OECD countries.

As for the current state of ICT education, 41.0% of elementary school students own a dedicated smartphone and use digital devices daily. However, their main use tends to be for games, and the ratio of students utilizing computers for learning is quite low among OECD member countries. On the other hand, they are strongly affected by the filter bubble phenomenon, and the impact of "peer pressure" inside and outside of schools has become an issue, making the development of digital citizenship an important issue. Furthermore, the number of teachers who can handle programming education is small, and the possibility of not being able to provide adequate education is an issue.

2.3 Practical IT Education at Universities

Turning to university education, practical IT human resource development has been conducted since 2006 at the initiative of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) for universities with information fields nationwide. That was called the "Collaborative Network for Practical Information Education Across Fields and Regions" (enPiT), an educational project for master's degree and undergraduate students. enPiT was implemented until March 2021 and has been expanded nationwide with 35 universities across Japan. enPiT2 was implemented until March 2021 and was expanded nationwide, centering on 35 universities nationwide.

Although enPiT was highly satisfactory from the perspective of both students and companies, there were some problems with the system for implementing education. Those were based on PBL but there was a lack of personnel specializing in project management among university faculty in Japan. So the PBL was mainly conducted by faculty members who had temporarily transferred from companies or jointly with companies. After the end of enPiT program in 2021, it is not possible to ascertain whether project management knowledge has taken root. In addition, many Japanese university faculty members are not trained as education specialists in the first place, and many of them feel uneasy about PBL management. Especially, IT faculty are deemed not good at communication, so practical faculty training is required.

3 RELATED STUDIES

3.1 Active Learning

Active Learning (AL) has been practiced mainly in the U.S. since the middle of the 19th century Taba stated in his 1932 book that "active learning is that in which the learner has some activity" (Taba 1932), indicating that attention has been focused on the learner's independent activity since that time There is no unified definition of AL but it is used differently depending on the context, referring to the learners' own active learning itself, as in Bonwell and Eison's "the act of learning in which students are made to engage in activities of acting and thinking about the content of their actions" (Bonwell and Eison 1991), or the educational methods used to achieve this. Yamauchi analyzed educational technology papers in Japan since the 21st century and organized them into four areas of research: teaching, evaluation, environment, and support (Yamauchi 2018).

In recent years, more specific research has been conducted on the effectiveness of AL implementation. For example, Michael Prince (2004) compared active learning, collaborative learning, cooperative learning, and problem-based learning in engineering education, and described the importance of selecting methods that match class objectives.

The core of AL is, as mentioned above Bonwell and Eison (1991), "Learners' self-directed learning by realizing the need for learning. In other words, it is important to elicit a learning attitude through reflection. Therefore, coaching and facilitation skills are necessary for educators. In the perspective of research on AL, according to Yamauchi (2018), there are very few studies on the skills and competencies required on the part of educators. The need for teacher education will become increasingly important in the promotion of AL.

3.2 PBL Research in the IT Field

Through a series of enPiT initiatives, a great deal of knowledge has been accumulated about PBL in the IT field. For example, various efforts have been made, such as Kondo et al.'s practical report (2014) on ICT environment development and Hiroto et al.'s report (2019) on assessment. In addition, Tanabata et al. have attempted to evaluate the amount of participation of members in PBL using function points (2014). Especially since the implementation of enPiT, various practical studies have been conducted. However, most of the research is related to devices such as PCs, network environment, curriculum structure, and evaluation methods, etc. There are few studies on relationship building among students in PBL or on teaching methods. This may be attributed to the fact that the faculty members in charge specialize mainly in ICT and have little knowledge of management.

4 APPROACH OF THIS RESEARCH

4.1 PBL Structure

PBL can be divided into two types: Project Based Learning and Problem Based Learning. In this study, PBL is used in the sense of Project Based Learning, which is mainly used in Japan. This is due to the background that group work is introduced for the purpose of learning through dialogue as described in Chapter 2. However, in practical IT human resource development programs such as enPiT, Project Based Leaning is often conducted on real issues (=Problem) (PPBL). In either case, project management knowledge and skills are important.

In project management, Lesson Learned is important. The aim is to improve the quality of project management by learning from experience and applying it to the next project. In other words, PBL projects are also learned by pairing reflection with learning. And this applies not only to learners but also to educators' projects.

Learning through dialogue," which is the most central type of learning in AL, is about deepening learning by gaining awareness through dialogue with others. PBL is also considered to deepen learning as AL through learner reflection. Applying this to PBL, PBL has a double project structure. In other words, there are two projects: one for students to work on as learning, and one for educators to work on as class management. Each project is paired with project management and reflection for learning. Figure 1 shows the elements of PBL.

The educator's project includes management of the hard and soft aspects of the operation. In other words, the creation of mechanisms such as curriculum structure, implementation environment, and evaluation methods correspond to the hard aspects, while team management and motivation are the soft aspects. This study focuses on the soft aspects.

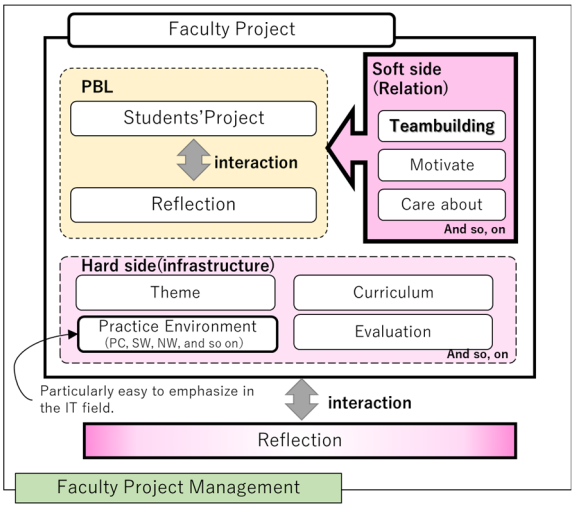

Figure 1: PBL structure.

4.2 Team Building

This section summarizes how relationships grow. Building trust is important in the workplace (Lee and Karimata 2017). People cannot build a relationship of trust simply by meeting each other. A trusting relationship is built gradually through mutual exchange (communication). Figure 2 shows the growth process of trust.

Figure 2: Growth Process of trust.

After "meeting" each other, people "get to know" each other through the process of exchanging information to learn about each other and about themselves. In this process, they "know" not only personal information, but also various other things such as skills and approaches to work. However, it is not possible to know all these things at once. Work is done through the cooperation of multiple people, and through this process of "cooperation," we learn more about each other. The process of knowing includes "knowing" in the sense of "obtaining information" and "knowing" in the sense of understanding the intention or true meaning, or so-called "understanding. The term "knowing" has been the subject of various studies in cognition, psychology, etc. Here, however, we use the term "knowing" to focus on the process of building trust in business. As a result of repeated "knowing" and "cooperation," "trust" gradually accumulates. In other words, it takes a certain amount of time for interpersonal trust, systemic trust, and contextual trust to be established. When trust is further developed, the relationship becomes a "good friend" with a sense of intimacy. However, in a working relationship, becoming good friends has not only a positive aspect but also a negative one. In other words, there is a risk of becoming "familiar" with each other. Familiarity tends to lead to compromise, which must be avoided to achieve the project goal. In business, it is important to maintain a level of "trust".

Applying this to Enokida and Matsuodani's team growth model (2004), the process of knowing begins in the formative period, followed by a period of mayhem through cooperation. During the tumultuous period, understanding of the aims and intentions of the other party is advanced, and the team is considered to move toward the normative period while deepening mutual understanding. In today's projects, where teams need to be set up quickly, the leader needs to be actively involved in team building from the early stages, rather than letting things happen naturally, to ensure a smooth transition to the normative phase. The leader must be actively involved in team building at an early stage, rather than letting it happen naturally. Li and Karimata (2022) introduced that interpersonal trust arises when others engage in verbal and non-verbal conformity, consideration, equality, self-disclosure, and integration. In other words, early team building is effective, and it needs to be even more relational than icebreaking.

4.3 Proposed Method

We propose the "Sentai-Hero-Exercise" developed in this study as a team-building method that can be implemented even by teachers with limited experience in team management. This is an exercise in which members play the role of SENTAI heroes* (hereafter referred to as "team heroes") by applying the famous Japanese form of team-based heroes to PBL teams.

*SENTAI heroes: SENTAI Hero is the "Super Sentai" series. It is a Japanese TOKUSATSU TV drama series started in 1975 by Toei Co. and has been broadcast for more than 50 years, with a new show aired every year with a new setting. Although the settings change, the format remains consistent, with several characters transforming into heroes armed with their own color-coded masks and suits to fight evil trying to take over the world. Super Sentai is a popular content series broadcast in 150 countries around the world as Power Rangers.

The purpose of this exercise is to perform the relationship-building steps of "knowing" and "working together" in a short period of time. This requires a deeper level of cooperation than a typical icebreak. Furthermore, the objective is to enable participants to proactively facilitate team building even if the educator does not have team-building skills.

The "team hero" was chosen as the theme for the exercise because (1) it is widely known and easy for participants to visualize, and (2) it can be adapted to project members with various personalities. In designing the exercise, we interviewed actors who had played heroes in TV shows to design the composition of team members and the team-building process.

Team heroes have a vision of the world they want to achieve and the monsters they need to fight. To this are added the goals and impediments to achieving the project. To accommodate diversity, each hero should have strengths and weaknesses, as well as special skills that match their personality. The goal is to create a relationship in which members help each other and enhance the strength of the team. It is like a child playing "pretend," where members introduce their strengths and weaknesses and discuss how to demonstrate and cover them in order to achieve the project's goals, thereby building mutual understanding.

The Troop Hero Exercise consists of five steps. They are as follows.

Step 1. Self-introductions [know]
Aim: To break the ice.
What to do: Briefly talk about the name you would like to be called, your strengths and special skills, and your role in the team.

Step 2. The world and the monster we are aiming for [Cooperation]
Aim: Become aware of the project goal and the challenges to reach it.
What to do: Express the project goal in one sentence that they can understand. Personify the obstacles that will be the most difficult to achieve the goal and make them into monsters.

Step 3. Team name and hero name [know]
Aim: Self-disclosure.
Each team member decides on a hero name and a name. At that time, they talk about their strengths and roles, and how they will contribute to the team's goal. Ask each other questions to find commonalities and decide on a consistent name. Discuss special moves against the monster. Also, decide on a team name that synthesizes the names of the heroes.
(e.g., Ichiro Tanaka, the Python Helping Blue who dashingly appears when he has technical problems)

Step 4. Transformation pose [cooperation]
Aim: Transformation into a team member
Decide the hero's name and the pose when saying the team name.

Step 5. Presentation [Cooperation]
Aim: Commitment to the goal
Make a declaration to the whole class

4.4 Practice and Discussion

4.4.1 Contents of Implementation

We tried the exercise in August 2022. Three teams were targeted, with five to six participants per team, all of them mixed teams of business person and university students. Each team will work on the development of a new product as a three-month project, following the design thinking process. This exercise was conducted as a team-building activity. The participants knew each other as business person and university students, but the business people and university students were meeting each other for the first time. The exercise was scheduled to last approximately one hour, including the explanation of the exercise. The following is a description of the content of the exercise and the results of the observations.

First, the overall flow was explained and Step 1. was conducted. The team members were gathered for the development of a new product, but since no role other than that of the leader had been determined, I asked the team to discuss the roles they would need to play. Ten minutes were used here. This phase corresponds to "meeting" and "getting to know each other. Since they were meeting for the first time, they awkwardly introduced themselves.

Next, Step 2. and Step 3 were conducted in succession. because the time for Step 1 was short, much time was spent on linking strengths to roles in the team and on establishing commonalities. As a result, the team spent about 25 minutes, exceeding the scheduled 10 minutes. At this point, the leaders of two teams had already taken the initiative to draw out the strengths of their members by becoming the leaders of the heroes. The remaining team was facilitated by a member other than the leader.

Next, Step.4 was conducted. 2 teams had members who participated remotely, so it was

difficult to think of specific physical movements. There were some poses that the team members could not do because of their stiffness, and there were some opinions that they did not want to do them, resulting in confusion and conflict. However, since the presentation time was fixed, those who did not want to do the poses seemed to have compromised to some extent. It took 55 minutes from the start of the exercise to this point.

Finally, as Step.5, the teams made their presentations. Each team announced its name and transformation. The figure3 and figure4 show the presentation; one of the participants was on Zoom, so he was transforming himself in the computer. The facilitator was only in charge of the opening explanation and timekeeping and left the rest to the teams. Finally, the session exceeded the scheduled time and ended in 1 hour and 15 minutes.

4.4.2 Result

According to the participants' questionnaire, this exercise was found to be beneficial for team building, with approximately 70% of the participants answering, "very good" or "good" and 30% answering "average. When asked the question, "Do you think you could have become a team? About 70% of the participants answered "Yes, I think so. The free description included the following items: "I think I was able to understand and get along with the team members to some extent in a short period of time (about one hour). The game was fun, and I think it will be useful in other team-building activities as well. Positive evaluations of the exercise were notable. The new product development meeting held the week after the exercise was very smoothly for all three teams.

4.4.3 Consideration

The results of the participants' questionnaires suggest that even a short time was effective for team building. However, in this trial of the SENTAI-Hero-Exercise, the target project was the development of a new product, and it is thought that many of the participants were originally proactive in their interactions with others. As a result, it is possible that the team building process went smoothly even in a short exercise. Since we were only able to evaluate the progress of the project through observation, it is necessary to study the evaluation method.

However, the use of the Team Hero format made it easy for the leader to exercise leadership even among members who had never met each other before, and the members were able to "get to know" and "cooperate" with each other while having fun. The fact that the facilitators were able to build the team by themselves with little intervention is also commendable.

Figure 3: Step 5 (one member in PC).

Figure 4: Step 5.

5 CONCLUSIONS

In this paper, we organized the structure of PBL and proposed a exercise method that facilitates team building even for teachers with little experience in team management. we found that the Sentai-Hero-Exercise can implement team building even with little experience in facilitation. We also confirmed that the exercise enables the "knowing" and "working together" of the trust-building process to be conducted in a short period of time, promoting mutual understanding among teams, and achieving teambuilding. Future issues include implementation in teams with a larger number of members and demonstration of the proposed method by teachers with limited experience in team management.

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