TOYO UNIVERSITY

Japanese Society and Culture

Volume 4 Article 9

3-31-2022

Analyzing the Development of a Remote Debate Program Using Video Annotation through a Systems Approach

Ryohei Ryohei Matsumura
Faculty of Business Administration, Toyo University

Munemi Asai
Faculty of Commerce, Chuo Gakuin University

Hideki Nakai
Faculty of Commerce, Osaka Seikei University

Akio Suzuki
Faculty of Business Administration, Toyo University

【**Received** 31 May 2021 / **Revised** 21 June 2021 / **Accepted** 25 June 2021】

Analyzing the Development of a Remote Debate Program Using Video Annotation through a Systems Approach[1]

Ryohei Matsumura※, Munemi Asai※※, Hideki Nakai※※※ and Akio Suzuki※※※※

Abstract

Abstract: This study aims to apply a systems approach to analyze the development of an education system for remote asynchronous debates. Although several studies have applied a systems approach to various objects, they attempted to improve projects using the approach by intention. However, in our study, the use of a systems approach was an unintentional part of the process, with stakeholders not being explicitly aware of the concepts behind systems thinking. In the midst of the process, a variety of systems thinking methods were partially adopted, making the project more systemic; however, the project was not oriented to follow specific problem-solving techniques. An educational program and information system for education support with sufficient systemic properties was created with such a systems approach. We propose that working on a problem with significant underlying systemic properties may help one to naturally adopt a systems approach.

Keywords: Remote Debate, Video Annotation, Systems Approach, Soft Systems Methodology, CATWOE

1. Introduction

As the COVID-19 pandemic continues, remote teaching practices using information systems have become common at universities. Stakeholders realising the advantages of remote teaching are expected to continue using this approach even after the pandemic. However, instructors in the field are still in a trial-and-error stage regarding remote teaching expertise, as there are no established methodologies.

Moreover, in Japan, there is an ongoing search for various methodologies for practicing active learning, which is important for the paradigm shift from “teaching to learning” as advocated by the Central Education Council of the Ministry of Education, Culture, Sports, Science, and Technology.

※ Ph.D. (Toyo University, Faculty of Business Administration, Department of Business Administration), Professor, Editor-chief of Contemporary Social Studies.
※※ Ms.S. (Chuo Gakuin University, Faculty of Commerce, Department of Commerce), Professor, Dean of Faculty of Commerce
※※※ Ms.S.(Osaka Seikei University, Faculty of Commerce, Department of Commerce), Associate Professor, Chief of Management Course
※※※※ Ph.D. (Toyo University, Faculty of Business Administration, Department of Accounting and Finance), Associate Professor

1 This paper is a largely expanded version of following three Japanese papers.

1) Matsumura, R., (2013) ‘Systems Approach to the Education Program for Development of Employability’, *Journal of Business Administration Keiei Ronshu*, Vol. 81, pp.81–90.
2) Matsumura, R., (2014) ‘Analysis of Educational Program for Improvement of Abilities to Find Appropriate Jobs by Using SSM’, *The Journal of Contemporary Social Science*, Vol. 11, pp.79–85.
3) Matsumura, R., Asai, M., Nakai, H., and Suzuki, A. (2016) ‘A Trial of the Remote Async Type Debate Program between Universities’, *Journal of Business Administration Keiei Ronshu*, Vol. 88, pp.43–52.

(MEXT, online). In particular for discussion-oriented education which is a method of active learning, there are several practical examples of remote education using information systems; however, the availability of existing methods in every possible environment, with regard to the inclusion of students who are unable to attend simultaneous sessions, cannot be guaranteed. Thus, there is a need to accumulate research findings from various perspectives in various cases. Considering the unique characteristics of how Japanese people evaluate others, there is no guarantee that the results of studies conducted in other countries in education engineering will yield the desirable effects when directly applied to Japanese universities. Accordingly a new methodology that suits Japanese characteristics is required.

The aim of this study is to use a systems approach to analyze the development of an education system for remote asynchronous debate implemented at four geographically separate universities in Japan and introduce a profile of relevant educational programs and information systems for educational support.

Several studies have applied systems approach methods, such as the soft systems methodology (SSM), to education projects (Saad *et al.*, 2006), attempting to improve projects using organisational means by intention (Mingers and Talor, 1992). However, in the case introduced in this article, the use of a systems approach was an unintentional part of the process, and the stakeholders were not explicitly aware of the concepts behind systems thinking. A variety of systems approaches has been partially adopted, including Kolb's experiential learning (Kolb, 1984; Smith and Kolb, 1986; Raschick *et al.*,1998) and Zimmerman's self-regulated learning (Zimmerman, 1989; Zimmerman and Schunk, 2001), both of which have a high affinity with systems thinking, making the project more systemic.

One of the contributions of this study is its reporting on an educational program and information system for educational support with sufficient systemic properties (=system-like natures) being created with such a half-intentional systems approach, such that even customer, actor, transformation, weltanschauung (worldview), owner, and environmental (CATWOE) can be observed. It has been suggested that working on a problem with substantial underlying systemic properties (Kitahara, 1986; Kitahara and Ito, 1991) can lead to naturally adopt a systems approach, even if stakeholders do not have full intention. Such cases have not been introduced in the past researches.

The details of the evolution of this system—in chronological order—are provided in later sections. However, the features of the system can be summarized as follows. The education system is a complex system comprising education programs, education support information systems (such as programs and databases) to support the programs, and instructors and students involved therein. In this system, a number of systemic properties exist, for example,

1) students' autonomous learning considered in the education programs;
2) critical roles played by communication (interactions) among instructors, or among students for project-based learning (PBL);
3) consciousness of synergies among subsystems (e.g., a synergy between formal learning and PBL);
4) the project as a whole and each product (education program or education support information systems) is a clear feedback system.

The authors believe that this study expands the application of a systems approach in the field of education and also provides valuable insights into the development of education programs using information systems, particularly discussion-oriented education programs, whose importance has grown substantially owing to the COVID-19 pandemic. In particular, this is true for discussion-type

educational programs at universities in Japan, where hesitancy is especially evident in mutual reviews. Electronic portfolio and video annotation systems created using systems thinking are both new systemic information systems involving rich feedback from themselves and others. We believe that they would make significant contributions to remote education in the future.

2. Soft Systems Approaches[2]

While there are a variety of soft systems approaches, this study used (a part of) Checkland's SSM as a means of post-verification. While we did not use specific problem-solving techniques explicitly but proceeded by partially adopting various systems thinking methods, post-verification indicated that there had always been CATWOE throughout the project. Accordingly, CATWOE is used as a tool for post-verification of how the system evolved to be effective.

Below is an overview of the SSM. While the SSM itself has changed from what it was originally through several case studies, the initial basic model of the SSM, which is simple and easy to understand, is discussed herein for the purpose of this study. This overview is based on the studies conducted by Checkland (1981), Checkland and Scholes (1999), Wilson (1990), and Takahashi (2007). The SSM consists of seven stages, as described below.

Stage 1 refers to the stage in which an unstructured problem exists. The stage sharing a problematic situation is manifested as Stage 2. In this stage, it is desirable that the problematic situation be detected and manifested without pushing a certain structure on the first parties; however, this is known to be difficult. People tend to act immediately rather than contemplate what the problem may be. An instrument called a rich picture is used for the manifestation of a problematic situation. While Checkland (1981) presents examples of a rich picture, there are no rules regarding creating one. However, the aim is to depict a problematic situation, rather than the problem itself in a picture as richly as possible to promote later recognition of the system.

In Stage 3, the root definition is fixed based on the rich picture created in Stage 2. The root definition necessarily includes a transformation process and a worldview. Subsequent discussions and communication are conducted, by considering this root definition to be the ground truth. However, for the SSM, there exists no rule that prohibits reversion after the completion of each process, which is a rule that applies to the lifecycle-based information system design method; thus, reversion and undoing a root definition are taken for granted. Consequently, it is not necessary to finalize the root definition during the first cycle.

It is also a characteristic of the SSM to consider a system to be a transformation process. In other words, the SSM recognizes a system as an input-output system. Thus, the definition of the education system as "a complex system composed of education programs, education support information systems (such as programs and databases) to support the programs, and instructors and students involved therein" is in line with the SSM policy when students with insufficient generic skills and those with sufficient generic skills are considered as inputs and outputs, respectively. A more detailed definition is provided in Section 4.

It is said that CATWOE analysis is useful prior to attempting to set a root definition. The term CATWOE comprises the set of initials of six factors for building a soft systems root definition: customers

---

2 Section2 is the revised version of a part of Matsumura (2014).

(customers or beneficiaries), actors (actors in a transformation process), transformation, weltanschauung (worldview), owner (owner or a party with an authority to terminate the transformation process), and environmental constraints.

After a root definition is fixed, a conceptual model is created in Stage 4, which is a relational model of actions that enables the transportation articulated by the root definition. Subsequently, the conceptual model and rich picture are compared in Stage 5, followed by Stage 6, in which a viable and desirable alternative is proposed, and Stage 7, in which an action to improve the problematic situation is performed. However, the SSM can be initiated in either of these stages, and the stages other than the root definition may be skipped.

For the education project introduced earlier, this study used a systems approach analysis with a focus on CATWOE analysis for the following reasons:

1) Stages other than the root definition are often skipped in practice;

2) This project was not developed with explicit use of the SSM.

Initially, a systems approach was used unintentionally. Although the use of a systems approach became semi-intentional, the SSM was not used in its entirety. While the changes in the root definitions of stakeholders in all phases are quite interesting, this cannot be considered as a complete case study for the SSM. Consequently, Section 4 advances the analysis with a particular focus on changes in root definitions, without considering rich pictures or conceptual models.

Moreover, this study exemplifies action research. Wilson (1990) explained action research as a simultaneous attempt to bring about a change to a situation as a research subject (action) and gain something from the process that generates that change (research). While ordinary scientific research adopts an approach of objectively observing a research subject from the outside, Checkland (1981) argues that it is virtually impossible to avoid interactions with the subject when the research subject itself entails social interaction. The origin of the SSM was a research education program of the Department of Systems Engineering, Lancaster University, which was designed to provide consultation to clients (businesses and municipalities) for problem solving.

The first author was not an initial member of the project, conducted interviews with initial project members, and proposed ideas for improvement. He elicited ideas for the evolution of the system into a more desirable system from systems theories and approaches. As he communicated these ideas to project members and witnessed actual process improvements, he finally became a project member.

In this study, the first author played a central role in the research and analysis of the education program from a project management perspective, whereas the initial members served as actors in this regard. Conversely, in terms of the actual research and development of the education programs, the research group of initial members served as researchers. However, the roles were not fixed, as the first author himself occasionally took on internal roles for program improvements, recommendations, and corrections. The research was conducted in the form of action research.

3. Transitions of the Education Project

In this section, the transitions of the project are discussed in chronological order in four phases for convenience. This section is based on facts recognized by the authors and project members through 42 face-to-face meetings (from January 25th, 2012, to February 6th, 2020). Moreover, we have rechecked these facts through video conversations and e-mails (March to May 2021).

Phase 1 From 2008[3]: It was the first project leader who initially recognized the problematic situation, which was perceived to be "Students are struggling in job hunting. E-learning should be introduced to create a more effective learning support system". The problem consciousness was not manifested at the beginning, but he reaffirmed it while persuading his institution.

Phase 2 From 2009: The project was initiated by obtaining an external budget. The theme was shifted to the development of so-called generic skills through the interaction between the first project leader and three other members of various backgrounds. It is well known that society and business attach a high value to the generic skills and competencies that students are expected to possess. Generic skills are skills that businesses expect from students, which may largely overlap with systemic properties (Kitahara, 1986; Kitahara and Ito, 1991). As mentioned previously, MEXT is leading the development of this capability in Japan (MEXT, online).

The education group of Osaka Seikei University, led by the first project leader, focused on this aspect, leading to the launch of an education project to develop such generic skills. Specifically, a PBL project was initiated in 2009 in cooperation with the university's affiliated high school and a feedback system was established—however, it was not a sufficiently effective feedback system as is described later—where the project outcomes (grasped through questionnaire surveys and heard by expert counselors) were fed back for subsequent implementation.

More specific details are as follows (Osaka Seikei University Faculty of Management Job Hunting Competency Development GP Project, 2011). In the project, mixed groups consisting of sophomore students of Osaka Seikei Girls High School and sophomore students of the Department of Modern Management Information, Osaka Seikei University (5–8 students per group) were used to create a webpage to introduce the high school and its events. Twelve preparatory lessons (of 90 min each) to acquire the basic knowledge for webpage production were held during the first term, followed by 12 PBL classes during the second term. The university students were assigned the role of supporting the high school students in production, serving as team leaders. The aim of the project was to develop the students' autonomy, planning skills, faculty, and problem-solving abilities by working on a problem without a definite answer, in addition to developing their communication and leadership skills through group work. For this purpose, an electronic portfolio system was developed. Details of this information system are described in 5-2.

While the principal aim of the project was to develop generic skills, it did not disregard the importance of expert knowledge and IT literacy. For these properties, an e-learning program was designed and implemented to keep students motivated to acquire the necessary knowledge and information at appropriate times—for example, during job-hunting periods. Thus, the project pursued the acquisition of both generic skills and expert knowledge. In other words, PBL and e-learning programs for the acquisition of expert knowledge constituted subsystems of the whole system.

---

[3] The following analysis in this section is a modified version of a part of Matsumura (2013) and Matsumura (2014) up until Phases 2. Although Phase 3 was also based on a part of Matsumura (2013), Matsumura (2014) and Matsumura *et al.* (2016), it includes the facts that were recognized only after consultations with project members during the writing of this paper. Similarly although Phase 4 is based on a part of Matsumura *et al.* (2016), it includes the facts that were recognized only after consultations with project members during the writing of this of this paper.

Phase 3 From 2012: Until this phase, the project was almost solely led by Osaka Seikei University. From this point onwards, other universities, including Toyo University, joined the project, which developed into an inter-university project. Of the stakeholders from other universities, the first author initially joined the project as a collaborator and gradually became an influential member of the project.

According to Asai *et al.* (2013), the background to the development of the video annotation system is as follows: Although certain effects of the initial PBL program using the electronic portfolio system on the development of generic skills were observed, answers to a questionnaire survey among learners regarding their behaviors and results—conducted during the "reflection" phase following the implementation of PBL (i.e., a process of establishing an internal feedback system for individual learners)—were mostly simple and superficial. This suggests that the program was not highly effective. Consequently, the members concluded that implementation of PBL would not lead to effective development of generic skills without appropriate reflection and improvement of the learners' own activities based on the results of their reflection.

Accordingly, from 2012, members started to use videos to support accurate observation and evaluation of themselves and others; PBL group activities were filmed, and the videos were used for students to evaluate themselves and others as "reflective" learning. To support this "reflective" learning, the additional development of a video annotation feature added to the electronic portfolio was conducted, which began to be used in 2013. This video annotation feature can be described as follows: Video files of the recorded PBL activities were shared among group members, and individual students could watch the videos and directly enter their evaluation of each video scene via an electronic portfolio screen. Individual students could directly insert their comments about what they felt and their evaluation of a specific video scene while watching the video on the electronic portfolio screen. The subjects of the comments and evaluations were both group members and the students' own activity videos. Students' evaluations written into a video were displayed in the respective scenes when the video was replayed, enabling students to observe evaluations and comments of their own and others at any time by repeatedly watching the video (Asai *et al.*,2013).

This process could be described as an extension of a complex system in which a feedback system built within each learner's brain was manifested, and learners could acquire feedback from other learners.

Phase 4 From 2014: Project members realized that implementation of the program only within Osaka Seikei University would not effectively preclude hesitation in providing honest evaluations and activities of highly homogeneous members alone would reduce the chance of emergence, which is highly valued in system studies. Therefore, the members attempted to expand the project into a more interorganizational project.

In general, it has been pointed out that Japanese people tend to positively evaluate people close to them (Kobayashi, 2012). Fujiwara (2007) also demonstrated from experiments conducted by Japanese university students that "mutual" evaluations tend to be swayed by the so-called "reciprocal effect" which often facilitates positive evaluations of each other. While this effect may have a positive impact on human relations and other aspects, project members have determined that neutral, uncontrolled, or more objective, evaluation of others is effective for the reflective learning of participants in this educational program.

This was the starting point of the cooperation with Tokyo Keizai University and Hokusei Gakuen University, as well as Toyo University, which had already joined the project. Through the exchange of opinions between instructors of the participating universities, an idea of inter-university debate sessions to be implemented for more effective development of generic skills and to promote the evolution of the program into an educational program delivering synergistic effects was proposed. More details of remote debate and education support information systems are described in a section 5.

In 2017, the first project leader moved to Chuo Gakuin University, and the second project leader inherited the role of project leader, including the management of information systems. In action research, it is appropriate to be subjective in understanding the environment of an organization. Nonetheless, we could verify the facts objectively because of the first project leader's transfer, and as a result, various relationships were reset.

4. Systems Approach Analysis of the Evolving Project Process

The properties of this project with a high affinity to the soft systems approach include

1) root definitions largely vary;
2) the diversity of value sets and worldviews and the sharing of root definitions are combined;
3) multiple autonomous learning agents exist;
4) action research is conducted; and
5) feedback systems are observed frequently.

This section describes the evolving process of this project from a systems approach perspective, particularly in the form of SSM CATWOE analysis. Initial members who had taken part in the project prior to the first author's entry were not equipped with insight into several system concepts, including CATWOE. After the first author joined, such concepts were explained during project discussions, but no decisions were made explicitly from the consciousness of these concepts. In other words, as discussed in Section 1, the use of a systems approach was an unintentional part of the process, with stakeholders not being explicitly aware of the concepts of systems thinking or a systems approach. In the middle of the process, a variety of systems thinking approaches was partially adopted, including learning models that had a high affinity to the systems approach, which made the project more systemic—however, the project was not particularly oriented to follow specific approaches or techniques.

In this section, we employ CATWOE analysis for post-verification. The details of these components are described in the following subsections. (The phases are the same as those discussed in Section3.)

Phase 1 From 2008[4]: The first project leader initially recognized the problematic situation, perceived as stated in the previous section. A root definition for the problem consciousness at that point should have been "a system to transform students who are not yet competent in expert learning into those who are competent in expert learning". CATOWOE at this point was as follows: C: students; A: instructors of the Department of management, Osaka Seikei University; T: students not competent in expert learning students competent in expert learning; W: acquisition of expert knowledge has a significant impact

---

4 The following analysis in this section is a modified version of a part of Matsumura (2013) and Matsumura (2014) up until Phases 2. Although Phase 3 was also based on a part of Matsumura (2013), Matsumura (2014) and Matsumura *et al.* (2016), it includes the facts that were recognized only after consultations with project members during the writing of this paper. Similarly although Phase 4 is based on a part of Matsumura *et al.* (2016), it includes the facts that were recognized only after consultations with project members during the writing of this of this paper.

on improvement of students' competency in learning; O: first project leader or the department; and E: budget constraints of the department.

At this stage, the project had not yet been launched, but it could be said that the first project leader had already recognized a system comprising himself, the department, and students. While recognition of the system generated several ideas for its evolution, the idea that was adopted was the acquisition of external budgets for the introduction of e-learning.

Phase 2 From 2009:

a) Change in root definition

The first project leader obtained the external budgets, allowing the other three project members to join the project. The observation of students and the interaction between project members of various backgrounds thereafter led to the simultaneous pursuit of PBL and the acquisition of expert knowledge. It is interesting to note that the initial aim of introducing e-learning to acquire expert knowledge was transformed through observation of the students into the simultaneous pursuit of PBL and the acquisition of expert knowledge—and the new objective substantially governed the evolution of the system thereafter. Consequently, changes in views and objectives decisively changed the meaning of the system.

As implied by the fact that the SSM can be started during any of the project stages and it tolerates their reversion, the above-mentioned change in objective was not regarded as a negative event. The first cue that encouraged the first author to reflect on the project from an SSM perspective was the observation of this significant change in the basic objective.

The system's root definition of the project's adoption of the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT)'s Good Practice (GP) project—that is, the acquisition of the budget—and the joining of the project members should have been as follows: "a system to transform students without high generic skills and competency in knowledge acquisition into students with both", where: C: students; A: project members; T: students not competent in job hunting –students with high academic abilities to acquire expert knowledge and high generic skills; W: generic skills significantly affect students' competency in job hunting; O: project members or the department; and E: GP budget constraints and GP-required outcomes. However, while the simultaneous pursuit of generic skills and the acquisition of expert knowledge were superficially declared, specific interactions were not considered, and the members acknowledged that their awareness of the interactions faded along with the project's progression.

As adopted for the GP project, the education program and education support information system evolved substantially. It was confirmed that the various ideas created during this phase were strongly influenced by the aforementioned root definition.

Project members' backgrounds ranged from education engineering to business administration, justice studies, and information engineering. Given their diverse backgrounds, it was natural for diverse value sets to exist. However, it was found through interviews that, for the system, there were few conflicts between members. Despite differences in their value sets and views on education, only a few outward conflicts of interest or emotional confrontations were observed. It is presumed that the project evolved relatively steadily largely because of an organizational culture in which members engaged in research within the framework of a root definition for a certain period of time once the root definition had been

implicitly fixed despite their diverse value sets. While the first project leader was in the leadership role, the organizational structure was considerably flat.

b) Development of education support information system

For information system development (which started in 2010), a spiral-up method was employed—that is, a mixed-type of lifecycle development and prototyping method. At the time of determining the e-learning introduction, it was decided to entrust the orthodox system development arranged for Osaka Seikei University as a requirement definition for a system developer. Subsequently, it was improved by adding features to the initially developed information system.

If there had been no changes in the system's root definition, the total development cost would naturally have been lower using a lifecycle-type development method. The first project leader pointed out the poor outlook at the beginning as a reason for the employment of the spiral-up method. The poor outlook was derived from the complexity of the problem, suggesting that a soft systems approach would be appropriate for the problem. Specifically, with regard to the poor outlook, it was indicated that there was originally no intention of supporting the PBL part with an information system—that is, the information system evolved to support PBL, as outlined below.

Originally, the education support information system— developed since 2010—had been designed and completed (in 2011) as a system equipped with three features: a bulletin board system feature for discussion between students, a feature to assist knowledge learning, and a feature to accumulate self-reflection and instructor/counselor comments on various activities. Although it had already been equipped with a simple feedback feature during the initial stages, it was limited and was not fully functional, as discussed earlier.

However, through repeated PBL processes, it was organizationally discovered that students' goal setting and reflections had significant meaning (this was recognized during the next phase), and consequently the information system was then improved by adding a function to support goal setting and reflections.

In any event, the awareness of the poor outlook of the problem leads to avoidance of the development of a complete system using the lifecycle-type development method during the initial phase accompanied by a large cost. While it is difficult to anticipate how a complex problem may progress, this is a good example of the fact that unnecessary costs can be avoided by recognizing the complexity of the problem. If the root definition had merely been the introduction of e-learning rather than the improvement of job-hunting competencies, there would have been no such evolution. Thus, the course of the project development exemplifies the importance of the root definition.

Phase 3 From 2012:

a) Commencement of the first author's action research

The first author started his action research in January 2012. After interviews with relevant parties, he presented two proposals from a systems approach perspective, as described below.

- Consciousness of the synergy: Within the whole system, there were two subsystems: a program specializing in improving generic skills (e.g., PBL) and a program specializing in the efficient acquisition of expert knowledge. From a systems perspective, it is important to improve the system to maximize its use of interactions (synergy) between the two subsystems in a positive way.
- Group forming method and assignment of specific tasks: Small groups of students engaging in PBL

themselves also serve as subsystems. Furthermore, individual members of a small group may also be regarded as a system comprising a larger hierarchical system. As one of the fundamental objectives of the education program system was to equip individual students with sufficient systemic properties, it is clear that such small groups would constitute an important system. Specifically, it was thought that certain considerations given in grouping people—that is, the determination of a group composition—and the assignment of specific tasks to develop systemic properties, should be important.

It was also thought that other system concepts would become familiar to the members through discussions, conference presentations, and the drafting of academic articles. Although this does not imply that the two proposals were fully realized and that members became aware of systems thinking, it could be considered that the series of interactions delivered indirect effects that led to systemic ideas within the group. From this perspective, the project started evolving with systems thinking half-intentionally and half-unintentionally since the first author joined the project.

b) Recognition of the importance of reflection and feedback

Around this time, the awareness of the importance of "reflection" grew through the sharing of various educational engineering methods in discussions among the project members (Asai *et al*. 2013). Reflection can be paraphrased as a feedback system in system studies. As mentioned earlier, feedback from instructors and counselors was adopted as of 2009 but delivered ineffective outcomes. Accordingly, it was recognized to be an important problem in reinforcing the feedback loop.

In the field of educational engineering, for example, researchers such as Krajcik *et al*. (2008) have proposed learning models that explicitly involve feedback. Moreover, Kolb's experiential learning model also clearly depicts a feedback loop of "Concrete Experience" → "Reflective Observation" → "Abstract Conceptualization" → "Active Experimentation" → "Concrete Experience" (again), weighing heavily on reflections and feedback (Kolb, 1984; Smith and Kolb, 1986; Raschick *et al*.,1998). Zimmerman's self-regulated learning was also modelled on a cycle comprising three phases, "forethought", "performance", and "self-reflection", which also used feedback as a key element (Zimmerman, 1989; Zimmerman and Schunk, 2001). The above-mentioned concepts and techniques were deeply discerned by the members.

These feedback-oriented learning models already exhibited sufficient systemic properties and were not only mere educational models but could be deemed to include a high degree of systems thinking. The fact that PBL including rich feedback processes had already induced system thinking may also be pointed out as a reason for the project to be naturally led using a systems approach without the explicit use of specific techniques.

Here, we introduce the concept of peer assessment. Regarding the effectiveness of peer assessment, Festinger (1954) pointed out in his social comparison theory that people had a desire to assess their own opinions and abilities; people attempted to assess themselves by comparing their own opinions and abilities with those of others when there was no physical or objective means of assessment; and people similar to themselves were generally desirable as a target of comparison. This arguments also suggested that feedback from instructors and counselors was not sufficient, and peer review was important. In addition, Shimizu (2012), discussed generic skills, and identified the following three points as important in practice in the section "Implications for School Education in Japan" in his paper.

1) Reform of curriculum structure
2) Reform of teacher education
3) Introduction of formal assessment

The peer assessment introduced in this project perfectly matches 3).

In other words, the original worldview (i.e. W of CATWOE in the SSM) of the members, which was "generic skills and acquisition of expert knowledge both significantly affect students' competencies in job hunting", was extended with additional concepts, "interactions and communication among students, between students and members, and among members and students' proactive learning are important" and "reflection plays an important role in the acquisition of generic skills", leading to a change in the system's root definition.

CATWOE at this stage was defined as follows: C: students; A: project members; T: students not competent in job hunting → students with high academic abilities to acquire expert knowledge and high generic skills; W: 1) generic skills significantly affect students' job-hunting competency. 2) Interactions and communication among students, between students and members, and among the members and students' proactive learning are important; 3) reflection plays an important role in the acquisition of generic skills; O: project members or the department; and E: GP budget constraints and GP-required outcomes.

From 2012, the members started to use videos as a means to support accurate observation and evaluation of themselves and others; PBL group activities were filmed, and the video was used for students to evaluate themselves and others as "reflective" learning. Consequently, an education support information system was developed (adding a video annotation function) to enable students to reflect effectively.

Phase 4 From 2014:

A remote debate program was created thereafter to eliminate hesitance in mutual evaluations. CATWOE at this stage was defined as follows: C: students of the four universities; A: project members (the first project leader and the second project leader from Osaka Seikei University, Sato from Tokyo Keizai University, Furuya from Hokusei Gakuen University, and the first author from Toyo University); T: students with insufficient generic skills and ability to acquire expert knowledge → students competent in both; W: "generic skills and acquisition of expert knowledge both significantly affect students' competencies in job hunting", "interactions and communication among students, between students and the members, and among the members and students' proactive learning are important", and "reflection plays an important role in the acquisition of generic skills"; O: project members or the department; and E: communication between classes held at different times and days of the week at geographically separate universities.

The remote debate program exhibited apparent improvements in the development of synergistic effects between formal knowledge and generic skills, as proposed by the first author, which made it a highly advanced version of the system. As the style of education called "debate" was effective in nurturing logical thinking and communication skills, as well as in so-called knowledge acquisition although generally narrow in scope, it was apparent that the program could help nurture synergistic effects and the project as a whole could be thought to have improved in the direction of greater systemic properties.

In comparison with its version until 2013, the education support information system at this stage was characterized by its cross-organizational nature, considerably greater effectiveness, ability to trigger synergy and emergence in various ways, and greater systemic properties.

In 2019, the second project leader, who had inherited the project leader role in 2017, did not present any seminars for the convenience of his department; consequently, the debate program stopped. However, we plan to restart it in 2022. In the next section, the two systems derived from this education system are described.

Table 1 CATWOE by different phases

Phase	CATWOE	System properties observed	Consciousness of system thinking	Information system as a product
1	C: students; A: instructors of the Department of Management, Osaka Seikei University; T: students not competent in expert learning → students competent in expert learning; W: acquisition of expert knowledge has a significant impact on improvement of students' competency in learning; O: first project leader or the department; and E: budget constraint of the department.	None	Unintentional	None
2	C: students; A: project members; T: students not competent in job-hunting → students with high academic abilities to acquire expert knowledge and high generic skills; W: generic skills significantly affect students' competency in job-hunting; O: project members or the department; and E: GP budget constraints and GP-required outcomes.	Students' generic skills, synergy between expert knowledge education and PBL, feedback (comments of expert counselors and self-reflection)	Unintentional	Electronic portfolio
3	C: students; A: project members; T: students not competent in job-hunting → students with high academic abilities to acquire expert knowledge and high generic skills; W: 1) generic skills significantly affect students' competency in job-hunting. 2) interactions and communication among students, between students and the members, and among the members and students' proactive learning are important 3) reflection plays an important role in acquisition of generic skills; O: project members or the department; and E: GP budget constraints and GP-required outcomes.	Students' generic skills, feedback (comments of expert counselors and others in the university and self-reflection)	Half-intentional, learning models of Kolb, Zimmerman are considered, synergy is considered.	Electronic portfolio, Video annotation
4	C: students of the four universities; A: project members (the first project leader and the second project leader from Osaka Seikei University, Sato from Tokyo Keizai University, Furuya from Hokusei Gakuen University, and the first author (Matsumura) from Toyo University); T: students with insufficient generic skills and ability to acquire expert knowledge → students competent in both; W: "generic skills and acquisition of expert knowledge both significantly affect students' competencies in job-hunting", "interactions and communication among students, between students and the members, and among the members and students' proactive learning are important", and "reflection plays an important role in acquisition of generic skills"; O: the project members or the department; and E: communication between classes held at different times and days of the week at geographically-separate universities.	Students' generic skills, synergy between expert knowledge education and PBL, mutual feedback (comments of others = those from other universities)	Half-intentional, learning models of Kolb, Zimmerman are considered, synergy is considered.	Electronic portfolio, Video annotation

5. Products of the Education Program

5.1. Remote Debate System[5]

The inter-university debate program is called a remote asynchronous-type debate (Nakai *et al*., 2016). The term "remote" is used in the sense that participants of a debate do not meet at the same place, whereas the term "asynchronous" is used in the sense that participants do not interact at the same time or in real time. Any real time, synchronous debate using a teleconferencing system would have no significant difference from a normal face-to-face debate even if it were held remotely; however, the difference between synchronous and asynchronous debates is assumed to have a significant impact on learning effectiveness.

Groups from Osaka Seikei University, Tokyo Keizai University, and Toyo University competed randomly. Students also served as judges in other debates. Students of Hokusei Gakuen University participated only as judges.

This program was designed to incorporate peer assessment and reflection, avoiding homogenous members and hesitancy. Although having real-time debates using a teleconferencing system was considered, the idea was declined as members had seminars at different times on different days of the week. The difficulty in scheduling was easily overcome using this asynchronous method. Other advantages were as follows: There was enough time for deep thinking or arguing with group members, and it was suitable for debate beginners. Moreover, they could repeatedly reflect their own comments, as well as those of group members, and opponents.

Simple measurements of the educational effects were performed in specific seminars in a given year; however, because unified and longitudinal research was not conducted, it cannot be described here.

5.2. Education Support Information System

This subsection introduces the education support information system, which is a core component of the program. We describe the final version of 2018. Although we followed Asai (2020) regarding the definition of function, we provide different explanations from the perspective of systems thinking. This system was designed to serve the CATWOE framework described in Section 4. C: students of the four universities; A: the project members (the first project leader and Nakai from Osaka Seikei University, Sato from Tokyo Keizai University, Furuya from Hokusei Gakuen University, and the first author (Matsumura) from Toyo University); T: students with insufficient generic skills and ability to acquire generic knowledge → students competent in both; W: "generic skills and acquisition of generic knowledge both significantly affect students' competencies in job hunting", "interactions and communication among students, between students and the members, and among the members and students' proactive learning are important", and "reflection plays an important role in the acquisition of generic skills"; O: the project members or the department; and E: communication between classes held at different times and days of the week at geographically separate universities.

---

5 Subsection 5.1 is based on a part of Matsumura *et al.* (2016).

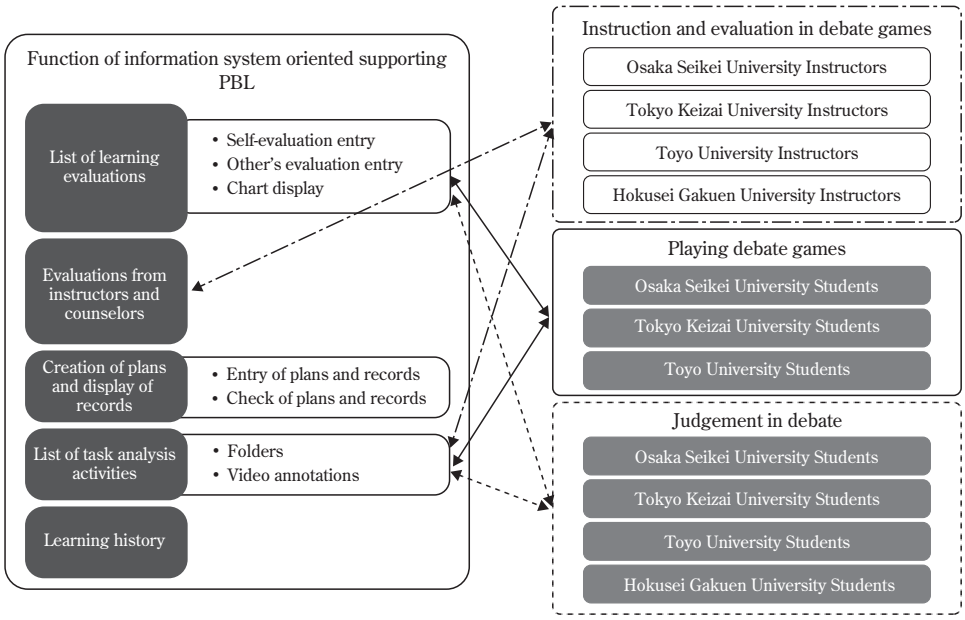

Figure 1

This was originally designed for the use of Osaka Seikei University's students, and although other university's students could access the system, their use was substantially limited. In this section, although we present the full version, we focus on the parts that are related to the debate program.

This system can be called a goal-oriented and clear feedback system that supports students' autonomous learning. It was designed to support autonomous learning by effectively using feedback information from the students or others. The repetition of learning through this system improved generic skills or systemic properties. In particular, this system presented an assessment of their behaviour in debate or other PBL projects effectively.

The menu comprised the following five elements:

1) A list of learning evaluations;
2) evaluations from instructors and counselors;
3) the creation of plans and display of records;
4) a list of task analysis activities; and
5) learning history.

This was built as a web application system available to both instructors and students over the Internet. The five elements are explained below.

1) List of learning evaluations
   a) Self-evaluation entry: Students performed self-evaluations through a questionnaire designed by the instructors. They also used this element in debates.
   b) Others evaluation entry: As with the self-evaluation entry, this was used to enter evaluations of others—such as group members or opponents—in the debates through a questionnaire designed by the instructors. Moreover, there was a free-description field.

c) Chart display: This was a feature to display evaluations (entered in a) and b)) in a radar chart format for easy understanding. Students could check all their PBL evaluations, including debates.

2) Evaluations from instructors and counselors

a) Instructors and counselors could also enter their evaluations through questionnaires such as 1-a) and 1-b). These evaluations were accumulated in the database, and students could check them at any time. In the debates, instructors who were judges entered the evaluations of debate players.

3) Creation of plans and display of records

a) Entry of plans and records: Students set their learning goals for each semester. Therefore, this system clearly became a goal-oriented system. Evaluations of 1-a), 1-b), and 2 were the feedback information enabling students to recognize the differences between their results and their goals. In the debates, we did not use this function. However, we are planning to use it in future debates.

b) Check of plans and records: This feature showed all goals set in 3-a) and actual records as a Gantt chart for easy understanding, and students could check these at any time. These were important feedback data. In the debates, we did not use this function, as in (3-a). However, we intend to use it in future debates.

4) List of task analysis activities

a) Folders: This is a folder that enabled group members to share and use files such as the discussion or presentation materials created through various PBL activities, including debates.

b) Video annotation: This part was the core of the system and played the most important role in the debates. This had the following functionality (described in Section 2): "Video files of the recorded PBL activities were shared among group members and individual students could watch the videos and directly input their evaluations to each scene of a video via the electronic portfolio screen. Individual students could directly insert their comments and evaluations of an exact scene of a video while watching it on the electronic portfolio screen. The subjects of the comments and evaluations were both group members and students' own activity videos. Students' evaluations written into a video were displayed during the respective scenes when the video was replayed. This feature enabled students to notice evaluations and comments of their own and others at any time by repeatedly watching the video".

5) Learning history

a) This feature was used to check past learning data, thereby enabling students to obtain useful feedback information at any time.

6. Conclusions

This study primarily used a part of the SSM, a systems thinking approach, to analyze the development background of an education system for remote asynchronous-type debates implemented by using specific information systems and introduced a profile of relevant education programs and information systems.

The systems approach analysis of the development history is valuable as an example of the application of the systems approach in the educational field. It indicates that even if there is no awareness regarding systems approach, the problem itself may naturally demand and lead to soft systems thinking. Although SSM were not used consciously, CATWOE was clearly there after the fact. This is because models such as Kolb's experiential learning and Zimmerman's self-regulated learning can be regarded as types of systems approaches. However, if the explicit use of a systems approach is started in the initial phase, its evolution can be achieved in a shorter period.

In addition, the information system created by systems thinking and the remote debate program using it has valuable implications for new remote education in the COVID19 age. In particular, the evaluation of others by video annotation will ensure the supply of material for objective reflection at universities in Japan that are so prone to the "reciprocal effect."

Although the remote debate program began in 2015, it established a complete methodology by 2017. It was stopped in 2019, as described in the previous section. We plan to restart the program in 2022 with sufficient research on its educational effects.

References

Asai,M., Inamura,M., Nakai,H. and Chiyohara,R. (2013)' Fostering Reflective Learning by Video Annotation', *Journal of the Educational Application of Information and Communication Technologies*, Vol.16(1), pp.24-29. (in Japanese)

Asai,M. (2020) 'Study on a Learning Model Using e-Portfolios to Expand Active Learning and Ongoing Support: Development and Educational Practice of e-Portfolios Focused on Performance' *Journal of Information and Management*, Vol.39(4), pp. 3-14. (in Japanese)

Checkland, P.B. (1981) Systems Thinking, Systems Practice, John Wiley & Sons.

Checkland, P.B. and Scholes,P. (1999) Soft Systems Methodology in Action, John Wiley & Sons.

Festinger, L. (1954) "A Theory of Social Comparison Processes," *Human Relations*, Vol.7, pp. 117-140.

Fujiwara,Y.Ohnishi, H and Kato, H. (2007) 'An Evaluation Support System for Impartial Peer Evaluation : "Reciprocal Effect" Occurred by Selecting Evaluators in Case of Peer Evaluation of Learning Outcome', *Japan Society for Educational Technology*, Vol.31(2), pp.125-134. (in Japanese)

Kitahara,T. (1986) Introduction of System Science, Yuhikaku. (in Japanese)

Kitahara,T and Ito, S. (1991) Japanese System Thinking, Chuo Keizai. (in Japanese)

Kobayashi,T. (2012) 'Relationships among Evaluations of Self and Close Others and their Effects on Social Adaptation', *Japanese Journal of Interpersonal and Social Psychology*, Vol.12, pp.129-134.

Kolb, D.A. (1984) Experiential Learning as the Science of Learning and Development, Englewood Cliffs: Prentice Hall.

Krajcik, J., McNeill, K. L., & Reiser, B. J. (2008) 'Learning-goals-driven Design Model: Developing Curriculum Materials That Align with National Standards and Incorporate Project-based Pedagogy', *Science Education*, Vol. 92(1), pp. 1–32.

Matsumura, R., (2013) 'Systems Approach to the Education Program for Development of Employability', *Journal of Business Administration Keiei Ronshu*, Vol. 81. pp.81–90. (in Japanese)

Matsumura, R., (2014) 'Analysis of Educational Program for Improvement of Abilities to Find Appropriate Jobs by Using SSM', *The Journal of Contemporary Social Science*, Vol. 11, pp.79–85. (in Japanese)

Matsumura, R., Asai, M., Nakai, H., and Suzuki, A. (2016) 'A Trial of the Remote Async Type Debate Program between Universities', *Journal of Business Administration Keiei Ronshu*, Vol. 88. pp.43–52. (in Japanese)

MEXT, "Toward a Qualitative Transformation of University Education to Build a New Future: Creating Universities that Foster the Ability to Continue Learning for Life and Thinking Independently, Report 1/2", [online] https://www.mext.go.jp/component/b_menu/shingi/toushin/__icsFiles/afieldfile/2012/10/04/1325048_1.pdf (Accessed 24 May 2021)

Mingers,J. and Taylor,S. (1992) 'The Use of Soft Systems Methodology in Practice', *Journal of the Operational Research Society*, 43(4), pp.321-332.

Nakai,H., Asai,M., Sato,O., Matsumura,R., Furuya,J., (2017) 'A Study on the Practical lnitiatives on the Education with Asynchronous Remote Debate System', *Bulletin of Osaka Seikei University*, Vol.3, pp.63-70 (in Japanese)

N.H.Md. Saad, Alias,R.A. and Rahman,A.A. (2006) 'Using Soft Systems Methodology (SSM) in Formulating Knowledge Management Systems (KMS) Strategy for Malaysian Public Institutions of Higher Education (PIHE), *Proceedings of the 5th International Conference on ICT and Higher Education*, Tokyo, Japan.

Osaka Seikei University Faculty of Management Job-hunting Competency Development GP Project (2011), "MEXT: University Student's Job-hunting Competency Development Support Program: Industry High-school University Cooperation and PBL for Training Student's IT and Generic Skills; Heisei 23 Yearly Progress Report Document" (in Japanese)

Raschick,M., Maypole,D.E. and Day,P.A. (1998) 'Improving Field Education Through Kolb Learning Theory', *Journal of Social Work Education*, Vol.34(1), pp.31-42,

Reiser, R.A. (2001) A History of Instructional Design and Technology: Part II: A History of Instructional Design. *Educational Technology Research and Development*, Vol.49, pp.57–67.

Shimizu,Y., (2012) 'The Development and Spread of the 'Generic Skills' and its Political Background', *Annual Bulletin, Graduate School of Education, Tohoku University*, Vol.61(1), pp.275-287. (in Japanese)

Smith, D. M., & Kolb, D.A. (1986) User's Guide for the Learning-style Inventory: A Manual for Teachers and Trainers. Boston: McBer.

Takahashi,S. (2007) Basics of System Theory, Baifukan. (in Japanese)

Wilson, B. (1990), Systems: Concepts, Methodologies, and Applications, John Wiley & Sons.→

Zimmerman, B. J. (1989) "A Social Cognitive View of Self-regulated Academic Learning," *Journal of Education Psychology*, Vol. 81, pp. 329-339.

Zimmerman,B.J. and Schunk.D.H.(Eds.) (2001) Self-regulation Learning and Academic Achievement: Theoretical Perspectives. New Jersey: Lawrence Erlbaum Associates.

Acknowledgment:

This work was supported by JSPS KAKENHI Grant Numbers JP24501161 and MEXT GP.