AGRICULTURAL KNOWLEDGE TRANSFER BASED ON EXPERIENCE FROM FAILURES

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ABSTRACT

In agriculture, the transfer of knowledge has become a problem. Agriculture has typically involved knowledge being transferred via it being handed down from parents to children or person to person over a long term. However, in recent years agricultural knowledge has become difficult to transfer because of a decrease in the number of agriculture workers and increasing number of novice agriculture workers in Japan. This study suggests a supportive framework for transferring agricultural knowledge via use of a system. The system supports the transfer of tacit knowledge-based know-how and experience using a SECI model. Furthermore, the system also uses experience gained in failures as part of the knowledge transferred because learn from those failures can be very important. In proving its validity subjects gained experience through cultivating vegetables. In that evaluation experiment the method of cultivation was classified into 3 patterns and the results of the 3 patterns then compared. This then resulted in the efficacy of the system being confirmed.

KEYWORDS

Knowledge transfer, agriculture, tacit knowledge, explicit knowledge, SECI model

1. INTRODUCTION

1.1 Background

"Knowledge transfer" is currently a very important theme in that it has been gaining a great deal of attention. The knowledge transfer issue is being tackled a variety of scenes, for example system engineering, artificial intelligence, and so on. However, these approaches involve a number of problems.

This particular research tackles the problem of transferring agricultural knowledge. Agriculture does not involve any corporatization and hence agricultural knowledge has typically been communicated from parents to children or person to person over a long period of time. In recent years, however, the number of people who have been changing jobs from being a corporate employee to being a farmer has been increasing in Japan, resulting in the need for agricultural knowledge to be transferred to them also increasing. That newly arisen need for agricultural knowledge to be transferred has taken place using the trial and error process. Recently the possibility for knowledge to be shared on a global scale because of the new ubiquitous network society has also arisen. This study therefore proposes that the "knowledge transfer in agriculture" should be based on "experience from failures."

1.2 Associated Concept

1.2.1 Tacit Knowledge

Nonaka defined tacit knowledge to be "knowledge gained from individual experiences or specific situations that include intangible elements such as beliefs, views, value systems, and so on [1]." This concept redefined Michael Polanyi's concept of tacit knowledge [2]. The assumption was therefore made that agricultural knowledge on the necessary chores, know-how, and experience gained form failures could be classified as tacit knowledge.

1.2.2 SECI Model

The SECI model was defined by Nonaka and Takeuchi as a knowledge acquisition process used to share tacit knowledge within companies. This model repeats four processes of knowledge conversion, which are "Tacit to Explicit (Externalization)", "Explicit to Explicit (Combination)", "Explicit to Tacit (Internalization)" and "Tacit to Tacit (Socialization)".

These four processes lead to the creation of new knowledge. Figure 1 shows the flow of the SECI model.

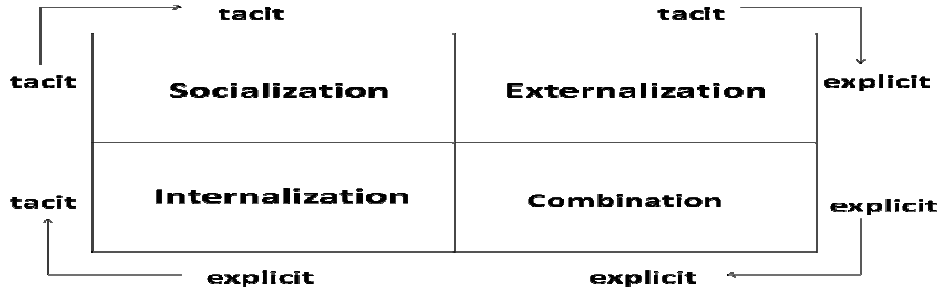

Figure 1. Flow of SECI model

Several studies have been made on the transfer of knowledge based on the SECI model (e.g., [3][4]), but support of Internalization process is inadequate.

2. SYSTEM ARCHITECTURE

2.1 Support Process

This system utilizes a SECI model and assumes the experience gained from failures to be tacit knowledge. The structure of the system therefore follows the four SECI model processes, with the flow of the system being given below. Repeating the processes allows the flow of the SECI model to be followed and thus the transfer of the knowledge attempted. Figure 2 shows an image of this system.

STEP1: Socialization Novice agricultural workers can learn from the experience gained in failures via use of the system.

STEP2: Externalization Experienced agricultural workers (or novice agricultural workers with experience gained from failures) input the experience they gained from failures into the system.

STEP3: Combination Rules resulting from experience gained from failures are stored in the system, which contain time data. Time data is the element of when the failure experiences occurred. The system then informs novice agricultural workers of experience gained from failures using those rules.

STEP4: Internalization Novice agricultural workers then carry out the actual work using the rules or their own thinking.

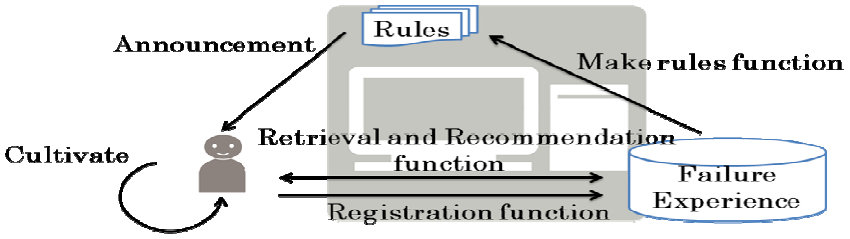

Figure 2. Image of the system

2.2 System

The flow of the system involves 5 main functions, with an explanation on each and the corresponding SECI model process “Retrieval Failure Experience function (Socialization)”, “Recommendation of relevant Failure Experience function (Socialization)”, “Registration of Failure Experience function (Externalization)”, “Make rules function (Combination)” and “Information function (Combination)”.

This system is not implemented via Internalization of the SECI model. In this system novice agricultural workers have to select the right chore to do before doing the actual work, which therefore plays the role of Internalization in the SECI model. Figure 3 shows the main screen of the system.

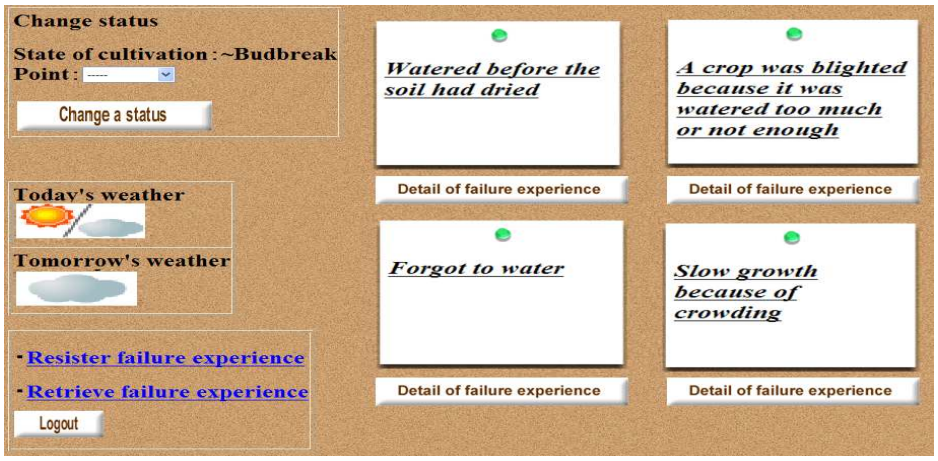

Figure 3. Screen shot of the system

3. CONCLUSION

3.1 Evaluation

3.1.1 Summary of Evaluation

The purpose of this evaluation was to confirm whether the subjects actually learnt from the experience of experienced agriculture workers and their own experiences. In addition, whether or not the subjects were able to gain individual knowledge also took place. Mizuna was selected as the cultivated crop in that evaluation as it can be cultivated throughout the year and quickly harvested. The evaluation involved the method of cultivation being classified into three patterns, the results of which were then compared. The three patterns were “Pattern where nothing is utilized”, “Pattern where a manual is utilized” and “Pattern where this system is utilized”. The subjects cultivated Mizuna for a month, following which they were interviewed and the results of the 3 patterns compared.

Before the evaluation a questionnaire was provided on their knowledge of agriculture, with 29 university students from a Social Communication Laboratory completing the questionnaire form. 6 subjects who gave the same answers to the questionnaire were then selected because of the assumption that their knowledge of agriculture would be basically the same.

3.1.2 Results of Interviews

The results of interviews were classified into three kinds of knowledge and experience, with the classified knowledge “Knowledge the subjects learned from this system or a manual”, “Knowledge the subjects learned via experience” and “Chores the subjects experienced”.

One of the results of the interviews is given below, which is based on the above classification. Table 1 shows the result of “Using nothing at all”, Table 2 the result of “Using a manual”, and Table 3 the result of “Using this system”.

Table 1. Result of "Using nothing at all"

< Knowledge the subjects learned from this system or a manual>
Nothing in particular
< Knowledge the subjects learned via experience >
Don't plant too many seeds at one time
< Chores the subjects experienced >
Planted a little less seeds / Watered the crop everyday / Watered the crop using a glass container and tap

Table 2. Result of "Using a manual"

< Knowledge the subjects learned from this system or a manual>
Water the crops carefully / Don't overwater
< Knowledge the subjects learned via experience >
Nothing in particular
< Chores the subjects experienced >
Planted seeds in a line / Watered the crop carefully / Watered the crop using the right amount

Table 3. Results of "Using this system"

< Knowledge the subjects learned from this system or a manual>
Narrowly-spaced planting results in slow growth
The crop can be blighted because of being watered too many times or not watered enough
< Knowledge the subjects learned via experience >
Mizuna seeds are very small / Take care not to plant seeds too close to each other / Mizuna leaves are not very big
< Chores the subjects experienced >
Planted seeds at appropriate spacing / Didn't plant one seed per space but instead two

3.2 Considerations

The results led to the following discoveries:

<Pattern where nothing is utilized>

Subjects experienced gaining knowledge they learnt from experience.

<Pattern where a manual is utilized>

Subjects experienced gaining knowledge they learnt from this system or a manual.

<Pattern where this system is utilized>

Subjects gained knowledge they learnt from this system or a manual but also via actual experience.

The traditional transfer of agricultural knowledge has involved experienced agriculture workers providing novice agriculture workers with knowledge and experience, and the novice agriculture workers then gaining individual knowledge via actual experience. These steps are used to transfer agricultural knowledge. The pattern that uses this system is thus similar to these steps when compared to the other 2 patterns. The system can therefore be used to efficiently transfer agricultural knowledge.

The results, however, did reveal that the system includes some problems, some of which are "Functional aspect problem", "Small number of failure experiences" and "Long-running evaluation not available because Mizuna can be quickly harvested". A further direction of this study would be improving the functionality of the system, adding more failure experiences, and validating its efficacy over a longer term.

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