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Introduction

After 3 years of COE NEWS reports, we have reported many findings of COE project activities to our readers.

One of our COE projects will try to apply knowledge science to diverse fields of the natural sciences in order to help researchers produce creative theoretical results. With respect to education, we will train graduate students to become "knowledge coordinators" who can manage creative research activities, and "knowledge creators", with advanced research and development skills. [1]

This project includes several sub-projects, which have some distinctive features, as follows.

- They support research activity in knowledge creating environments.
- Support is provided to laboratories of the materials science field.
- All supporters are doctoral students who belong to the School of Knowledge Science.

The educational concept of this project is that the students might learn to explain management activities to the material science laboratories.

This point attempts to not only support the laboratories as creative spaces, but also to educate their students about management.

Here we present 5 projects in which students are strongly involved.

Leader: Professor Minoru Terano,
"Innovation in Mature Industries"

Leader: Professor Nobuyuki Yui,
"Scientific Knowledge Creation based on Research Philosophy"

Leader: Professor Hidenobu Hori,
"Knowledge Representation Theory for Coordination"

Leader: Professor Eiichi Tamiya,
"Knowledge Management for Laboratories"

Leader: Professor Goro Mizutani,
"Laboratory Knowledge Management Utilizing Mobile Blog Albums"

We would like to complete the briefing reports on the above research by reference to the Japanese reports [2].

Leader: Professor Minoru Terano "Innovation in Mature Industries"

1. Introduction to Materials Science Laboratory [a]

This laboratory works in 4 research fields related to polyolefin materials, such as polypropylene and polyethylene. The fields are : 1) Clarification of the response mechanism in the initial stage of olefin polymerization 2) Observation of catalyst surfaces and development of new functional catalysts 3) Development of polyolefin nanocomposite material 4) Investigation of stability and deterioration mechanisms in polyolefin.

This laboratory investigates various olefin polymerization catalysts from an academic viewpoint, and aims to produce next-generation highly functional polyolefin materials based on the results obtained.

2. Target of The Project (Reason for choosing a specific theme: What results are expected?)

When master course students select their research theme, they consider the following points:

A. What kinds of research themes were chosen by former students?
B. What kinds of results have been found in each research field?
C. Are there compatibilities between needs and seeds, between the scientific industries and the research themes?

Here, our targets are making a support model for theme selection, and construction of research road maps for research themes, which allow for viewing many possibilities more clearly.

3. Term and actual conditions
This project research occurred from April, 2006 to September, 2007. There were several discussions on the above themes between students and the laboratory supervisor.

4. Outcome and Next Steps
A prototype for roadmapping was created [3]. Next step is a survey of opinions of the supervisor and students in this laboratory about its usefulness.

Leader: Professor Nobuyuki Yui "Scientific Knowledge Creation based on Research Philosophy"

1. Introduction to the Laboratory [b]
A variety of medical devices including artificial organs, drug formulations, and substrates for tissue regeneration are expected to support creative human lives, and their realization depends upon designing highly functional biomaterials. This laboratory is promoting advanced research on novel biomaterials design through supramolecular approaches. Supramolecular science can exploit the new world of biomaterials, beyond the field of conventional polymers.

2. Target of the project (Reason for choosing a specific theme: What results are expected?)
Almost all scientists or researchers have written books about their research achievements. But there are not many reports about how to train students to become good researchers, written from the viewpoint of active researchers. Several view points and discussions about current issues are presented, including the views of active researchers.

3. Term and actual conditions
This project took place from October, 2003 to September, 2007. We believe that virtues cultivated in our lives lie at the root of excellent research. Several times a month, professors and researchers in the graduate schools of Materials Science and Knowledge Science, had discussions about various educational topics.

4. Outcome and Next Steps
They discussed research philosophy and educational methods for promoting strategic and creative research activities. Specifically, we reflected on our own experiences of research activities, to explore significant meanings of these experiences. As a result, we also found three factors for promoting creative research: making a correlation between tacit knowledge and creativity, supervising laboratory members referring to "Shu-Ha-Ri *" process, which is a traditional Japanese human developmental process, and providing laboratory members greater peace of mind. We have already published "Research Philosophy" in October, 2005[4]. The sequel of "Research Philosophy" will be published in March, 2008.

Leader: Professor Hidenobu Hori "Knowledge Representation Theory for Coordination"

1. Introduction to the Laboratory [c]
Hori Laboratory is researching a new hybrid device with integration of electronics using electric charge and magnetic storage media using magnetic spin characteristic; both characteristics have been applied in different apparatus until now. Iwasaki Laboratory is researching high temperature superconductors using oxide compounds, heat-electric exchange semiconductor with high efficiency, etc., and Koyano Laboratory is now researching new nano-composite materials creation for energy exchange, such as heat-electric exchange materials.

Three professors have been cooperating in a project on how to transfer the essence of physics phenomena from the perspective of developing a good understanding of principles and transferring information by new media.

2. Target of the projects (Reason for choosing a specific theme: What results are expected?)
Prof. Hori, Associate Prof. Iwasaki and Associate Prof. Koyano are proceeding to train students who can coordinate physics researchers with nonprofessional people in physics, such as top management of companies, statesmen and students studying social science etc., by the three following means.
a) Arranged a textbook to explain principles of physics for nonprofessional people.
b) Teach essence of physics phenomena by executing representative experiments such as thermoelectric transduction, etc., in front of students, making students understand the principles [5].
c) Utilize animation in presentations as an explanation skill [6] [7].

*"Shu Ha Ri" is a Japanese term which describes the overall progression of martial arts training. Shu may be translated as "to protect" or "to obey.". Ha may be translated as "to break free" or "to frustrate." Ri is the stage where students separate from their instructors, having absorbed all that students can learn from them.

3. Term and Actual Condition
This project continued from fall 2004 to May, 2007. The software for the project was completed in May, 2007.

4. Outcome and Next Steps
Animation viewer software which included real-time rendering and a physics engine was developed. It can be used to embed objects in MS-PowerPoint. This embedding enables advanced animation expression in a presentation. Future expectations include:

1) Presentations will become more effective.
2) People can easily create animations of technical explanations for educational use.
3) Coordinators will be educated, with skills to explain new scientific phenomena.

Leader: Professor Tamiya "Knowledge Management for Laboratories"

1. Introduction to the Laboratory
This laboratory works on several research themes (1) Advanced Biodevices (2) Drug delivery systems (3) Geno/Protein Chips (4) Scanning probe microscopes (5) POC (point of care) bio sensors (6) Environment-conscious (7) Biomass energy (8) Design of functional biomolecules.

2. Target of the projects (Reason for choosing a specific theme: What results are expected?)
We contextualize research activities of the material science laboratories to social anthropology, and try to describe the research activities in environments objectively, such as meeting times and laboratory controls. Thereby we can see the differences in research activities and environments, such as organizational control or cultural influence, and so on from the perspectives of the supervisors, the researchers and the students there. This may be important research to refer to when proposing a new management style for research activities and the environment.

3. Term and Actual Conditions
This project has continued from 2006 to date. A doctoral course student from this laboratory in Knowledge Science visits a Material Science laboratory and proposes useful tools which the research supervisor recommended for the students in material science laboratories, and also surveys whether the tools are useful or not, from the perception of anthropology.

4. Outcome and Next Steps
Participants made a comparison between 2 laboratories and contextualized the differences in organization of controls, activities and environments [8]. The points of comparison are listed here.

- Relations with or effects of the outside environment such as marketing or industries and so on.
- The scale, education styles and research styles of the laboratories.
- The roles of the supervisors, except the roles of education and research.
- Special research findings, except papers, copyrights, patents and research funds.
- About "know-who", visualization of organizational knowledge.

Our next target is describing creative knowledge activities in research.

Leader: Professor Goro Mizutani "Laboratory Knowledge Management Utilizing Mobile Blog Albums (MoB Albums)"

1. Introduction to the Laboratory [d]
This laboratory is involved in determining the surface characteristics of active substances and the nonlinear optical effects in nano-scale structures, as well as in searching for new physical and natural phenomena in these structures. The research themes that have recently been of interest to our group are outlined here. 1) Elucidation of surface phenomena through optical second harmonic (SH) spectroscopy, 2) Research of surface adsorbents through vibration spectroscopy using Raman scattering and sum frequency generation (SFG), 3) Research of new properties of solids observed only on surfaces, 4) Development and application of optical second harmonic microscopes and sum frequency microscopes.

2. Target of the projects (Reason for choosing a specific theme: What results are expected?)
We used participant observation to comprehend directly about ordinary research activities at Mizutani laboratory. This study can be considered as basic research for clarifying methods of improvement of research performance. Though highly significant, research on laboratory management conducted in cooperation with experimental laboratories has not been carried out in Japan. This study is based on the need for research in this important area. In this research project, several research subjects are being examined concurrently.

3. Term and actual condition

This project continued from April, 2006 to March, 2008.

- 2006, April to Oct: Participant observation in the laboratory.
- 2006, Oct - 2007, April: Conceptual development of useful research tools for the laboratory, and proposal for a system of mobile blog albums (tacit knowledge sharing IT tool, which uses mobile phone with photograph function).
- 2007, May - 2007, Oct: Introduction and trial of the tools, and then evaluation of performance of these tools, to effect change in laboratory activities and communication style among the laboratory members. Monthly meeting between the laboratory members and supporters is held for evaluation of the tools.

4. Outcome and Next Steps

We will clarify changes in activities and communications at Mizutani laboratory after introducing mobile blog albums [9].

Next steps are (1) Develop a laboratory activation method using mobile blog albums, and (2) Introduce the tool to other experimental laboratories in various fields, such as biology, chemistry, and medicine. And then we will study the effectiveness of this tacit knowledge sharing tool by a comparative method.

Conclusion

The above contents are our results about multidisciplinary research in our COE projects throughout the past 5 years. We had searched for a solution to how to implement these activities for the program. There is much research about knowledge management (knowledge creation, evaluation and methodology) in industrial fields. But in the research field, for each laboratory in the university, there has not been much activity.

For effective knowledge based management in academia, we think of this research in materials science laboratories in JAIST as foundation research for theory and practice related to “Ba” in knowledge management, and we have studied this issue for 5 years.

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[a] http://www.jaist.ac.jp/ms/labs/bunrikinou/terano-www/
[b] http://www.jaist.ac.jp/ms/labs/yui/index.html
[c] http://www.jaist.ac.jp/ms/labs/jisei/hori.lab/
[d] http://www.jaist.ac.jp/ms/labs/mizutani/mizutani.html

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