Proposal of a Supporting System for Planning, Executing and Reflecting Tasks in Research Activities

Kenya Miyamoto\textsuperscript{a}, Hisayoshi Kunimune\textsuperscript{b,*}, Masaaki Niimura\textsuperscript{b}

\textsuperscript{a}Division of Science and Technology, Shinshu University, 4-17-1 Wakasato, Nagano, 380-8553 Japan
\textsuperscript{b}Institution of Engineering, Shinshu University, 4-17-1 Wakasato, Nagano, 380-8553 Japan

Abstract

Many students and graduate students are imposed research activities for 1-3 years in Japan. Some of them make plans of their research activities; however, they worry about they cannot make progress. We develop a system to support planning, execution and reflecting their tasks in their research activities. This paper describes the overview of the system and proposes functionalities for promote their self-regulation activities in their research activities.

1. Introduction

In many universities in Japan, undergraduate and graduate students are imposed research activities for several years. Iwase et al. describe that the goal of their research are not clear when they start it, and they search for the goal in the research activities\textsuperscript{[1]}. Iwase et al. also point out that planning is indispensable to smoothly promote their research activities. Therefore, it is desirable for them to make plans for the whole of the research activities in the beginning, to execute the research activities, and to review the plans at any time. The student also set various tasks (e.g. literature researches, experiments, data analyses and writing papers) in their research activities. These tasks have clear and schedulable goals; thus, it is necessary to set a deadline before starting a task to execute it smoothly.

We conducted a questionnaire survey, and its result clarified a lot of students have worry about that they cannot make progress in their research activities as they planned. We suppose that the causes of the lag of executing plans are 1) planned period for a task is too short to execute it, 2) mental factors such as lack of motivation, 3) external factors (e.g. interruption from unexpected tasks), and 4) getting insufficient results from executed task, although planning and execution of the task are appropriate.
We are developing a system to support for planning, executing and reflecting activities related on tasks in research activities. This system offers students, who are imposed research activities, functionalities to support following activities:

- referring to finished plans,
- managing plans of ongoing and future tasks,
- archiving files and their update history related to tasks,
- sharing the plans among supervisors and students,
- attaching comments for shared ongoing plans, and
- evaluating the result of the plans.

Students refer to finished plans executed by themselves and others in order to set the goal of the plan and appropriate period for executing the plan to avoid the cause 1). Sharing plans and attached comments for the plans increase students’ extrinsic motivation to avoid the cause 2). The cause 3) is inevitable; however, the system offers a functionality for easily changing the period of executing a task. The system support to share information about ongoing tasks and to comment for others’ tasks; thus, the risk of the cause 4) is decreased.

Moreover, this study focuses on self-regulation activities in self-regulated learning as an approach to execute research activities according to plan. Zimmerman states that a common conceptualization of students who self-regulate their learning has emerged as metacognitively, motivationally, and behaviorally active participants in their own learning[2]. He also describes the details of activities in self-regulated learning as follows:

In terms of metacognitive processes, self-regulated learners plan, set goals organize, self-monitor, and self-evaluate at various points during the process of acquisition[3,4,5,6]. These processes enable them to be self awake, knowledgeable, and decisive in their approach to learning. In terms of motivational processes, these learners report high self-efficacy, self-attributions, and intrinsic task interest[7,8,9]. To observers, they are self-starters who display extraordinary effort and persistence during learning. In their behavioral processes, self-regulated learners select, structure, and create environments that optimize learning[10,11,12].

The object of this work is to development a system supporting research activities with self-regulation activities, and this paper subscribes the overview of this system.

2. Related Works

This section describes related works about management and sharing systems of information related to research activities.

Hotta et al. have proposed a system, which supports to share the context of research activities in a laboratory[13]. This system relates the records of acquired information with the result of categorization/organization of the information to represent the context of acquiring the information.

Miyadera et al. have proposed a system, which solves tradeoff between individual management and organizational sharing of information produced in research activities[14]. This system represents the connection between information as two graphs, the nodes of which are placed from an individual viewpoint and from the unified viewpoint, to be used for the both sides of the tradeoff.

These systems require registering information about research activities (e.g. acquired/produced information, result of categorization/organization, or data indicating the aspects) by their users after they finish each task. Registering such information is time-consuming job to the users; however, it enables the users to externalize any tacit or undocumented information in research activities, for instance thinking about tasks and contents of discussions, and enables these systems to manage the information.

Zhang et al. have proposed a supporting system for novice learners of self-regulated learning and applied to research activities[15]. This system offers functionalities for supporting self-regulation as follows:

- setting plans,
• showing history of successful experiences,
• showing detail of these experience,
• monitoring execution of plans,
• evaluating plans, and
• showing history of evaluations.

This system also requires registering information about research activities.
On the other hand, the proposed system requires registering only a plan of each task and its evaluation, and automatically records update history of files related to the task through file operations by the users; thus, the load of registering information with the system is less than one with them. Moreover, the system offers functionalities to support grasping context of research activities from update history of files. The users of the system need to document tacit or undocumented activities in files, and they can manage these activities on the system.

3. Overview of Proposed System

This section mentions the overview of the proposed system.
The proposed system is a web-based application, and offers following functionalities to support planning, executing, and finishing tasks:

• searching helpful plans from finished plans of all users for planning,
• grasping and sharing status of execution and exchanging ideas or comments among supervisors and students, and
• reflecting why the finished task is executed as planned or not.

The following subsections explain the detail of the functionalities in planning, executing and finishing processes, respectively.

3.1. Planning of Task

The home screen, which is shown after logging in to the system, has a calendar, and existing plans of the user are on the calendar (Figure 1). Users of the system can make new plan of a task by dragging and dropping from the planned start date to the end date on the calendar. The system, then, requires the user to choose one from the steps shown in Table 1 to give the user awareness of the purpose of setting the task. We set these steps for students majoring in information technology or computer science.

The system stores all of past plans, and the users can search for stored plans by their task, step, and evaluation on the searching screen of the system (Figure 2). The users use found plans as a reference for setting new plan. For example, a student searches finished plans by the query “tasks in the step of Writing thesis and evaluated as adequate period for executing task”, and can set period of the plan for writing his/her thesis by referring to the periods of found plans.

3.2. Executing of Task

Ongoing and future plans on the system are shared among supervisors and other students. The others’ plans screen of the system shows all of ongoing and future plans of other users, and the user can narrow the plans to specified users’ ones (Figure 3). By choosing a plan on the calendar, the detail of plan screen shows the planned period, the numbers of extending the deadline and so on (Figure 4). Moreover, the user can browse the update history of files produced in executing the plan and download the files including programs, papers, theses, presentations, notes and so on.

The files are managed in an online storage provided by “Dropbox for business” (Dropbox). Any updates on the files in specified directories on the users’ computers are automatically reflected on the online files. The system periodically gets the history and files from Dropbox by using the Dropbox API. Browsing these history and differences between
some versions of related files helps the users to grasp the progress of a task and context of tasks in research activities. In the detail of plan screen the users can comment on the plan. The users can discuss or exchange their ideas with each other, and supervisors can comment to motivate students.
3.3. After Executing

After the deadline of the plan, the system requests the user to evaluate whether the user properly execute the task (Figure 5). The criterion for evaluation is the numbers of extending the deadline of the plan of the task. The user choose one from the following three levels of extending:

(1) finishing the task as planned,
(2) extending the deadline once or twice, or
Fig. 3: Others’ plans screen of proposed system.

Fig. 4: Detail of plan screen of proposed system.

(3) extending the deadline more than twice or unfinished.
Evaluating the plan promotes the users to reflect the update history, contents of files, and comments attached to the plan and to consider factors of the success/failure in executing the task.

![Fig. 5: Evaluation form of proposed system.](image)

### 4. Self-Regulation Activities in Research Activities

This section mentions self-regulation activities for promoting active execution of research activities.

We suppose that the model of self-regulation activity has three stages in research activities: planning, executing and reflecting, and these stages form a loop structure. This model is based on self-regulation model in social cognitive theory. The students do not have enough experiences for self-regulation activities (naive self-regulator), and such students have negative characteristics in self-regulation activities. Appropriate support is needed for such students to self-regulate themselves.

In the stage of planning, naive self-regulator tends to set general and distant goal and feel low self-efficacy\(^{[15]}\). The system supports to set not general and not distant goal by referring past plans of similar tasks.

Self-efficacy influences motivation for research activities and is important to keep self-regulation activities. Completing execution of tasks helps to increase self-efficacy. The degree of execution becomes an index for evaluating one’s self-efficacy, and self-regulators acquire it by comparing their status of execution with others’ one and reflecting succeed/failure in their executions.

In the stage of executing, naive self-regulator tends to monitor not overall of his/her activity but fragmentary information of it. However, monitoring correctly overall of the activity is important to carry out self-regulation activities.

In the stage of reflecting, naive self-regulator tends to avoid reflecting finished tasks. The system automatically displays an evaluation form when there are finished and not evaluated tasks to promote reflecting the tasks.

In order to support comparing, monitoring and reflecting in these stages of self-regulation activities, we propose the functionalities of the system for showing execution status of tasks. The below subsections describe the detail of the functionalities.

The functionalities extract the following information from the information about files related to a task to expressing the status of task execution:
• summary of activity,
• amount of activity, and
• contents of activity.

The system extracts modified time of every version of every related file, and displays the users periods when the student modifies related files in the short term as the summary of activity. We find that about 70-80 percent of modifications of files are occurred within 10 minutes from the last modification. Thus, we guess the summary of activity helps to find the period when a student actively carries out activities in executing tasks. Students can grasp overview of their own activities in a task, and easily compare the status of execution of ongoing task with similar finished tasks.

The system calculates Levenshtein distance and difference of size between two versions of related file as the amount of activity. Levenshtein distance shows the minimum number of modification, insertion and deletion to change a character sequence to another sequence. Students can find large changes in related files with this information.

The system displays differences between two versions of related file as contents of activity. Students can focus on the two versions of a related file by referring the summary and amount of the activity, and find the context of the activity from the concrete changes of related file. It helps monitoring and reflecting the tasks.

Tasks have relationships with other tasks, for example, tasks 'considering the outline of the thesis', 'writing text of the first section' and 'drawing the figure of the overview of proposed system' are the parts of the task 'writing the thesis'. We recommend the students not to make only general and distant plan such as 'writing the thesis' but detailed plan such as 'writing text of the first section'; however, these detailed plans are evaluated after executing the parent plan 'writing the thesis'. Thus, the system offers the functionality to express hierarchical relationships between tasks.

The system shows the status of task execution in a chart as Figure 6. The horizontal axis and the vertical axis of the chart represent a time series and the amount of activity. The dots shows the versions of related files of the task, and each color of the dots represent each related file. The blue bars above the chart represent the periods when many versions of a related file are created in a short term i.e. a student actively executes the task.

5. Conclusion and Future Works

We proposed a system to support planning, executing and reflecting tasks in research activities. We also proposed functionalities for supporting self-regulation activities in research activities by extracting status of execution from related files of tasks.

We will implement the system the functionalities for supporting self-regulation activities, and evaluate the effect of these functionalities in research activities.

After that, we will collect data about executing plans from actual operation, and construct models for making and executing plans appropriately from the data.

References


Fig. 6: Chart of task execution.