

## A Visualization System of the Contribution of Learners in Software Development PBL using GitHub

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**Abstract**—In recent years, the paradigm of social coding in software development has attracted attention to developers all over the world, and GitHub which is a social coding tool has spread to an area like education. There are many cases using it as a platform of PBL (Project Based Learning). However, since GitHub is not a tool for education, it is difficult to evaluate learners. This research focuses on the contribution of learners and proposes a system that teachers can grasp the contribution of learners.

**Index Terms**—GitHub, Project Based Learning, Contributing Student Pedagogy

### I. INTRODUCTION

Attention to software development PBL (Project Based Learning) is increasing as a practical educational method in software engineering [1].

In recent years, a paradigm of social coding in software development has attracted attention to developers all over the world [2]. GitHub [3], which is a social coding tool, collects many users and projects in a short period of time [2]. GitHub provides various functions for each project so that users can easily participate in the development of open source projects.

Until now, GitHub focuses on code and project management in software development. Its focus is now expanding to areas like education. Some case studies using it as a platform of PBL [4] [5] are reported. The PullRequest function that can conduct code review corresponds to the education theory called Contributing Student Pedagogy (CSP) whose definition is “Contributing to others’ learning and promoting learners to evaluate the contribution of others.” It is a very important skill in the industry.

However, it is difficult to evaluate students conducting reviews to the PullRequest. GitHub does not have the function to manage learners like learning management system (LMS), and teachers must evaluate them using the same interface as the learner.

Therefore, this research focuses on the contribution of learners and proposes a system that teachers can grasp the

contribution of learners in software development PBL using GitHub. By being able to grasp them, we think it is possible to evaluate learners who contribute between learners including code review.

### II. RESEARCH QUESTIONS

In this section, we will organize research questions (RQ) from the points mentioned in the previous section. RQs are as follows.

**RQ1. What is the contribution of learners in software development PBL using GitHub?**

**RQ2. How can the teacher grasp the contribution of learners by visualization?**

### III. MODEL OF TARGET PBL

The model of PBL that is the target of this research is a team size of 3 to 5 people, each team develops software from software design to implementation. It does not matter whether PBL is done in a classroom or a distributed environment. Also, there are no restrictions in the number of groups and development period.

### IV. THE CONTRIBUTION OF LEARNERS

Computer science and software engineering education are beginning to incorporate not only technical skills but also pedagogy focusing on soft skills such as communication and team work. One way to develop these skills is that learners contribute to each other’s learning experience. Hamer et al. call this concept CSP [6] that is officially defined as “A pedagogy that encourages students to contribute to the learning of others and to value the contributions of others.” It promotes a learning experience that supports activities such as reviews, content construction, or solution sharing by using learning tools. We suppose these activities are conducted on GitHub.

The PullRequest function can conduct code review. Learners use the Wiki to build documents and contents and to share expertise on technical knowledge and solutions [6] [7]. In the Issue function of GitHub, discussion, problem management,

and bug reporting are done [3]. The Wiki and Issue can be referred by all team members and their active use can be said to be a contribution of learners.

From the above, in this paper, the contribution of learners in software development PBL using GitHub is to make a review for the PullRequest, to create a Wiki, to edit Wiki, to create issues, and to give comments on them. Here, contributions have scale. For example, even with a PullRequest, if more comments to it are given, its contribution is larger than that simply merged. We define the scale of the contribution of learners as follows.

- 1) The review to the PullRequest is assumed that the greater the number of commits and comments to be merged, the greater the contribution of learners is.
- 2) The creation of a Wiki is assumed that the greater the number of revisions until the end of PBL, the greater the contribution of learners is.
- 3) The creation and comment of an Issue is assumed that the greater the number of comments until closing of it, the greater the contribution of learners is.

## V. PROPOSED SYSTEM

In this section, the requirements of the system are described in V-A, and the outline of the proposed system is described in V-B.

### A. Requirement

This section describes the requirements of the system as follows.

- 1) A user can select learners.
- 2) The contribution made by one learner will be visualized separately for PullRequest, Wiki, and Issue.
- 3) Review to the PullRequest is visualized until Merge.
- 4) To create a Wiki, the system visualizes the change history until the PBL ends.
- 5) In the Issue creation and comment, the system visualizes the process until the Issue is closed.
- 6) The more the contribution of learners, the larger the entity is visualized.

The entity is described in detail in V-B. The scale of contribution in PullRequest is shown in the Fig. 1.

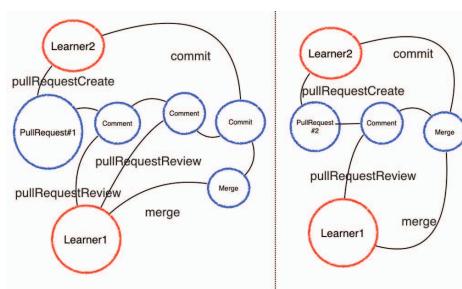


Fig. 1. Visualization of contribution to the PullRequest

### B. Outline

In this paper, we focus on the contribution of learners and propose a system that teachers can grasp their contribution.

The whole flow of the proposed system is shown in Fig. 2.

The proposed system is divided into two steps. In the first step, we acquire learners' events as entities from GitHub API and develop the API that associates learners' contributions with the learner. The entity is Learners, PullRequest, Commit, Merge, Wiki, Revision, Issue, Comment, and Close. pullRequestCreate, pullRequestReview, wikiCreate, commit, merge, revision, comment, and close are relationships. The association done by the API is stored in MongoDB [8] which is NoSQL database.

In the second step, we visualize the association constructed in the first step as a graph structure and provide it as a single page application rendered server-side to teachers. It is implemented using Nuxt.js [9] which is the framework of Vue.js [10].

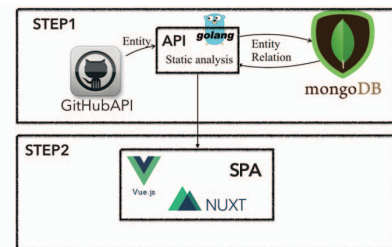


Fig. 2. The whole flow of the proposed system

## VI. SUMMARY AND FUTURE WORKS

In this research, we have proposed a visualization system of the contribution of learners in software development PBL using GitHub.

In the future, after implementing functions, I will ask the teacher to actually use this system at software development PBL and evaluate it.

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