

EXPLORING THE APPLICABILITY OF THE QUESTION-PROMPTING CHATBOT IN PBL: PRACTITIONER INSIGHTS ON GOAL SETTING AND REFLECTION

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Abstract

This study evaluates the potential of a chatbot, originally designed for language learning, to be adapted for wider applications in self-directed learning settings, specifically within Project-Based Learning (PBL) frameworks. The research focuses on the chatbot's utility in promoting questions regarding goal setting and reflection by providing personalized notifications. Through interviews with new PBL instructors, the study identifies key challenges, including the scarcity of class time allocated for these activities, a lack of training in intervention methods, and a general underestimation of their significance. Addressing these challenges, the study proposes the augmentation of the chatbot's functionality by incorporating access to a case database. This enhancement is anticipated to foster a constructive cycle of goal setting and reflection, thereby offering robust support to instructors in their pedagogical endeavors. The enhanced chatbot aims to bridge the identified gaps, facilitating more effective educational interventions in PBL contexts.

Keywords: *Project-Based Learning, self-directed learning, reflection, chatbot.*

1. Introduction

1.1. Question-prompting chatbot for SDL

It becomes crucial in global language policies to promote Self-Directed Learning (SDL) and leverage assistive technologies. SDL involves identifying learning needs, setting objectives, selecting strategies, and evaluating outcomes. As language learning is a long-term, varied process, proficiency in SDL is essential, yet challenging for many. The lead author teaches a mandatory Japanese course for international students at a Japanese university, typically offered in the first academic year. It's believed that this period is vital for students to develop SDL skills, especially in setting and reflecting on learning goals, which is key to their success (Knowles, 1975). However, guidelines for instructors to support these skills effectively are lacking.

The leading authors developed and implemented an activity model at a university in Japan to support SDL of Japanese as a second language (Kai, Matsuba, Goda, Wada, & Suzuki, 2020). This model involves activities such as recording observations about the use of the target language outside of class, reflecting on these observations in class, sharing with peers, and receiving counseling while revising goal settings. We designed activities based on a Design-based Research framework (McKenney & Reeves, 2019), and developed a chatbot to support continuous recording. The chatbot runs within LINE, one of the most popular communication applications in East Asia, and has the function of sending a series of questions predetermined by the instructor to students ("What was the most impressive thing you learned today", "Why", etc.) and recording their responses. One unique feature of our system, distinguishing it from similar platforms, is its approach to notifications. While we encourage learners to actively record their learning, we also understand the importance of reminders to prevent oversights. What sets our system apart is that learners can set the timing of these reminders themselves. By allowing students to decide when they receive these prompts, we make the learning process more personal and relevant to them, thereby making the transition from receiving a notification to making a record more seamless and natural. This system strikes a balance between fostering learner autonomy and providing the necessary structure to ensure consistent and thorough documentation of their learning journey. With this system, learners can write reflections solely through LINE, and their writings are automatically stored in our LMS via LTI integration. This system is designed to respect and encourage learner autonomy. Students have

the flexibility to actively log their learning activities at times they choose, or they can opt to have the system automatically remind them to reflect. The study results suggest that the feature allowing students to set their own notification times may have contributed to a higher rate of continued recording. Furthermore, the results indicate that meaningful reflective activities based on these records can be conducted and that goals tend to improve as a result. The authors believe that this chatbot can be used not only for language learning but also for goal setting and reflection guidance in many fields.

The authors propose that one area where their approach could be beneficial is in Project-Based Learning (PBL), an increasingly popular educational method worldwide (Guo, Saab, Post, & Admiraal, 2020). The second and third authors have served as consultants to integrate PBL in institutions (Ishida & Matsuba, 2019). In PBL, it's common for instructors to request students to write reflections after each activity. However, it has been noted that students often produce reflections of suboptimal quality. Furthermore, instructors sometimes do not thoroughly engage with these reflections, only marking them as 'read,' which can lead to student dissatisfaction. We suggest that the primary reason for this situation is the scarcity in both quality and quantity of reflective records, which are essential for effective consultation in student goal setting and project progression. We posit that if this assumption is supported, the situation could significantly improve by introducing our activity model with chatbot, which would enable students to produce more meaningful reflections. This, in turn, could enhance the quality of tutoring and subsequently improve students' learning outcomes.

The common activity in both cases is to write reflections on the set goals, and if PBL requires students to write these reflections outside of class due to lack of time during class, it is easy to assume that some students will forget to write them down. Our chatbot's easy-to-use writing interface and reminder function will support continuous recording. However, we also found that the SDL support required for this PBL differs from our approach in Japanese language learning. One is that goal setting and reflection involve more skills in collaboration with others, such as leadership, and the other is that instructors are on site where students are working, so they can also intervene with students' reflections in action. It is necessary to consider whether to modify the chatbot based on these differences or to include other strategies. We therefore interviewed instructors to see what interventions they are doing and what they are not doing at each phase of the project.

1.2. PBL course offered at a Japanese *KOSEN*

To grasp the situation more clearly, we will carry out an initial study involving instructors who are new to PBL. We aim to explore how they help students set their goals, execute their projects, and reflect on their progress. This will help determine the chatbot's potential in supporting goal setting and reflection in PBL settings. The survey aimed to identify the interventions instructors are using and the challenges they face. It was conducted in a large-scale PBL course offered at a Japanese *KOSEN* (National Institute of Technology), known for practical engineering education. This *KOSEN* operates on a semester system, with two semesters each year, and the PBL course is a year-long course, spanning across both semesters. The course is mandatory for all 2nd to 4th year students, totaling around 500, from four departments: Mechanical Engineering, Electrical and Computer Engineering, Urban Systems Engineering, and Architecture. Students, grouped into diverse teams across grades and departments, work on selected year-long projects under an instructor's guidance. Despite not choosing their teams, students have autonomy over their project themes. Under this framework, a student typically dedicates themselves to three distinct topics across six semesters, covering the three years until graduation. The curriculum, emphasizing critical reflection and goal setting, aims to cultivate personal growth and a profound understanding, countering the tendency to overly focus on the final product in PBL.

In this course, each semester is structured into three phases: Orientation, Main Activities, and Wrap-up. During the orientation phase of the program, students will participate in activities aimed at understanding the course structure and getting to know their team members. Initially, they will be introduced to the course's objectives, the activities they'll engage in, and the expected outcomes. They will also be guided to set personal goals. The goals to be achieved in this subject are: 1) to be able to self-regulate (autonomy), 2) to work in teams while respecting others (collaboration), and 3) to be able to collect and organize information, identify issues, and make proposals (creativity). Individual goals are set and evaluated each semester by each student, corresponding to the achievement goals (autonomy, collaboration, and creativity). In this course, students use a rubric for self-assessment to critically reflect on their performance. The rubric is centered around three major objectives, each broken down into three specific criteria, resulting in a total of nine criteria which includes goal setting and reflection. Students evaluate themselves on each criterion using a five-level scale, from Level 0 (the lowest) to Level 4 (the highest). Additionally, for each major objective, students select one criterion they particularly wish to achieve and write down action plans detailing what steps they will take to meet this goal. This self-assessment tool empowers students to critically analyze their performance, aligning their

understanding and skills with the course objectives. At this point, instructors review students' self-set goals and action plans. If needed, they discuss with the students to guide revisions. Next, students establish their team's theme. The theme must meet three conditions: it should benefit others, pose a challenge for the team, and align with one of the 17 Sustainable Development Goals (SDGs). After setting a theme, the team members divide roles and create an action plan.

During the activities phase, students carry out the activities according to the plan. Students are required to fill out a reflection sheet each time. This sheet is designed for students to reflect on their weekly progress, what they managed to do well, what they struggled with, and their feelings during the activities. Instructors review these reflections to provide targeted guidance and support. During the wrap-up phase, students will report on their achievements as a team in a final debriefing session. After conducting a self-assessment using the rubric for their individual goals, students have a meeting with their assigned instructor. During this meeting, they receive feedback comments from both their team members and the instructor. From the second semester onwards, students set their personal goals regarding their self-evaluations from the previous term. These activities are designed with the expectation of proactive and self-driven engagement from the students. To facilitate these activities, students are provided with a guidebook. This guidebook is well-organized, detailing the tasks to be accomplished, and is enriched with templates, worksheets, and a collection of reference resources, all aimed at streamlining the activities. While students progress through the activities using the workbook as a reference, they are also welcome to seek support from their instructor if needed. In this course, instructors are not instructed to micromanage tasks. Instead, they are expected to provide educational interventions when students seek support or when the instructor perceives a particular need.

2. Method

The study investigates the types of educational interventions new instructors are implementing during the course and whether these interventions are improving students' skills in goal setting and reflection. It examines the involvement of new instructors in these interventions, their effectiveness in helping students achieve personal goals, the instructors' perceptions of the value of these interventions, and any challenges they face in managing the course. The survey participants consist of six newly appointed instructors who have been responsible for this subject for less than three years. The survey was carried out through individual pre-surveys and semi-structured interviews conducted in November-December 2022, coinciding with the wrap-up phase of the second semester of the full-year course. The interviewers provided written explanations to the interviewees in advance regarding data handling and related matters, and obtained their consent for participating in the research. Before the interviews, interviewees filled out a pre-survey questionnaire on Google Forms as an initial step to pinpoint focus areas for the interviews. This course is a year-long subject spanning over an extended period, and it also aims to facilitate interviewees in recalling events from the first semester by having them respond to survey questions. The pre-survey included the following question items:

[Orientation phase]

- ☞ Do you believe that students improved their ability to set and reflect on goals?
- ☞ At which phase did you intervene with advice or guidance in this course?
- ☞ Did you have students set personal goals (in the first or second semester)?
- ☞ Did you provide advice, guidance, or require revisions during the goal-setting phase?
- ☞ Did you encourage the use of a workbook during the goal-setting phase?

[Main Activities phase]

- ☞ What strategies did you employ to facilitate smooth learning activities for the students?
- ☞ Did you instruct students to write weekly reflection sheets?
- ☞ How frequently did you review the content of the students' reflection sheets?

[Wrap-up phase]

- ☞ Were you able to conduct interviews with the students at the end of the first term?
- ☞ How much time did you spend on interviews per student?

The interview questions were prepared in advance to solicit detailed explanations about the survey results. Specifically, interviewers first asked whether they had taken actions such as encouraging students to read the workbook at each stage. If there was intervention, interviewers inquired about the specific nature of the intervention, the use of resources provided (sheets, senior instructors, etc.), and the outcomes of such intervention. If there was no intervention, the reasons for not intervening were explored. Interviewers also asked about any overall challenges or issues faced. Additionally, to understand the instructors' values, the perceived frequency of the need for advice and guidance was also a topic of inquiry. Interviewers shared the pre-survey results with the interviewees and conducted

90-minute interviews with each participant. The interviews were recorded, and the second author, familiar with the context, transcribed and initially analyzed the content, extracting parts relevant to the main theme. Then, the lead author and the third author, who were not familiar with the setting, analyzed and organized the data from an objective perspective. Finally, all authors collaborated in the discussion and interpretation of the findings.

3. Results

Three reported observing growth in their team's students concerning the goal of goal setting and reflection. Only one believed that the goal was necessary for students. During the orientation phase, all six instructed their students to set personal goals. Of these, four mentioned using a workbook. Only one provided specific advice on the goals set by the students. The reasons for not providing advice included feeling unable to intervene at an early stage when they do not understand the students well, and some were not even aware that they should provide advice or guidance on the students' personal goals. Even among those who did provide advice, there was a sentiment of frustration regarding the students' tendency to set goals below their actual capabilities. Regarding the team activity planning, three offered advice, focusing on building member relationships and assigning roles, with five responding that they provided advice and guidance. The reasons for providing advice included the goals not fulfilling the established criteria, the potential for future challenges if students failed to reach a consensus, and the advisability of planning activities in advance when coordinating with fixed-date college events like a college festival. Other interventions at this stage were primarily related to team-building, like ice-breaking activities and senior students guiding the juniors. During the main activities, three instructed their students to write weekly reflection sheets. However, only one reported consistently reviewing these sheets. Two mentioned reviewing the sheets only at the end of the term, while three did not review them at all. In the interviews, the reasons provided for not utilizing the reflection sheets included the following:

- ☞ Although the benefits of completing the reflection sheets were explained during the orientation phase, I would not check the content, leaving it to the students to decide whether to use them. Based on observations during the classes, it seemed that likely none of the students were writing them.
- ☞ There was neglect in reviewing the reflection sheets.
- ☞ As the hands-on work became more intensive, finding time within the class to complete the reflection sheets became hard.

Other common interventions included asking about the activities and outcomes at the end of each week (five noted), providing encouragement when activities were stagnant (five noted), and encouraging active participation from students (four noted). In the summary phase, all six respondents conducted individual meetings with students. The average meeting time was around 9 minutes, ranging from a minimum of 5 minutes to a maximum of 15 minutes, with the most common duration being 10 minutes. The main focus of the consultations was to convey evaluations from the team members and from the instructor. Additionally, interviewees identified the following challenges and difficulties:

- ☞ Finding it challenging to guide senior students who believe they are performing well.
- ☞ Finding a loosening of the students' tempers around the second month of the first semester.
- ☞ Struggling to determine the appropriate level of control an instructor should exert in this course, which emphasizes student autonomy.
- ☞ Deciding on intervention methods when progress stalls.
- ☞ Noticing a tendency for compromise among senior students who are taking the course for multiple times.
- ☞ Wondering how I should suggest students who intentionally give low self-evaluations at the beginning to produce growth.

4. Discussion

The interview results, centered on the skill of 'setting goals and reflecting,' indicated that despite instructors recognizing a lack of improvement in this ability among students, active intervention was lacking. This finding corroborates the authors' initial hypothesis presented at the outset of the paper. Many of the reasons for not intervening stated by instructors was the lack of time. However, they made sure to carry out their assigned duties, such as setting goals at the beginning and having meetings with their students at the end. Besides, except for one individual, everyone had been intervening as needed since the orientation phase, such as managing time and encouraging active participation. It would not be difficult to find enough time for instructors to encourage students to write reflections, so there must be another reason why this was not done. It might be that the new instructors were proactive in offering

interventions for tasks that were straightforward or could be taught through experience, yet they were uncertain about how to effectively intervene in the process of 'goal setting and reflection.' Statements from instructors expressing uncertainty about the extent of their intervention and their confusion regarding students deliberately providing low self-evaluations further substantiate this perspective. Despite having access to a guidebook to understand the overall flow of the course, the new instructors were not fully utilizing the formats, such as the weekly reflection sheets, provided in the guidebook, though they were aware of their existence. A senior instructor was available in the same room to address any questions or uncertainties on an ongoing basis. Nevertheless, the fact that these resources were not being utilized suggests the possibility that the resources provided are insufficient or that there may be other reasons for the lack of utilization. We deduce that the neglect of 'goal setting and reflection' may stem from a limited number of instructors recognizing the importance of cultivating this skill.

5. Conclusion

In this study, we explored the challenges instructors face in implementing educational interventions during different course phases. The survey identified three main issues: instructors not recognizing the need for intervention, uncertainty about intervention methods, and the challenge of finding sufficient time for effective intervention. Firstly, time constraints make it challenging for instructors to provide adequate intervention. In this institution, students must monitor project progress and reflect on personal growth, often prioritizing the former due to time limitations. Facilitating reflection and ensuring instructors have access to students' reflective records prior to class can help in preparing effective intervention strategies. However, creating these analyses and plans is time-consuming, emphasizing the need for systems to alleviate instructors' workload. As a solution to this issue, our proposed chatbot is expected to play a significant role by enabling recording outside of class hours and facilitating easy referencing when needed. Secondly, many educators, especially the inexperienced, lack coaching skills for effective intervention in goal setting and reflection. They tend to rely on personal educational beliefs rather than systematic methods. Sharing successful case studies and insights could quickly enhance their intervention capabilities. Integrating with an instructional case database might be one solution. Lastly, in this institution, instructor interventions are optional, often limited to those with sufficient time and motivation. To encourage more proactive engagement, the institution could formalize these interventions and require outcome reporting, while ensuring this process doesn't overly burden instructors. It's essential to foster intrinsic motivation by showcasing the positive impact of interventions through instructor exchanges and student feedback. As previously discussed, if the chatbot can collect students' reflective records and refer to similar cases in the case database to suggest appropriate interventions, instructors can then use these suggestions for their educational interventions. The outcomes of these interventions can be fed back into the database as new insights, creating a beneficial cycle. Such a cycle is essential for enhancing instructors' motivation by providing them with practical, evidence-based strategies for intervention. We recognize the need for this positive feedback loop and will continue to consider enhancements to the chatbot's functionality to facilitate this process.

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References

- Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, 102, 101586. <https://doi.org/10.1016/j.ijer.2020.101586>
- Ishida, Y., & Matsuba, R. (2019). *Design of a supporting system for educational improvement with active learning approaches*. Paper Presented at the International Conference on Education and New Developments, Porto, Portugal. <https://doi.org/10.36315/2019v1end059>
- Kai, A., Matsuba R., Goda Y., Wada T., & Suzuki K. (2020). Design and implementation of a supporting system for encouraging low-level reflection with interactive recording in Japanese using experiences. *Transactions of Japanese Society for Information and Systems in Education*, 37(4), 330-335. <https://doi.org/10.14926/jsise.37.330>
- Knowles, M. S. (1975). *Self-directed learning: A guide for learners and teachers*. New York, NY, USA: Association Press.
- McKenney, S. E., & Reeves, T. C. (2019). *Conducting educational design research* (Second edition). London; New York: Routledge/Taylor & Francis Group.