Using ePUB3 eBook-based Project-Inquired Quality Talk to Enhance Students' Learning Effects in Flipped Classes

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Abstract: In flipped learning, students take learning activities based on their preferred ways to promote their learning interests and effects. For its advantages, we presented earlier an ePUB3 eBook-based problem-inquired quality talk flipped learning model that supports students' learning by ePUB3 eBooks and Problem-solving Inquired Quality Talk discussions. In this paper, to enhance further the students' discussion effects, we explore the employment of a more practical Project-based Inquired Quality Talk method in students' discussions to form a new ePUB3- based project-inquired quality talk flipped learning model. As a result, the new model provides students in their discussions with project-based inquiry steps to find the solutions of a designated project where quality talk questions/responses are executed in each inquiry step. For illustration, the model is applied to a 'Reading & Writing' class at a university in Taiwan where a comparative study on students' reading & writing abilities in experimental and controlled groups is taken to validate its usefulness.

Keywords: ePUB3 eBook, eBook-based flipped learning, project-based inquired quality talk, reading & writing ability, comparative study.

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1 Introduction

In flipped learning [1-5], students complete learning using their preferred ways to increase their learning interests and effects. Under guidance and help from the teacher, students take self-conducted learning activities from previewing curricular contents before the class to completing group discussions during the class. By taking its advantages, we presented earlier an ePUB3 eBook-based flipped learning model [6] that used ePUB3 eBooks [7,8] as the media to deliver curricular contents before and during the class. However, after practical teaching of this model, we noticed that students' discussions in the class was not so effective as we expected, e.g., only a few students referenced eBooks for their interactions and had ideas about converging interactions to make conclusions. Therefore, an important issue about the use of this model was recognized, that is how it could be improved to enhance the effects of students' discussions.

In the literature, there are already many ways to provide effective conducts on students' discussions to enhance their interactions about the thinking and analyzing of the discussion subjects. For instances, Inquiry Learning [9-11] supports effective discussions by following a series of inquiry steps where specific guidance is provided for exploring the solutions of the discussion subjects. In general, there are two modes in its inquired discussion guidance, i.e., problem- and project-based ones to address respective problematic and productive subjects. In education, it has been well known as an effective way to conduct students' discussions for improving their reading, writing, and thinking abilities. Similarly, Quality Talk [12,13] also provides students with conducted discussions but stresses more interactive collaborations to improve their thinking and reasoning abilities. Its effects in education have also been recognized as an efficient way to support students' discussions with four characteristics: self-interpretation and leadership, motivating and sustaining interactions, thinking and analyzing contents, as well as disciplined and harmonious dialogues.

Considering the benefits of the above two methods, a Problem-based Inquired Quality Talk method was presented [14,15] that conveyed the sound features of these two methods to provide students with an effective discussion mechanism. That is, it conducts students' discussions with a series of problem-based inquiry steps to explore the solutions of concerned problematic subjects where quality talk questions/responses are executed in each of the inquiry steps. Then, we employed this method in our earlier ePUB3 eBook-based flipped learning model to form an ePUB3 eBook-based problem-inquired quality talk flipped learning model [15] to enhance the effects of students' discussions. The validity of such an extended model had been verified by applying it to the practical teaching of our 'Reading & Writing' flipped class.

In this paper, to enhance further the effects of students' discussions, we explore the use of a more practical Project-based Inquired Quality Talk method in students' discussions to form a new ePUB3 eBook-based project-inquired quality talk flipped learning model. As a result, the model provides students in their group discussions with the project-based inquiry steps to find the solutions of a designated project where quality talk questions/ responses are executed in each of these inquiry steps. Afterwards, the new model is illustratively applied to our 'Reading & Writing' flipped class at a university in Taiwan where a comparative study on students' reading & writing abilities in experimental and controlled *groups* is taken to validate its usefulness.

2 Related Work

In this section, we present the related work about our ePUB3 eBook-based project-inquired quality talk flipped learning model.

2.1 The ePUB3 eBook-based Flipped Learning Model

As presented in [6], the ePUB3 eBook-based flipped learning model uses ePUB3 eBooks [7,8] as the media in a flipped learning class to deliver the curricular contents before and during the class. In general, ePUB3 eBooks provide many features for delivering curricular contents in various spectacular ways to motivate students' attention on these contents. For instances, as shown in [16], many accessible modalities or functions can be embedded in the *textual pages* of the eBooks such as *reference link, guided reading, automatic repetition, video, communication,* and *exercise*. Therefore, in the ePUB3 eBook-based model, students can use ePUB3 eBooks in their flipped class to effectively support pre-class learning activities such as previewing curricular contents and taking exercises and also in-class learning activities such as viewing curricular contents and making group discussions.

2.2 The Problem-based Inquired Quality Talk

As shown in [15], the ePUB3 eBook-based problem-inquired quality talk flipped learning model employs the spectacular features of the Problem-based Inquired Quality Talk method [14] in ePUB3 eBook-based flipped learning to guide students' interactions for their group discussions. Therefore, students' discussions are supported by the Problem-based Inquired Quality Talk mechanism as below.

1. Before discussions, students develop their thinking and reasoning experience about a concerned problem through practicing a series of quality talk questions/ responses. Therefore, in their practices, students are first grouped and given a less complicated problem relevant to the comprehension and application of curricular contents and then start their exercises on a series of questions/responses in each of the following problem-based inquiry steps: (1) identify critical issues about this problem, (2) collect information and extract knowledge about these issues, (3) find solutions of these issues, and (4) make conclusions about this problem in terms of these critical issues' solutions. In particular, based on Quality Talk [17], seven types of questions need to be exercised: (1) authentic one AQ - ask for thinking and reasoning about concerned subjects, (2) uptake one UQ - ask about something that was said earlier, (3) speculation one SQ - ask for considering alternatives, (4) high-level thinking one HLQ - ask for new ideas or information, (5) affective one AfQ - eliciting connections between experiences and concerned subjects, (6) connection one CQ - eliciting connections to something that is common to all group members, and (7) test one TQ - presupposing answers of concerned subjects. In contrast, three types of responses for responding these questions need to be exercised: (1) elaborated explanation EE - giving evidenced claims, (2) exploratory talk ET - giving reasoned challenges, and (3) cumulative talk CT - giving positive supports on what was said earlier.
2. After practices for developing thinking and reasoning experience, a more complicated problem is given for students to think and reason out solutions. As one may conceive, such a problem means usually more needed endeavors for finding adequate solutions to address its problematic issues. Therefore, students need to apply their practiced inquiry steps to figure out solutions.
3. Then, students start their group discussions about the solutions of this problem. As in their practice, they take a series of quality talk questions/responses in their problem-based inquiry steps to make conclusions about this problem in terms of its critical issues' solutions. Therefore, after identifying the critical issues about this problem, students start to collect related information about these issues from various media such as referenced materials (e.g., class eBooks or internet sources), social media (e.g., online or virtual societies), and subject experts (e.g., relevant faculty or staff members). Then, they extract useful knowledge from the collected information to develop their thinking and reasoning about the solutions of these issues. Finally, after sufficient group discussions, the solutions for these issues can be identified and converged to ensure their solving the problem.
4. Finally, after making conclusions about the problem in terms of its critical issues' solutions, students share their conclusions with the peers of other class groups. This can help them to enhance further their thinking and reasoning about the problem solutions by soliciting the values and advantages of the conclusions from other groups.

2.3 The Project-based Inquired Quality Talk

As mentioned above, there are two modes in Inquiry Learning, problem- and project-based inquiries, to address respective problematic and productive subjects. Therefore, as a more practical one than Problem-based, Project-based Inquired Quality Talk provides students in their group discussions with project-based inquiry steps to find the solutions of a designated project where quality talk questions/responses are executed in each of these inquiry steps. Thus, students' discussions are supported by its project-based mechanism as follows.

1. Before discussions, students develop their experience in thinking and reasoning about a productive project. Therefore, they are first given a less complicated project relevant to the comprehension and application of curricular contents and then start to exercise a series of questions/responses in each of the project-based inquiry steps: (1) identify necessary constructs for completing this project, (2) collect information and extract knowledge about these constructs, (3) design and implement these constructs, and (4) make conclusions about the solutions of this project in terms of these constructs. It is noted that as in the problem-based mode, a series of questions/responses are also exercised in the inquiry steps based on Quality Talk with seven types of questions for students to practice and three types of responses for students to respond these questions.

2. After practices, a more complicated project is given for students to think and reason out necessary constructs. As in the problem-based mode, such a project means usually more endeavors needed for finding adequate constructs to address its productive issues. Therefore, students need to apply their practiced inquiry steps to figure out adequate constructs and implementations.
3. Then, students start their group discussions about the constructs for completing this project. Also as in their practices, they have a series of quality talk questions/ responses in the project-based inquiry steps to make conclusions about the solutions of this project in terms of these constructs. Therefore, after identifying the necessary constructs for this project, students collect related information and extract useful knowledge about these constructs, design and implement these constructs, and finally identify and converge the conclusions for completing this project in terms of these constructs.
4. Finally, as in the problem-based mode, after making conclusions about the project, students share their conclusions with the peers of other class groups. This can help them to enhance further their thinking and reasoning about the project solutions by referencing other groups' artifacts.

3 The ePUB3 eBook-based Project-Inquired Quality Talk

With the above project-based mechanism, our ePUB3 eBook-based project-inquired quality talk flipped learning model can be formed that supports the following learning activities in a flipped class:

1. Preview curricular contents in ePUB3 eBooks as shown in Figure 1 by all students before the class. This is to develop students' basic concepts about these contents for helping them to find the solutions of a designated project by applying their learnt from these contents through well-conducted group discussions in this class.
2. Take a pre-class test by all students at the beginning of this class. This is to verify students' concepts about the reading and writing of the curricular contents through their preview before the class.
3. Make group discussions by all students during the class. In general, these are made by each group using a series of quality talk questions/responses in each of the project-based inquiry steps. More specifically, after the teacher explains the meaning and usage of the quality talk questions/responses, students develop their experiences about these questions/responses for a less complicated project by a serial practice of interactive moves between these questions/responses in each project-based inquiry step. Then, given a formal productive project, they start discussions by identifying the necessary constructs for this project. Afterwards, with sufficient interactions of questions and responses in each project-based inquiry step, they can gather consensus about the design and implementation of these constructs and then the project conclusion in terms of these constructs.
4. Share discussion conclusions by all students during the class. In general, this is taken by each group to help students enhance further their critical thinking and reasoning about the given project's solutions through capturing the pros and cons of other peers' constructs and implementations. As one may conceive, while students' sharing their conclusions, the teacher can give comments or suggestions about the conclusions or even the sharing itself. This can help students to take more assessments or reflections about their discussions and conclusions in this class.
5. Take a post-class test by all students at the end of this class. This is to verify students' learning effects from the above class activities.

4 Practical Application of The Model

In this section, our model is applied to a 'Reading & Writing' class at a university in Taiwan. In general, this class focuses on enhancing the reading and writing abilities of students and hence addresses their reading the curricular contents in an ePUB3 eBook and then figuring out the solutions of an applied writing project through the project-based inquiry steps. For verifying the validity of the model, the learning effects between experimental and controlled *groups* are compared with a comparative study.

4.1 Class Design

In the class, two *groups* of students are instructed separately where the experimental *group* applies the new ePUB3 eBook-based project-inquired quality talk flipped learning model, and the controlled *group* instead uses the earlier ePUB3 eBook-based flipped learning model. Therefore, these two *groups* in general use the same flipped learning model except for applying the Project-based Inquired Quality Talk in the experimental *group*.

Table 1 shows the learning activities in a class of 3-week instructions by these two *groups*. Therefore, as shown in the experimental *group*, students' discussions at each week start from a 15-min lecture by the teacher for explaining the quality talk questions/responses. Then, they take 15-min to develop their experiences about these questions/responses by practicing a series of interactive moves in each of the project-based inquiry steps. Afterwards, given a formal productive project, they make discussions in the practiced project-based inquiry steps: (1) using 5 minutes to identify the necessary constructs for this project, (2) making 20-min discussions to complete the project in terms of these constructs through a series of interactive moves between the quality talk questions and responses, and (3) taking 5 minutes to gather consensus about the design and implementation of these constructs and then the project conclusion in terms of these constructs.

In addition, it is noted that both of the two *groups* use the same ePUB3 eBooks to deliver the curricular contents for students' reading at each week: 'Wait for The Name of A Flower', 'Medicine', and 'The Last Sahara' respectively.

Figure 1: The ePUB3 eBook for delivering curricular contents

Figure 1 presents part of the ePUB3 eBook used at the 3rd week that introduces a novel entitled 'The Last Sahara' by a well-known Taiwanese writer K.S. Liu, and Figure 2 shows the YouTube film [18] played via the video link on page 6 that delivers the realistic scenery of the Chinchuan tribe in Hsinchu county introduced in the eBook. Further, it is also noticed that for verifying the validity of the new model, both of the two *groups* use also the same questions in their pre-class and post-class tests to verify their learning effects from the different activities in discussions.

4.2 Data Collected from the 3-Week Instructions

According to the academic schedule of a university in Taiwan, the class of 3-week instructions was held at the Spring semester in 2020 where the experimental *group* had 34 students starting their class from 3/13/2020, and the controlled *group* had 26 students startig their class from 3/11/2020.

As shown in Figures 1-2, students in the experimental *groups* previewed the ePUB3 eBook before each-week instruction and made discussions in the instruction through a series of quality talk questions and responses in each of the project-based inquiry steps. The following illustrates the designated project and part of the students' discussions about its solutions at the 3rd week instruction from a group of students S1 – S4 in the experimental *group* (note that these are the translated English version for illustration from their original Chinese contents):

1. The teacher designated first an applied writing project for students to solve as follows.

   After reading the descriptions in 'The Last Sahara' about the author's imagining wandering around the Sahara desert under his experience of natural ecology, please write down a 300-word novel that depicts a few-seen scene and the feelings it brings us using the 5-sense descriptions and comparative narratives that I emphasized in the class.

2. The group of students S1 – S4 started then their discussions from identifying necessary constructs for the project as follows.
   (1) S3: Yes, as told by the teacher, what we should do first is to identify the necessary constructs for this project. (AQ question)
   (2) S4: Sure, it is! I also think this is quite trivial by screening its words like "5-sense descriptions", "comparative narrative", "few-seen scene", and "the feelings it brings us". (TQ question)
   (3) S2: I agree! These constructs are obviously critical for us to address. (EE response) However, they should be discussed in some kind of order such as deciding first which "few-seen scene" is good for us to depict, clarifying then what "5-sense descriptions" & "comparative narrative" are the best to describe the scene, and identifying finally what "the feelings it brings us" are for us to address. (TQ question)
   (4) S3: Well, not really! I think this order seems not good. It is better to clarify "the feelings it brings us" before "5-sense descriptions" & "comparative narrative". (ET response)
   (5) S1: Yes, I think also so because "the feelings it brings us" should be clarified earlier such that we can identify then what "5-sense descriptions" and "comparative narrative" are the best to describe our feelings. (CT response)
3. Therefore, after discussions, the constructs identified by these students for solving the project are (1) which "few-seen scene" is good to depict, (2) what "the feelings it brings us" are for us to address, and (3) what "5-sense descriptions" and "comparative narrative" are the best to describe the scene and our feelings.

Table 1: learning activities in a class of 3-week instructions by experimental and controlled *groups*

Activities		**Experimental *group***	**Controlled *group***
Preview the curricular contents in ePUB3 eBooks by all students from 7 days before the class of 3-week instructions		Yes	Yes
Take a 5-min pre-class test by all students at the beginning of the first week instruction		Yes	Yes
Make 60-min group discussions through the project-based inquiry steps by all groups of students during the first week instruction for completing an applied writing project designated by the teacher		**Project-based inquired quality talk**	**General discussion**
		Give 15-min explanations by the teacher about the quality talk questions/responses	Make 60-min general discussions by each group of students to conclude the solutions of the designated project in terms of implemented constructs
		Take 15-min practices of a series of interactive moves by each group of students to develop experience about these questions/responses	
		Make 5-min discussions of a series of interactive moves by each group of students to identify necessary constructs for the designated project	
		Make 20-min discussions of a series of interactive moves by each group of students to complete the project in terms of these constructs	
		Take 5-min by each group of students to conclude the solutions of the project in terms of these constructs	
Take 15-min by all groups of students during the first week instruction to share their discussion conclusions with each other		Yes	Yes
r e p e a t	Preview the curricular contents in ePUB3 eBooks by all students from 7 days before each of the remaining 2-week instructions	Yes	Yes
	Make 60-min group discussions through the project-based inquiry steps by all groups of students during each of the remaining 2-week instructions for completing an applied writing project designated by the teacher	**Project-based inquired quality talk**	**General discussion**
	Take 15-min by all groups of students during each of the remaining 2-week instructions to share their discussion conclusions with each other	Yes	Yes
Take a 7-day post-class test by all students after the end of the last (3rd) week instruction		Yes	Yes

Figure 2: The YouTube film played via the video link on page 6 of the eBook

4. After identifying the three constructs, these students continued their discussions for implementing these constructs. The following are their interactions for implementing the first construct - which "few-seen scene" is good to depict:
   (1) S3: Okay, let us think about the first construct - which "few-seen scene" is good to depict. (AQ question) I think the term "few-seen scene" may mean some sites or events we do not experience often in usual days. Therefore, we need to consider first what the theme of such a scene is. As we know, the novel we read in the eBook describes a travel of the author to the Chinchuan tribe at a rural area in Hsinchu county. The author has many descriptions about the scenery of such a rural area, so I think a rural area canbe considered as our "few-seen scene". In addition, I guess we all must have experience in rural areas, but most of us living in Taipei or nearby must not go there often in usual days. (TQ question)
   (2) S4: Yes, there are many rural areas around the suburb of Taipei, but we all do not go there often in usual days. Their scenery is of course quite different from Taipei such as few people, fresh air, and leisure atmosphere. Thus, I advocate also using a rural area around the suburb of Taipei as our "few-seen scene". (ET response)
   (3) S1: Great! I agree also and believe everyone does too! (CT response)
   (4) S2: Yes, as you said, I do as well. (CT response)
5. Then, after discussions in the time limit, the group of students S1 – S4 gathered their consensus about the implementations of the three constructs and then concluded their solutions for the project in terms of these constructs. The following are their words about the project - *depicts a few-seen scene and the feelings it brings us using the 5-sense descriptions and comparative narratives that I emphasized in the class*:

   While in the New Year festival, I often go with my family back to my hometown at Pingxi in New Taipei city. Each time, when approaching its entrance, I always have a happy mood of returning to a quiet and peaceful rural township. Yes, it is a rural area and has many attractive scenes that let me be able to enjoy the leisure time during the festival holidays. In this area, I can not only take a "look at" its nearby rice fields, orchards, and windbreak forests, but also walk around its farm trails to "sniff" the flowers along roadsides, "touch" the fruits on trees, and "listen to" the sounds by birds. All of these make me feel so easy and relaxed. Further, I also like to "see" many neighbors' taking care of their rice fields and orchards, chatting happily after working, and sharing crops with each other. These also give me many warmest living hours. Therefore, with these scenes and feelings, I can refresh from my busy time in usual days by enjoying the "simple and leisure" life in my hometown. I thus should say that in addition to the "tensed and boring" urban area in Taipei that we live and work in usual days, we should go into rural areas as often as we can to enjoy a "simple and leisure" life time through their wonderful rurality.

Table 2: The t-test between experimental and controlled *groups*

Test		N	Mean	S.D.	T-Value	P-Value
Pre-class test	Experimental group	34	88.5	8.8	0.66	0.496
	Controlled group	26	86.5	13.3		
Post-class test	Experimental group	34	88.7	6.27	2.54	0.023
	Controlled group	26	84.8	6.42		

6. Finally, with discussion conclusions, these students S1 – S4 shared their conclusions with other groups of students. This could help them to enhance their critical thinking and reasoning about the project by capturing the pros and cons of other groups' solutions. In addition, the teacher also gave some comments to motivate their further reflections on discussions and conclusions.

4.3 Validity Verification of The Model

After the practical teaching of the 3-week class instructions, the scores of the pre-class test and post-class test from the experimental and controlled *groups* were respectively collected. In particular, the pre-class test at the beginning of the first week instruction had multiple-choice questions about the basic concepts of the curricular contents. In our knowledge, this could identify students' concepts about the reading and writing of the curricular contents before the 3-week instructions. Further, the post-class test after the end of the last week instruction was a more comprehensive project for students to write down individually a 1500-word novel using the 5-sense descriptions and comparative narratives learned from the class. As one may conceive, this could verify the learning effects of students' reading and writing abilities from the 3-week instructions.

Then, for verifying the learning effects of these two *groups*, we first calculated the means and standard deviations of their tests' scores. Then, based on such means and standard deviations, we conducted an independent t-test between these two *groups*. The results of the t-test were shown in Table 2. Thus, as the mean scores of these two *groups* indicated, these two *groups* had almost the same mean scores of their pre-class tests (86.5 and 88.5, respectively). Further, as the results of the t-test for their pre-class tests indicated, these two *groups* had no significant difference between their students' concepts about the reading and writing of the curricular contents (t-value is 0.66 and p-value is $0.496 > 0.05$). Therefore, based on these two indications, we ensured that students in these two *groups* were similar in their concepts about the reading and writing of the curricular contents before the 3-week instructions.

In contrast, as the mean scores of their post-class tests indicated, the experimental *group* had a higher mean score than the controlled *group* did (84.8 and 88.7, respectively). Further, as the results of the t-test for their post-class tests indicated, these two *groups* had a significant difference between their students' reading and writing abilities (t-value is 2.54 and p-value is $0.023 < 0.05$). Therefore, based on these two indications, we ensured that students in the experimental *group* had better learning effects about their reading and writing abilities after the 3-week instructions. As one may conceive, such better learning effects can thus verify the validity of the project-based inquired quality talk flipped learning model in enhancing students' reading and writing abilities by more active interactions in discussions.

5 Conclusion

In this paper, we address an important issue about the use of a flipped learning model: how it can be applied more actively to enhance the effects of students' class discussions. This is valuable to explore because in our knowledge students' learning effects in flipped classes can be enhanced by having more effective discussions through active interactions about the comprehension and application of curricular contents.

For this, we explore the adoption of a more practical Project-based Inquired Quality Talk mechaism in our earlier ePUB3 eBook-based flipped learning model to form a new ePUB3 eBook-based project-inquired quality talk flipped learning model. Therefore, the resultant new model supports the following learning activities in a flipped class: (1) students preview the curricular contents in eBooks before the class, (2) students take a pre-class test at the beginning of this class to identify their concepts about the reading and writing of the curricular contents, (3) the teacher gives necessary explanations about the quality talk questions/responses, (4) students develop their experience about these questions/responses by practicing a series of interactive moves in each of the project-based inquiry steps, (5) the teacher designates a formal productive project for students to solve, (6) students make discussions in the project-based inquiry steps from (6.1) identifying the necessary constructs for this project, (6.2) collecting related information and extracting useful knowledge to find the implementations of these constructs, (6.3) gathering consensus about the implementations of these constructs and then the conclusion about the solutions of the project in terms of these constructs, (7) students share their discussion conclusions with each other to enhance further their thinking and reasoning about the project through capturing the pros and cons of other peers' solutions, and (8) students take a post-class test after the end of this class to verify their learning effects.

This new model is then applied to an academic 'Reading & Writing' class at a university in Taiwan for verifying its validity. Afterwards, the application is verified by a comparative study between experimental and controlled *groups* where the experimental *group* applies the new model, and the controlled *group* instead uses the earlier ePUB3 eBook-based flipped learning model. After the practical teaching of 3-week class instructions, the scores of the pre-class test and post-class test from both of

the two *groups* are respectively collected for conducting an independent t-test. As the results of the t-test present, students in the experimental *group* have better learning effects about their reading and writing abilities after the 3-week instructions. As expected, such better learning effects thus verify the validity of the new ePUB3 eBook-based project-inquired quality talk flipped learning model in enhancing students' reading and writing abilities by more active interactions in discussions.

In the future, we will also try to apply our new model to other kinds of flipped classes. Since the model is applied herein only to a 'Reading & Writing' class that stresses both of the comprehensive reading of curricular contents as well as the productive writing of concerned subjects, its validity in more kinds of academic classes such as those focusing on the design of innovative products or services for various tracks or fields is thus valuable to explore for ensuring its usefulness in enhancing the effects of students' discussions on the solutions of these classes' productive projects.

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