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eBook-based mobile action learning to enhance learning effects in flipped classrooms

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ABSTRACT: In a flipped classroom, students conduct their learning activities by themselves before and in the class. An eBook-based flipped learning model with student-centred class activities was presented by the authors of this article in an earlier publication, and its advantages highlighted [1]. However, an important issue in the model's success, that has not been fully discussed before, is the effectiveness of students' previewing the eBook learning contents before the class because it can affect their subsequent discussion in the class, including their articulation and reflection of these contents. Hence, the authors extended the existing eBook-based flipped learning model by mobile action learning (MAL) to enhance the effects of students' previews, so as to increase the effectiveness of their class discussion. The extended eBook-based model was applied to an academic Reading & Writing flipped class, where a quasi-experimental study based on a comparative analysis between experimental and controlled groups was conducted to verify its validity.

Keywords: Mobile action learning, eBook-based learning, reading and writing flipped class, quasi-experimental study

INTRODUCTION

In education, flipped learning [2-4] is a kind of blended learning [5][6] that supports student-centred activities enabling students to learn by themselves before and in the class. In this approach to education, students preview their learning contents in their own way before the class, and then extend their self-conducted activities into group discussions or individual exercises in the class. The authors of the current article, presented the advantages of eBook-based flipped learning in their previous work highlighting student-centred class activities using eBooks (e.g. PDF or ePUB3) [1].

The method supported students' learning outside the class, enabled the preview of learning contents in the eBook, thereby preparing them for group discussions in the class. In this set up, the effectiveness of students' previews before the class is crucial because it can affect their subsequent discussion in the class, including the articulation and reflection of the learning contents. Therefore, the effectiveness of students' previews and their enhancement have been the focus of several studies. For example, mobile learning can support previews by using mobile devices (e.g. mobile phones) to complete such on-line activities as viewing learning contents and querying desired information [7-9]. In turn, action learning can enhance previews by directing learners to specific, relevant to the study field sites where actual situations are presented, and the learners can verify the existing or potential problems in these situations [10][11].

Considering the above-mentioned advantages of mobile and action learning and their robustness, the authors decided to extend their earlier eBook-based flipped learning model by mobile action learning (MAL) in students' previews [1]. The extended model was supposed to enhance students' preview learning effects, thereby increasing the effectiveness of their class discussion. The new eBook-based MAL model was applied to an academic Reading & Writing flipped class in a local university in Taiwan, where a quasi-experimental study was conducted with experimental and controlled groups to verify the model's validity.

MOBILE ACTION LEARNING

Mobile learning emphasises the use of mobile devices to complete on-line learning activities in a synchronous or asynchronous manner [8][9]. Therefore, with on-line materials or network resources, it can be carried out anytime and anywhere to complete such activities as viewing learning contents and querying desired knowledge. In contrast, action learning emphasises the actual experience that students have when working with real-life situations and problems that

can be verified, reflected upon and eventually solved [10][11]. Therefore, it amounts to field research at an actual site, where students gain experience through observation and participation.

The MAL approach developed by the authors, recognises the benefits of both approaches and has the following features:

1. Students use mobile devices to complete their learning activities anytime and anywhere before or in the class, where on-line materials or network resources can be utilised to enhance their learning effects.
2. Students engage in field research at the site included in the learning contents (e.g. observe this site) before the class to gain the experience on this site, while using mobile devices to access on-line materials or network resources to enhance their research effects.
3. Students utilise their on-site experience to complete, before or in the class, such actions as: understanding the actual situation of the researched site, clarifying the existing or potential problems at this site, and exploring the feasible solutions in light of the site's characteristics addressed in the learning contents.
4. Students can work on their field-research findings and actions in a group environment and collaborate with others when reflection and evaluating the findings and actions, thus enhancing their learning effects.

EBOOK-BASED MOBILE ACTION LEARNING

As an extension of the earlier model [1], the new eBook-based MAL model also uses eBooks in students' learning activities in a flipped class. However, in the new model the students' preview period is supported by MAL. The new model includes the following activities:

1. An anytime and anywhere preview of the learning contents in eBooks before the class: this is taken by all students using their individual devices to establish their preparative knowledge about the learning contents.
2. Field research: in the preview period, students also undertake a group field research visit to the site indicated in the learning contents to gain experience on this site. In such field research, students focus on the understanding of the actual situation, clarify the existing or potential problems in this situation and explore the feasible solutions for these problems in light of the site's characteristics addressed in the learning contents.
3. A pre-class test in the classroom at the beginning of the class: this is also taken by all students individually to capture how they have prepared via previews and field research for learning in the class.
4. A group discussion in the classroom to answer a subject question assigned by the teacher: all students in groups engage in a discussion with the following steps:

    (1) The discussion starts with group members talking about the subject question in regard to the actions of a) understanding the subject of this question; b) clarifying the specific problems in this subject; and c) exploring the feasible solutions in light of the local characteristics addressed in the learning contents:

    - In general, the subject question would focus on some in-depth problems in the actual situation of the site indicated in the learning contents. In their answer, group members are thus expected to figure out how these problems can be solved through the above three actions. Further, to complete these actions, a series of interactive questions/responses is posed among group members to understand the subject of this question, clarify its specific problems and explore the feasible solutions.
    - As mentioned before, through their field research, group members have already developed the experience to deal with the situation of the site indicated in the learning contents. In addition, they have also experienced the actions of understanding the actual situation, clarifying the existing or potential problems in this situation and exploring the feasible solutions in light of the site's characteristics addressed in the learning contents. Thus, an informed discussion can be carried out in a friendly manner to come up with a reasonable answer to the subject question in light of these characteristics.
    - Similarly to the quality talk approach [11], seven types of question are suggested for the group members' discussion: Q1 - authentic question (AQ) to stimulate thinking about the learning contents; Q2 - uptake question (UQ) to encourage thinking about something that was said earlier; Q3 - solutions question (SQ) to assist in thinking about alternatives; Q4 - high-level thinking question (HLQ) to enable generating new ideas; Q5 - affective question (AfQ) to connect the actual experience with the learning contents; Q6 - connecting question (CQ) to connect the issues indicated in the learning contents; and Q7 - test question (TQ) to presuppose solutions about the issues in the learning contents. Also, the following three types of response are suggested for the discussion: R1 - elaborated explanation (EE) to support the claim with appropriate evidence; R2 - exploratory talk (ET) to challenge the claim with supportive reasons; and R3 - cumulative talk (CT) to support earlier statements.

    (2) Afterwards, with sufficient interactive talks, the group members can gradually reach a consensus about their answer to the posed question in terms of its subject, specific problems and feasible solutions.
    (3) Finally, the discussion ends with the group members' conclusions after reaching the consensus.

5. A sharing of conclusions among all groups in the classroom: this is to help each group enhance its understanding of the answer by thinking about the value and advantages/disadvantages of the conclusions from other groups.

In addition, the teacher also gives comments and suggestions about each group's conclusions to assist reflection on the answer.

6. A post-class test in the classroom at the end of the class: this is taken by all students individually to verify their learning effects from the class.

APPLICATION OF THE MODEL

In this section, the authors present the application of the new eBook-based MAL model to a Reading & Writing flipped class in a university in Taiwan. Students' learning effects are compared between experimental and controlled groups.

Instructional Design

In the class design, the experimental group used the new eBook-based MAL model and the controlled group the designed earlier eBook-based flipped learning model [1]. Table 1 shows the learning activities of the two groups in the class. As can be seen from this table, the eBook chapter: N.J. Wu <Go to the show> was used to deliver the learning contents for students' reading and discussion. In general, these contents describe some personal stories among families in Jiufen (a gold mine town in decline in northern Taiwan). Further, implied from these stories, were two main characteristics of Jiufen's residents: *(1) they are optimistic to face the decline of their living town*, and *(2) they are enthusiastic to take care of each other in their living*. Therefore, these two characteristics were taken into consideration in students' learning activities.

As mentioned before, in addition to the preview and discussion, students in the experimental group participated in field research during their preview period. They had to observe the actual situation at Jiufen to gain some experience and knowledge of that township. During the visit, the research focus was on understanding the actual situation of Jiufen, clarifying the existing or potential problems there and exploring the feasible solutions in light of the above characteristics. Further, students in the two groups started their discussion by 40-minute group members' interactive talks about a subject question assigned by the teacher. Then, after sufficient interactions, they engaged in a five-minute discussion to reach a consensus about their answer to the posed question in terms of its subject, focused problems and feasible solutions. Finally, they had five minutes to reach their conclusions based on the consensus.

Data from Practical Instruction

Based on the academic schedule, a 32-student class for the experimental group and a 41-student class for the controlled group were held in October 2020. According to the learning activities shown in Table 1, students in the experimental group started their class by previewing the N.J. Wu <Go to the show> chapter from the eBook (as shown in Figure 1 for its original Chinese edition: 吳念真 <看戲去囉>) before the class.

Table 1: The learning activities of the two groups in a N.J. Wu <Go to the show> class.

Activities	Experimental group	Controlled group
A seven-day preview of the N.J. Wu <Go to the show> chapter before the class.	Previewing the eBook chapter.	Previewing the eBook chapter.
Field research regarding the actual situation at Jiufen during the preview period (seven days before the class).	Searching the eBook chapter for the desired information.	No
	Observing Jiufen to understand the actual situation there, clarify the existing or potential problems and to explore the feasible solutions for these problems in light of the residents' characteristics addressed in the chapter.	
A five-minute pre-class test at the beginning of the class.	Yes	Yes
A 50-minute group discussion to answer a subject question designated by the teacher.	Searching the eBook chapter and field research records for the desired information and reflecting on the on-site experience.	Searching the eBook chapter for the desired information.
	40-minute group members' informed discussion about the subject question through the actions of a) understanding the subject of this question; b) clarifying the specific problems in this subject; and c) exploring the feasible solutions for these problems in light of the residents' characteristics addressed in the chapter.	40-minute group members' discussion about the subject question through the actions of a) understanding the subject of this question; b) clarifying the specific problems in this subject; and c) exploring the feasible solutions for these problems in light of the residents' characteristics addressed in the chapter.

	Five minutes for group members to reach a consensus about their answer to the question in terms of its subject, specific problems and feasible solutions.	Five minutes for group members to reach a consensus about their answer to the question in terms of its subject, specific problems and feasible solutions.
	Five minutes to conclude the discussion based on the group consensus.	Five minutes to conclude the discussion based on the group consensus.
30 minutes for sharing conclusions among groups.	Yes	Yes
A 15-minute post-class test at the end of the class.	Yes	Yes

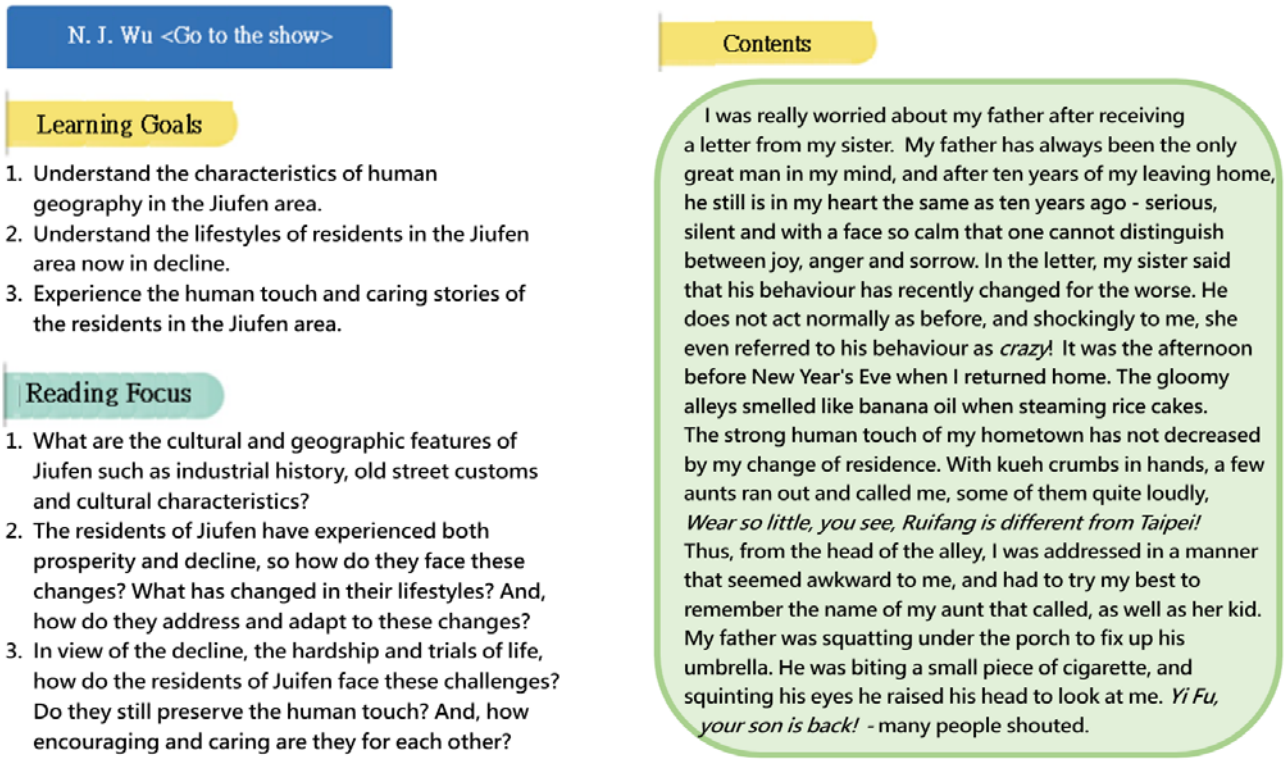

Figure 1: The eBook chapter used in the class.

During the preview period, students from the experimental group took a group field research trip to Jiufen Township indicated in the eBook chapter to gain experience on Jiufen, thereby facilitating their preview effects. The following points illustrate some aspects of the field research by a group of students (S1-S3) in the experimental group.

1. In Juifen, the students visited local stores and residents along Qingbian, Jishan, Shuqi, and Lunding streets, and focused on:

   (1) Understanding the actual situation of Jiufen, i.e. How has the decline proceeded? How have residents faced the decline? How have residents helped each other in the reduced circumstances? And, what is the current situation in Juifen?
   (2) Clarifying the existing or potential problems in Jiufen, i.e. What are its existing or potential problems? And, how have these problems impacted Juifen's current environment or future development?
   (3) Exploring the feasible solutions for these problems, i.e. How do residents face these problems? What are the possible ways to solve these problems? And, how do residents support these solutions?

2. During the research visit, including the town's attractions and its residents, the following information has been gathered:

   (1) About the actual situation of Jiufen: it started to decline around 1980s due to the depletion of gold mines; facing the decline, many young people left the town to earn a living elsewhere, but the remaining residents cared for each other with warmth and affection; later on, with the residents' determination, mutual co-operation and governments' assistance in the town's reconstruction, Jiufen has gradually started to recover its prosperity since 2000s; it is now a well-known attraction with many tourists visiting its historical, cultural and artistic sites.
   (2) About the existing or potential problems at Jiufen: residents have been aware of some problems that could impact the town's future development, such as: a) the uneven distribution of resources, with only a few residents benefiting from the town's reconstruction; and b) only the old streets near the visited area, extending at the bottom of the mountain are lively, while those above are very quiet, empty and even totally abandoned.

(3) To address these problems, some information from residents has been collected and opportunities explored, such as: a) many of those quiet and empty streets have actually rich histories and relics; b) many residents living in these streets are actually familiar with the culture and history of Jiufen and are also willing to participate in the development of these streets; and c) up to now, only a few people working in culture or history have stayed in those parts of Jiufen to promote it as a world cultural heritage site; if more such people came and settled there, it would attract tourists to visit their studios and notice the histories and relics of those streets that are now quiet and empty.
(4) In regard to solving these problems, some feasible ways have been suggested by residents, such as: a) residents may assist people working in culture and history to initiate some sightseeing and other tourist activities under the residents' guidance around those streets with local histories and relics; b) residents can participate in applications for governmental assistance on the reconstruction of those streets with local histories and relics to promote the Jiufen area as a world cultural heritage site; and c) residents can co-operate to use the Internet and other communication media in promoting, advertising and marketing the Jiufen area.

After their field research and information gathering in Juifen, students S1-S3 had a group discussion in the class to answer the following subject question assigned by the teacher: *As we know, since 2000s, Jiufen has recovered its prosperity from its earlier decline. However, the impact of Covid-19 pandemic has caused its current decline. What is your plan for its reconstruction in the post-pandemic era based on the two residents' characteristics at Juifen addressed in the eBook chapter?*

The following points illustrate some aspects of their discussion, guided by a series of interactive questions/responses meant to understand the subject of the question, clarify its specific problems and explore the feasible solutions:

1. The discussion started with questions relating to the students' understanding of the subject and included the following interactions:

   (1) S1: I think this question related to how Jiufen can be reconstructed in the post-pandemic era! (AQ question)
   (2) S2: Yes, it also requires the two local characteristics, which are being optimistic to face the decline and enthusiastic to take care of each other during the reconstruction. (CT response)
   (3) S3: Do you all think that the current decline has been caused by the pandemic? (UQ question)
   (4) S1: This is definitely true based on the media reports about the worries of residents and tourists regarding the spread of Covid-19. (CT response)
   (5) S3: Great, I thus feel that if the spread of Covid-19 can be controlled by Juifen residents, then tourists will be attracted to visit the area again without worries about the Covid-19 infection. (CT response)
   (6) S2: Yes, very clear!

2. After clarifying the subject, the discussion continued to address the specific problems as outlined below.

   (1) S1: Continuing on, do we all agree that this subject refers to the problem of Covid-19: how can the spread of Covid-19 be controlled around the Jiufen area to eliminate the worries of residents and tourists? (AQ question)
   (2) S3: Sure! In addition, I think it also prompts another question: how can the controlled status be widely advertised to attract tourists to safely visit Jiufen? (CT response)
   (3) S2: Yes, I think so! These two issues are essential for answering the question. I thus think the reconstruction plan can be prepared with a focus on controlling the spread of Covid-19 and the promotion of Juifen's safe status (CT response)
   (4) S1: I agree too! However, this plan should be drafted in light of the residents' characteristics addressed in the eBook chapter. (CT response)

3. In regard to specific problems, the discussion continued to explore the following solutions:

   (1) S1: I think the spread of Covid-19 can be controlled as advised by the government, by means such as regular disinfection of public areas by residents, enhancing air convection in stores and body temperature checks, mask-wearing and disinfecting when appropriate by tourists. (AQ question)
   (2) S3: Sure! But the point is how to ensure the strict execution of these rules. Some kind of guidance and advice for residents and tourists seem necessary. (UQ question)
   (3) S2: I feel this can be down by asking residents to volunteer and initiate the guidance and advice needed around the crowded area along Qingbian and Jishan streets. As I know, many local residents are willing to participate in such initiatives to reinvigorate their streets and make them more attractive. (CT response)
   (4) S1: Good idea! Based on the experience from our field research, many residents are actually willing to co-operate and contribute to those initiatives. I think this is a feasible way to solve the problem of controlling the spread of Covid-19. (CT response)
   (5) S3: I think so too! How about the other problem? That is how the safe status can be widely advertised to promote Jiufen? (AQ question)

4. After a series of interactions, students S1-S3 had gradually reached a consensus about their answer to the question in terms of its subject, specific problems and feasible solutions. For example, they agreed about the reconstruction

plan that encompassed the control of the Covid-19 spread and the promotion of Juifen's safe status. Also, they agreed to ask residents to volunteer and initiate guidance and advice about controlling the Covid-19 spread around the crowded area along Qingbian and Jishan streets.

5. At the end of their discussion, the students concluded that their answer to the posed question would cover the reconstruction plan encompassing both the control of the Covid-19 spread and the promotion of Juifen's safe status. Further, considering the two local characteristics addressed in the eBook chapter, residents could be asked to volunteer and, in a co-operative manner, to initiate guidance and advice about controlling the Covid-19 spread around the crowded area along Qingbian and Jishan streets in Jiufen.

Upon finalising their answer, students S1-S3 shared it with peers in other groups to enhance their thinking about the value and advantages or disadvantages of the answers from other groups. Finally, a post-class test with the following question was given to students S1-S3 at the end of the class to verify their learning effects from this class: *Using the story design template discussed last week, please outline your plans for the reconstruction of Jiufen in the post-pandemic era.*

Verification of Learning Effects

After practical class instructions, the scores of the pre-class and the post-class test were collected from each group, and then the mean and standard deviation of the two groups were calculated. To ensure that the two groups had similar reading and writing concepts instilled before the classes, the authors conducted a five-minute closed-book pre-class test with ten multiple choice questions at the beginning of each class. Then, an independent *t*-test on these two groups' scores (0-100 integer points) was carried out, of which results as shown in Table 2. As can be seen in that table, the mean score of the two groups were nearly the same (75.6 and 74.4, respectively), and there was no significant difference between these two groups with respect to their reading and writing concepts ($t = 0.38$, $p = 0.934 > 0.05$).

Afterwards, the authors also conducted a 15-minute open-book post-class test using the above-mentioned question at the end of each class. Then, an independent *t*-test on these two groups' scores (0-100 integer points in light of the assessment rubrics) was carried out, of which results as also shown in Table 2. As can be seen in that table, the experimental group had a higher mean score than the controlled group (84.8 and 75.3, respectively), and there was a significant difference between these two groups ($t = 2.49$, $p = 0.035 < 0.05$). The significant increase in the mean score in the experimental group presents an enhanced development of students' reading and writing abilities through the use of the eBook-based MAL model in their flipped class.

Table 2: Results of *t*-test between controlled and experimental groups.

Test	Group	N	Mean	SD	*t*-value	*p*-value
Pre-test	Experimental	32	75.6	16.2	0.38	0.934
	Control	41	74.4	14.9		
Post-test	Experimental	32	84.8	16.5	2.49	0.035
	Control	41	75.3	15.9		

CONCLUSIONS

In this study, the authors extended their earlier eBook-based flipped learning model [1] by mobile action learning in students' previews to enhance their preparation for class discussion. Then, the new model was applied to a Reading & Writing flipped class for experimental and controlled groups. After practical class instructions, the scores from the pre-class and post-class tests of these two groups were collected for an independent *t*-test. The results of the *t*-test indicated that there was no significant difference between the pre-class tests of the two groups. In contrast, there was a significant difference between the post-class tests of these two groups. The enhancement of the experimental group's reading and writing abilities can be attributed to using the new model.

However, it should be noted that although the *t*-test has verified the results of these two tests, some aspects of the results' reliability and validity, such as measurement invariance and internal reliability should also be addressed. Thus, future research should validate these aspects to enhance the results' verification.

In their future work, the authors will continue to explore the application of the new model, including more classes. Since the new model has been applied only to an academic Reading & Writing class, its application to more classes in different academic disciplines will be conducted in future studies. Further, in addition to the earlier flipped model, the authors will also try to add MAL to other variants of blended learning. As outlined by Bonk and Graham, there are many other blended learning models, such as rotation, on-line laboratory, flex and on-line driver models that could be considered [4][5]. The validity of adding MAL to these models to enhance students' learning effects will also be discussed.

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