A blended learning lesson design for an EPUB3 e-book-based course

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ABSTRACT: In recent years, using Internet technologies and cloud applications has not only provided more education opportunities outside classrooms, but has also gained much attention for prospective learners to acquire knowledge in a more convenient way. In this new paradigm of the so-called e-learning, many efforts have been made to build Web-/cloud-based learning systems that provide controllable processes of learning activities with desired curricular content. From the learning perspective, this means that desired content is delivered in spectacular ways, such as those e-book-based EPUB3 functions presented in previous work. Continuing the work on using these functions as blended learning in academic courses, the authors present in this article a method for developing a lesson plan that designs a course with these functions used in learning activities for delivering curricular content in desired EPUB3 e-book-based ways. For illustration, the method is applied for developing a lesson plan for a Java Programming course. Finally, an assessment of using the EPUB3 functions in learning is discussed for ensuring their usefulness and effectiveness.

INTRODUCTION

The rapid advances in Internet technologies and cloud applications in recent years have provided more education opportunities to learn outside classrooms. This has gained considerable attention as a new theme for prospective learners to acquire knowledge in a more convenient way. In this new paradigm of the so-called electronic learning (e-learning), many efforts have been made to build Web-/cloud-based learning management systems (LMS) that provide controllable processes of learning activities with desired curricular content [1].

To the authors' best knowledge, e-learning is managed for what learners really care about, including the recognition of expected learning objectives and how these objectives are achieved by teaching activities under a commitment mechanism (i.e. engaging the achievement of these objectives through a designated process for monitoring and controlling these activities).

Many approaches that deal with these needs have been presented; most of which focus mainly on specifying/directing the learning activities, including for instance:

1. SCORM that uses sequencing control modes to represent the learning activities in an activity tree [2][3];
2. rule-based systems that use access rules to specify and direct a specific process of teaching/learning activities [4][5];
3. relationship-based systems that use logic relationships to define a course structure with the relationships among its course components [6];
4. workflow-based systems that employ the power of workflows to define a stream of activities that constitute a learning process [7].

In general, these approaches support well the provision of a controlled process of learning activities. However, they have the following deficiencies: 1) their mechanisms do not address the delivery ways of desired content in the controlled process (i.e. how this content is delivered in spectacular ways for achieving expected objectives); and 2) there are no discussions about the implementation of such delivery ways by using selected publication formats. In the authors' view, delivering the desired content in spectacular ways is beneficial in getting the learners to pay more attention to the reading of that content. For instance, keeping the content vivid by employing such internal techniques as using contrasting colours and bright pictures can strengthen the richness of this content for stimulating the learners' different senses [8]. Keeping the content interactive by imposing interactive media, such as browsing links and question/survey options can help the learners to initiate or react to a communication for motivating their mindfulness on this content.

For this need, the authors have presented in their previous work [9] discussion about the ways of delivering the desired content, the implementation of these ways by the standardised EPUB3 format for e-book publications [10] and, finally, the delivery of these constructed functions by the referenced Readium reader for EPUB3 [11]. Continuing their work on using these functions as blended learning [12] in academic courses, the authors present in this article a method for developing a lesson plan that designs a course with these e-book-based EPUB3 functions used in learning activities for delivering curricular content in desired EPUB3 e-book-based ways.
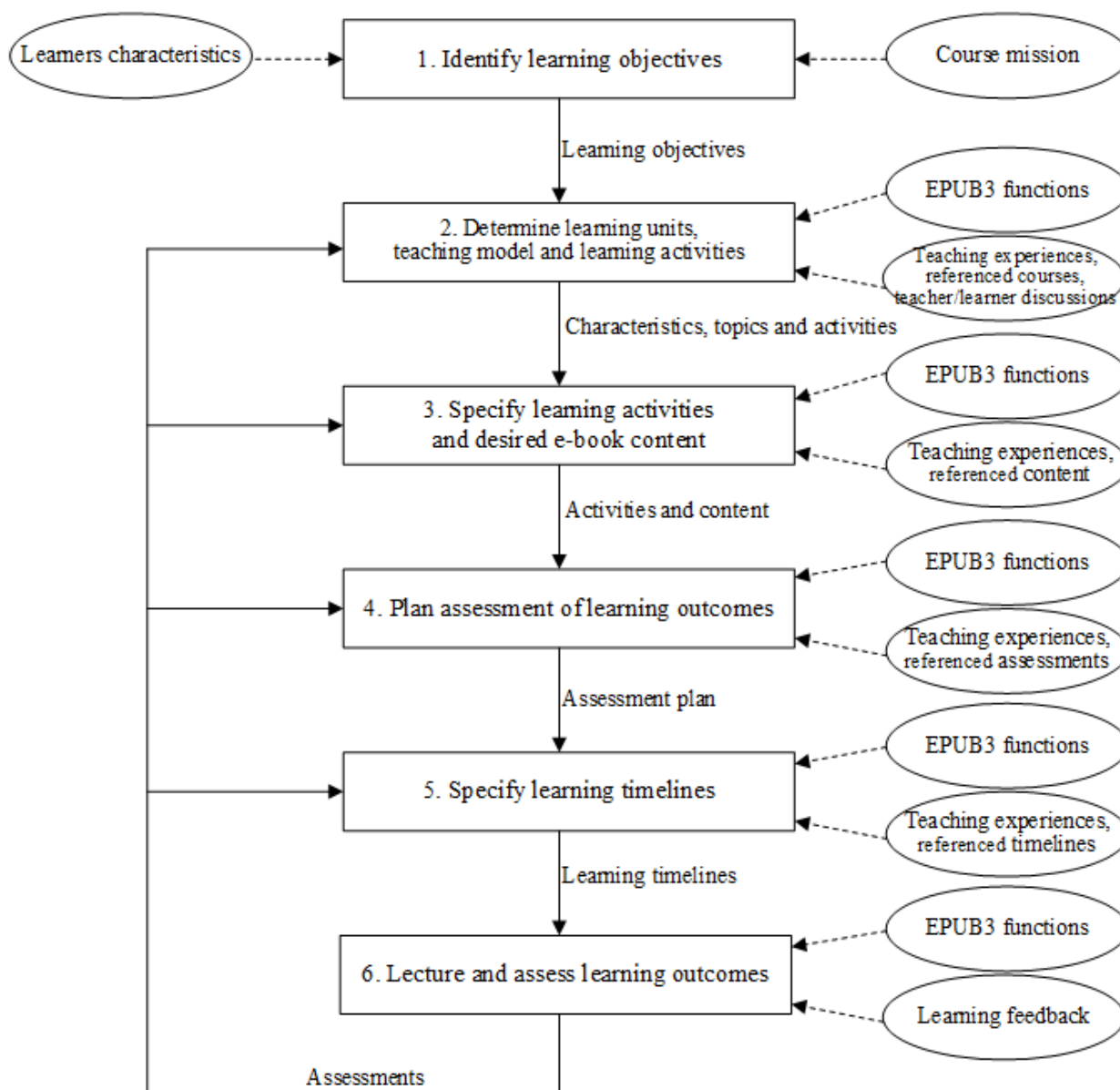

Figure 1: The EPUB3 e-book-based blended learning lesson plan development method.

In general, as a pilot discussion about the employment of EPUB3 functions in learning activities, the method is based on the blended course design issues presented by McGee and Reis [13], as well as on the well-known ASSURE approach presented by Smaldino et al [14], with the following extensive considerations: 1) identifying the learning units of the course and the teaching model for each lesson of a unit (i.e. how the lesson proceeds before, within and after its lecture in the context of blended learning); 2) identifying the learning activities and relevant lesson content that will be taken and delivered by using EPUB3 functions (e.g. a learning activity that delivers the desired content in spectacular ways to catch the attention of the learners or to enhance their comprehension of this content); and 3) specifying suitable EPUB3 functions for these activities/ this content (e.g. delivering the content with suitable ways to achieve the objectives).

For illustration, the method is applied to the development of a lesson plan for a Java Programming course in the Department of Information Management at Ming Chuan University, Taipei, Taiwan. Note that there are already many discussions about blended learning lesson plans in the literature [15-23]. However, due to the differences between their supportive environments and applicable domains, any statements on their dis/advantages are quite difficult. Therefore, the authors do not address herein the comparisons between their method and these existing approaches. Finally, an assessment of using the EPUB3 functions in learning is conducted for ensuring their usefulness and effectiveness.

THE DEVELOPMENT METHOD

In general, as shown in Figure 1, the method is based on the design issues [13], as well as the well-known ASSURE approach [14], with the following six steps:

1. Identify learning objectives - this step addresses the purposes of the course for the learners, such as what knowledge they acquire, what practices they experience and what capabilities they possess. In order to identify these expected objectives, two perspectives may be considered as follows:

    a) The mission of the course is referenced for addressing the expected achievement, which is usually approved by the institute via formal procedures. For instance, a Java Programming core course is designed in the Department for providing freshman students with the basic capabilities of designing and executing Java programs. This course is, thus, approved with the mission - *making students possess the capabilities of designing and executing basic Java programs*.
    b) The characteristics of students can be considered for clarifying the feasibility of any specific objectives identified for achieving the above approved mission. These characteristics may, in general, include the attributes of students, such as academic abilities and interests; their prior competencies, such as experiences of executing programs; and their learning styles, such as direct instruction, cooperative learning, inquiry-/project-based learning and seminar.

    Afterwards, the feasible objectives for accomplishing the course mission may be identified as below:

    −   Students understand the syntax and semantics of the basic constructs in the Java language.
    −   Students comprehend the design of Java programs by using these basic constructs.
    −   Students experience the execution and debugging of these basic Java programs.

2. Determine learning units, teaching model and learning activities - this step focuses on three perspectives:

    a) The learning units of the course that address the units to be lectured about in the course. For instance, for the Java Programming course, there are such learning units as Java Program Structures, Object-Oriented Concepts, Object-Oriented Programs and Executions and Debugging. In general, this can be determined in many ways, such as the teaching experience of the teacher, references from other relevant courses, and the possible discussions between the teacher and those students who have ever taken this course.
    b) The teaching model of the course that specifies how the course proceeds before, within and after a lecture for each lesson of a unit (i.e. a lesson). In general, in the context of blended learning, this may include the specification of the learning ways of each lesson like direct instruction, cooperative learning, inquiry-/project-based learning and seminar; and the learning locations of each lesson, such as inside/outside the classroom. For instance, an inside pre-lecture introduction by a direct instruction may be required at the beginning of a lesson; the lesson is, then, lectured inside classroom by direct instruction under the necessary helps from the teacher; and an inside post-lecture exercise via a project-based learning is, finally, taken at the end of the lesson.
    c) The learning activities of the course that focus on the necessary activities (via using the e-book-based EPUB3 functions) for completing each lesson under the teaching model. For instance, a pre-lecture short introduction may be imposed via an EPUB3 *video* function at the beginning of a lesson; the lesson is, then, lectured by direct instruction via various EPUB3 content delivery functions; and a post-lecture exercise is finally taken by a project-based learning via an EPUB3 *exercise* function at the end of the lesson.

3. Specify learning activities and the desired content - this step focuses first on the specification of the learning activities that includes the detailed descriptions of, and the sequencing relationships among, these activities. Since these activities are taken under the teaching model for completing the lessons, the desired content of each lesson and the suitable EPUB3 functions for delivering this content are, then, specified for enhancing the learning effectiveness of the lesson. For instance, the aforementioned activities for a lesson (i.e. a pre-lecture short introduction, the lesson lectures and a post-lecture exercise) may have a sequential relationship, where each activity is taken via its suitable EPUB3 functions. After that, the desired content of the introduction, lesson lectures and exercise need to be specified for being delivered in the lesson via EPUB3 functions, such as *recorded video*, *referential link*, *guided reading* and *automatic repetition* [9].
4. Plan assessment of learning outcomes - this step focuses on the planning of the outcome assessments of the course. In general, such assessments may include checking the learning effectiveness of each lesson via tests; and catching the dis/advantages of the activities and content of each lesson via questionnaires. For instance, a test via an EPUB3 *test* function may be set at the end of a lesson for verifying the learning effectiveness of the lesson; a questionnaire may also be taken at the end of the lesson via an EPUB3 *questionnaire* function for identifying the dis/advantages of current activities and content.

5. Specify learning timelines - this step addresses the schedule for completing the course by taking the activities and assessments of each lesson. In general, such timelines may include the consideration of: 1) the time needed for taking each activity or assessment in a lesson; 2) the sequencing relationships among these activities and assessments; and 3) the time limits and possible resources (e.g. supportive teaching assistants) for completing the course. Then, the timelines for the course may be specified such that all lessons and their activities and assessments are completed within scheduled time limits and available resources.
6. Lecture and assess learning outcomes - this step addresses the actual lecturing and outcome assessments of the course. In general, such lecturing and assessments are taken in the specified timelines, such that the learning activities and desired content in each lesson are taken and delivered under the teaching model, and the outcome assessments are also done for verifying the learning effectiveness of the course and catching the dis/advantages of current activities and content.

Table 1: The lesson plan for the Java Programming course.

Course name	Java Programming								
Objectives	1. Students understand the syntax and semantics of the basic constructs in the Java language. 2. Students comprehend the design of Java programs by using the basic constructs. 3. Students experience the execution and debugging of Java programs.								
Learning units	1. Java Program Structures; 2. Object-Oriented Concepts; 3. Object-Oriented Programs; 4. Executions and Debugging								
Teaching model	Before lecture			In lecture			After lecture		
	Inside classroom introduction			Inside classroom lesson lecturing			Inside classroom exercise		
				Help from the teacher					
Unit	Activities/ assessments	EPUB3 functions							Time (min)
		Video	Link	Reading	Repetition	Exercise	Test	Questionnaire	
1 Java Program Structures	1.1 Introduction	✓							5
	1.2 Lesson lecturing								30
	1.3 Exercise (I)					✓			5
	1.4 Test (I)						✓		5
	1.5 Questionnaire							✓	5
2 Object-Oriented Concepts	2.1 Introduction	✓							5
	2.2 Lesson lecturing		✓	✓					30
	2.3 Exercise (II)					✓			5
	2.4 Test (II)						✓		5
	2.5 Questionnaire							✓	5
3 Object-Oriented Programs	3.1 Introduction	✓							5
	3.2 Lesson lecturing	✓			✓				20
	3.3 Exercise (III)					✓			15
	3.4 Test (III)						✓		5
	3.5 Questionnaire							✓	5
4 Executions and Debugging	4.1 Introduction	✓							5
	4.2 Lesson lecturing	✓			✓				15
	4.3 Exercise (IV)					✓			20
	4.4 Test (IV)						✓		5
	4.5 Questionnaire							✓	5
Scores	10% for each exercise and test								
Resources	A supportive teaching assistant								

THE ILLUSTRATIVE LESSON PLAN

In this section, the authors illustrate their method by developing a lesson plan for the aforementioned Java Programming course. As shown in Table 1, the plan is organised with the following sections based on the first five steps of this method:

1. Course name - Java Programming.
2. Objectives - 1) students understand the syntax and semantics of the basic constructs in the Java language; 2) students comprehend the design of Java programs by using the basic constructs; and 3) students experience the execution and debugging of Java programs.

3. Learning units - four lesson units about Java programming, i.e. Java Program Structures, Object-Oriented Concepts, Object-Oriented Programs, and an Executions and Debugging program.
4. Teaching model - inside classroom direct instruction before, within and after each lesson lecture.
5. Units - activities and assessments for each unit via suitable EPUB3 functions. It is noticed that the desired content and outcome assessments of each unit are necessarily specified for being delivered and taken in the unit. Figures 2.1 - 2.6 illustrate a lesson example; where Figure 2.1 is a pre-lecture short introduction via the EPUB3 *video* function, Figures 2.2 - 2.4 are the lesson lectures via various EPUB3 content delivery functions, Figure 2.5 is a post-lecture exercise via the EPUB3 *exercise* function, and Figure 2.6 is a test about the lesson via the EPUB3 *test* function.
6. Timelines - the times required for taking activities and assessments in each lesson.
7. Scores - the scores of students through tests and exercises.
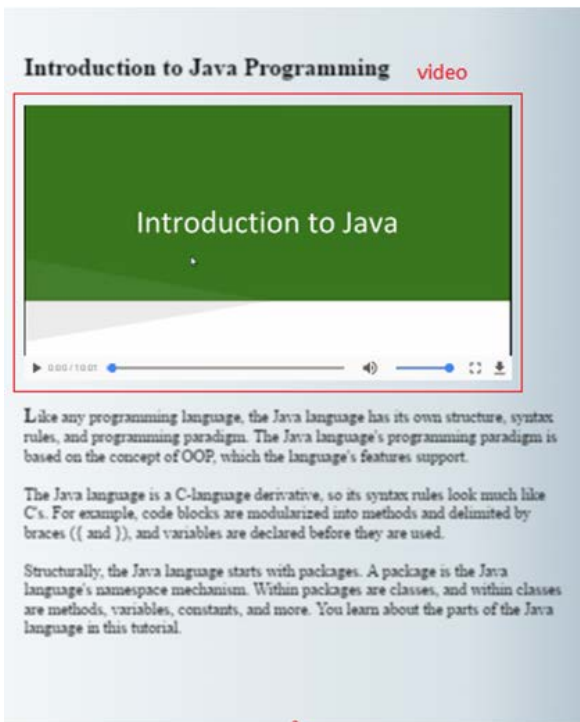8. Resources - a supportive teaching assistant.

Figure 2.1: A pre-lecture short introduction via *video*.

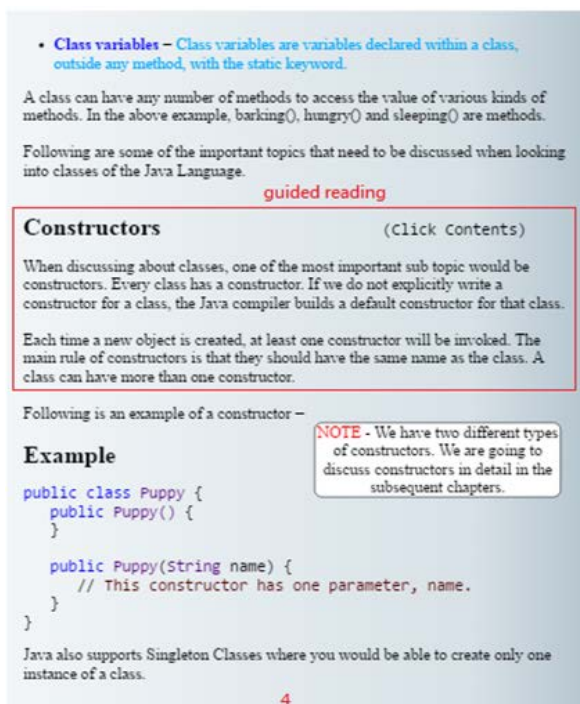Figure 2.2: Referencing *what are objects* via *referential link*.

Figure 2.3: Explaining class constructors via *guided reading*.

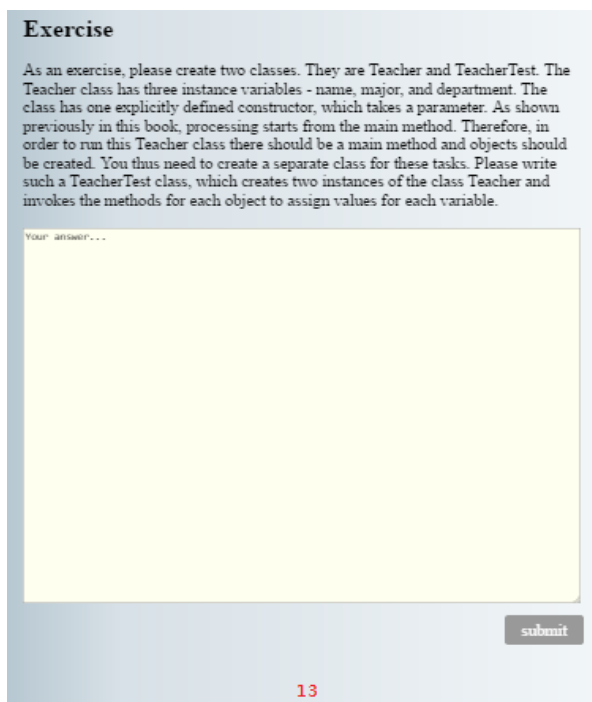Figure 2.4: Illustrating object creation via *automatic repetition*.

Figure 2.5: Taking a post-lecture exercise via *exercise.*

Figure 2.6: Taking a post-lecture test via *test.*

ASSESSMENT OF THE EPUB3 FUNCTIONS

After developing a blended learning lesson plan with e-book-based EPUB3 functions used in the learning activities, a questionnaire is given to 20 of the Department's senior students, to assess the usefulness and effectiveness of these functions in such a blended learning model. As shown in Table 2, the questionnaire is composed of nine questions within three categories - learnability, usability and satisfaction, where a seven-point Likert scale, with 0 = strongly disagree and 6 = strongly agree, is used. As can be seen from Table 2, all scores are above 5.0 and, hence, indicate that students have favourable attitudes towards enhancing their Java programming skills through the blended learning model via EPUB3 functions. In addition, students also advocate using EPUB3-based e-book in their learning, compared to using traditional textbooks, for increasing their interest, as well as providing them with more help on the learning of designing and executing basic Java programs. Here, a minor caveat should be noted, that the mean value (and standard deviation) of question number 3 is much lower (and also significantly higher) than others, because some students responded that the accent and temperament from the EPUB3 *guided reading* does not make them comfortable for listening while reading the guided texts.

Table 2: The questionnaire for the e-book-based EPUB3 functions.

No.	Questions	Mean	SD
Learnability			
1	The EPUB3 *video* function on page 1 for a pre-lecture short introduction helps me understand the basic concepts of Java programs.	5.35	0.48
2	The EPUB3 *referential link* function on page 2 for referencing the subject of *what are objects* helps me understand the basic concepts of class objects.	5.25	0.62
3	The EPUB3 *guided reading* function on the *Constructor* paragraph of page 4 for explaining the subject of class constructors helps me understand the basic concepts of class constructors.	5.00	0.89
4	The EPUB3 *automatic repetition* function on the Creating an Object paragraph of page 5 for illustrating the consecutive steps of creating an object helps me understand the basic concepts of creating a class object.	5.40	0.49
Usability			
5	The EPUB3 *exercise* function on page 13 for taking a post-lecture exercise provides me with a convenient way to complete the exercise.	5.15	0.57
6	The EPUB3 *test* function on page 14 for taking a post-lecture test provides me with a convenient way to complete the test.	5.55	0.50
Satisfaction			
7	Compared to the traditional textbooks, this e-book with EPUB3 functions used raises my interest in the learning of the designing and executing basic Java programs.	5.20	0.49
8	Compared to the traditional textbooks, this e-book with EPUB3 functions used provides me with more helps on the learning of the designing and executing basic Java programs.	5.35	0.50

CONCLUSIONS

In this article, the authors presented a method for developing a lesson plan that designs a course with e-book-based EPUB3 functions used in learning activities. In general, as a pilot discussion about the employment of EPUB3 functions in blended learning, the method is based on the well-known discussions about blended learning in McGee and Reis [13] and Smaldino et al [14], with extensive features: 1) identifying the learning units of the course and the teaching model for each lesson of a unit; 2) identifying the learning activities and relevant lesson content to be taken and delivered by using EPUB3 functions; and 3) specifying suitable EPUB3 functions for these activities/this content. For illustration, the authors applied the method in the development of a lesson plan for a Java Programming course in the Department. Finally, a questionnaire-based survey about using the EPUB3 functions in such a blended learning model was conducted, and the results positively showed its usefulness and effectiveness on learning activities.

As a well-recognised paradigm, blended learning is widely accepted and adopted, because it provides more support for achieving learning objectives. For example, it allows students to proceed through the learning activities with both on-line digital media and traditional classroom methods; students can, therefore, access more convenient environments for their autonomous learning and also, if necessary, receive more help from the teacher. Since the lesson plan developed through this method addresses the use of e-book-based EPUB3 functions in learning activities as a form of blended learning, it takes advantage of the multimedia and interactive features from the newly introduced EPUB3 techniques that can enhance the blended learning models with more flexible and attractive environments [10].

In future work, the authors will continue to explore the application of this method on the EPUB3 e-book-based course design for blended learning. In particular, its applications in the various teaching models of blended learning, such as flipped, rotation, flex, laboratory, and self-blend and on-line models will be respectively discussed [24][25]. The actual lecturing and outcome assessments specified in respective lesson plans will also be taken to ensure the usefulness and effectiveness of his method in the design of a blended learning course.

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