

The Cloud-Based Textbook: From Choice to Advantage

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Abstract—A common feature of professional learning in different disciplines is that the skills and knowledge are acquired through students' understanding, memory, and practice. This paper examines the impact of the cloud-based textbooks on students' learning achievements and finds that the use of cloud-based textbooks can affect and improve some students' academic achievements significantly. At a university in China, our team conducted a study of offering free cloud-based textbook for a class of 160 students in 8 weeks. It was found that more than 50% of students were open to using cloud-based textbook. In the final exam, students who used cloud textbooks scored significantly higher on total scores and difficult questions than those who did not. The result also showed that the cloud-based textbook's satisfaction rate reached 73%. The research team also found that female students have a higher percentage of in-depth reading after choosing to use cloud-based textbooks than male students. Based on these evidences, a plug-in containing a simple quiz game and card reward mechanism is recommended as supplementary content that affects the positive impact of students' interest in electronic textbooks.

Keywords— *E-textbook, cloud-based textbook, learning outcome, Satisfaction of cloud-based textbook*

I. INTRODUCTION

Since the beginning of the 21st century, young people have become familiar with e-books. Contemporary e-books have integrated audio-visual functions, printed text content, and web-based functions based on electronic devices. They have attracted increased attention from parents and educational institutions due to their enriched multimedia content and portability. Some scholars have believed that the introduction of using e-books as textbooks at schools would offer more interaction and enhance learning outcomes for students from around the world. However, numerous studies have found that younger readers seem to prefer printed textbooks [1, 2, 3, 4, 5]. Meanwhile, teachers and universities remain sceptical about the impact of the use of electronic teaching materials on student achievement. Previous studies also showed that e-textbooks had no significant positive impact on students' achievement as compared with traditional textbooks [1, 6, 7, 8, 9, 10]. In the past three years, a contrasting study argued that e-books, as electronic teaching materials, have had a direct positive impact on improving academic performance and enhancing students' comprehension ability based on the media's diversification and functional improvement [11, 12, 13]. Electronic textbooks empower the classroom and give choices to students and teachers. However, it is necessary for users to take the first step by assessing the strengths or weaknesses of e-textbook usage. And then, they will take the next step.

In this paper, the term "cloud-based electronic textbooks" is elaborated from two aspects to distinguish the previous concept of electronic textbooks. Firstly, this paper introduces

a new type of cloud-based e-learning material, which is a cloud-based learning material linked with a learning management system (LMS). It not only has multimedia content, but also provides embedded tests and various activities, as well as learning reports for users. This paper will refer to it as a cloud-based textbook. Secondly, a difference was found when comparing the final grades as well as the level of comprehension and analytical skills demonstrated by students who used the cloud-based e-textbook compared with those who did not use it. This confirmed the effectiveness of cloud-based materials on learning outcomes.

On the purpose of understanding the effect of the cloud-based textbook to enhance the academic achievement, a free experience of cloud-based textbook is conducted as an experiment in a university in Guangzhou, China. A group of undergraduate university students are selected for research to conduct an experiment with a free cloud-based textbook. The empirical study is conducted with 160 sophomores accounting majors in the 2nd 2020-2021 semester who are taking an 8-week tax law course with the free cloud-based textbook as an optional learning resource. The study finds that students who used this textbook attained academic achievements (i.e., final written exam scores) that differed significantly from those who did not use it. This is especially true for the case study learning activity that requires comprehensive reading skills and logical thinking to solve problems.

This research also confirms that students who are clearly motivated to learn are more likely to use the cloud-based textbooks to learn. In this experiment, no significant gender difference is found in either the academic achievement or the intention to use this textbook. However, a significant gender difference exists in the time spent to read and complete this textbook's content.

II. LITERATURE REVIEW

A. E-books

The commonly accepted scholarly definition of an e-book is the one that Armstrong (2002) proposed: "any piece of electronic text, regardless of size or composition (digital object) "...excluding journal publications, made available electronically (or optically) for any device (handheld or desk-bound) that includes a screen" [14]. Generally speaking, the term 'e-book' is a different term than that of the 'hardware, software, and content' perspective of an 'e-book'.

During the 1980s and 1990s, the possibility of e-books that provide digital instructional content was achieved, usually as reference materials in libraries. These e-books are usually published as CD-ROMs or used with personal digital devices such as personal digital assistants (PDAs) and personal computers [15].

Since the beginning of the 21st century, web-based e-books have more interactive functions for readers. Moreover, support from software or platforms can enable embedding of hyperlinks to web resources in e-book text, and it is possible to store the user's more interactive data on the platform.

B. From e-book to e-textbook

Textbooks have been viewed as key aspects of classroom learning. The argument that the use of e-books in higher education should be promoted was already in existence at the beginning of the 21st century [16]. With the development of information and communication technology (ICT) and cloud network technology, e-books have begun to play the role of textbooks. While e-books have consistently been used in libraries and for academic research, technological developments that enhanced their meaning and interaction have recently made it possible to introduce them into classrooms as electronic textbooks. Generally, E-textbooks are defined as e-books used for in-class or after-class study that are accessed by using an electronic device [17].

As more teaching materials and events are digitalized, e-textbooks are no longer limited to a certain type of teaching or learning but extend to activities beyond the classroom. Some researchers claim that the benefits of using e-textbooks instead of textbooks include lower costs, lighter physical weight, full-text search, electronic note-taking, and text-to-speech functions that provide better accessibility for sight-impaired students [3].

C. Theoretical basis for multimedia preparation of cloud-based textbooks

Students' ability to understand abstract concepts has always posed a challenge for educators. Similar to a non-technical discipline, such as accounting, teaching involves a hierarchical progression of understanding and interpreting concepts. This discipline includes many interconnected concepts and hierarchical progressions of concepts. Therefore, this research considers learning strategies that apply cloud-based textbooks by using multimedia, stimuli and constructivist learning models to address this issue.

Based on Paivio's dual-coding theory [18], Baddeley's working memory theory [19] and Wittrock's generative learning theory [20], Mayer et al. proposed a cognitive theory of multimedia learning [21]. Mayer et al. summarized a framework for designing and organizing multimedia materials, guide their usage, including methodologies of multimedia usage as well as principles of spatial contiguity, temporal contiguity, coherence, segmentation, and signaling induction. Conceptual understanding is believed to be caused by signals. The same content is presented in different media to provide a variety of stimuli for the senses, and then stimulate the learner's brain again in the form of a test, so that the learner can internalize knowledge and obtain feedback on the quality of learning. As shown in Fig. 1, the compilations of media- content and concepts used in the cloud textbook follow Mayer et al.'s principles. Multi-signal stimulation theory was practiced through the content with multimedia audio-visual effects and various automatic exercises in each chapter of the cloud-based textbook.

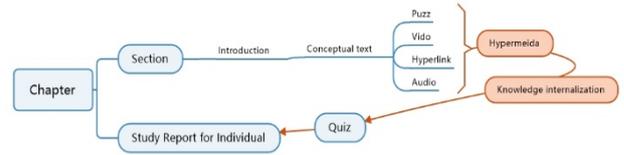


Fig. 1. Chapter multimedia learning content structure

III. CLOUD BASED E-TEXTBOOK

Since 2013, Intelligent Learning Tutor systems have considered the development of a new generation of e-text books. The new generation of e-textbook can provide students with recommended quizzes and guided questions based on their skills, abilities, and learning progression instead of only suggesting students to watch videos or read and highlight materials, or refer to external resources by using hyperlinks [22].

The development of the new generation of e-textbooks can be summarized based on three models. The first one is the old offline usage model of downloading a database and software, the second model involves downloading software and partial data along with feeding users' performance data to the LMS, and the third model is purely an online web-based model that does not require software or data downloads before students can start to use it [23].

The first model's disadvantages are its need for a lot of storage space and regular updates to ensure that students have the latest information and content. The third model's disadvantages are its dependence on the Internet and inconvenience for students who live in rural areas where the Internet is unavailable or who cannot afford the cost of using the Internet. The second model has the features and benefits of both the first and third models while reducing their device space requirements and Internet dependency. This research studies the learning effects and characteristics of the students who use the second model of e-textbook.

The second model of e-textbook can be referred to as a cloud-based textbook. Different from massive open online courses (MOOCs) or other LMS, cloud-based textbooks can be accessed primarily by downloading software to laptops, iPads, cell phones, and desktop/laptop computers, rather than just logging onto the Internet. When students download cloud-based textbooks, they can complete quizzes, read slides, use other learning materials, and watch videos without an Internet connection. Whenever a student returns to an area where the Internet can be accessed, data about the student's learning behavior and test scores will be automatically uploaded to the cloud server. Finally, at the end of each chapter, the cloud server-linked platform (LMS) generates learning reports for students.

Cloud-based textbooks integrate mobile learning, multimedia content, and cloud services. According to students' needs for contextualization, dynamics, and visualization, teachers are authorized to design enriched media content and teaching interaction modes that they can present on smartphones, tablets, and computers. In addition, students can use the hyperlink to participate in discussions on the LMS platform and receive feedback related to their score as their contextual learning material as a formative assessment for instructors. In short, cloud-based textbooks not only provide students with enriched graphics and

animated content, but also give them an extensible, interactive, traceable, and complex learning experience.

As shown in Figure 2, cloud-based textbooks have the following three characteristics of use and editing. The first is that teachers can conveniently review the result of multimedia content and various quiz's Result on the textbook linked LMS. The second is the automatic function of network connection. The cloud-based textbook supplier uses the cloud to process the data uploaded by the students into a complete learning report when students are online, and stores the usage data on their devices when they are not online. The third is the summary function. When the data is fed back to the server, it will be summarized in the learner's or teacher's academic performance report on the LMS, and the user interface for accessing the LMS information.

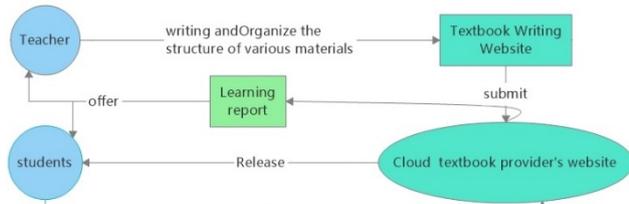


Fig. 2. The process of editing and using cloud textbook

Students' usage information includes the learning time spent for every login, the content watched or read, and number of clicks was recorded via cloud-based textbook. The usage information is uploaded to the cloud-based textbook provider's server. A learning report is then created in the Learning management system via the cloud server. The learning report, shown in Fig. 3, compares the student's learning time spent and their performance with their class session's average performance, and provides the students and teacher with information to improve their cognitive learning and teaching design strategies.

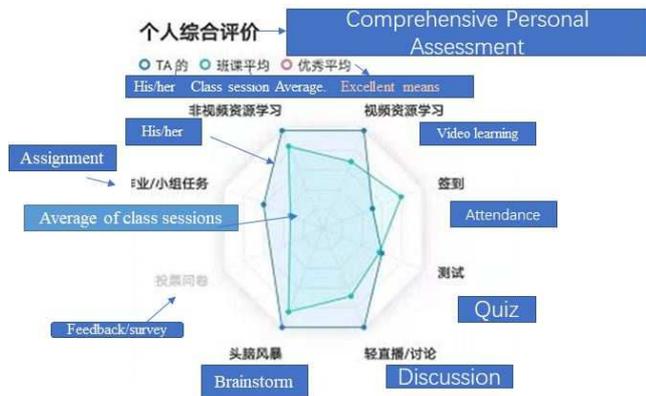


Fig.3. The learning report of cloud-based textbook on LMS

Based on the characteristics of cloud-based textbooks and technological innovations, the functions of the next-generation electronic textbooks (i.e., cloud-based textbooks) are summarized in Table I. The new generation of electronic textbooks with these five functions will enable teachers and students to work and study easily without being restricted by time and area. Help them achieve their teaching goals or learning goals through functions that were not available in the previous electronic textbooks. After teachers have grasped the functions and features of the new generation of electronic textbooks, they can use appropriate teaching strategies to obtain more personalized teaching. For

example, the teacher will be very clear that those students have problems with expressions, those students have problems with calculations, and those students have problems with expressions. Only then can we really achieve student-oriented [24].

The provider "Mosoink"¹ releases the cloud-based textbook separately and downloads them by a mobile app or adds them to the LMS platform "cloud classroom"². These are the digital textbook of the teacher's choice.

A variety of interactive resources such as hyperlinks, animation flash, and audio-visual materials have been added to the cloud-based textbook. Teachers compile teaching content materials licensed by copyright. All quiz and various exercises based on cloud textbooks are revised and uploaded by the teacher via "Cloud textbook online editor"³ before release, and they are components of the cloud-based textbooks. They can only be released after obtaining the ISBN code. Generally, teachers cannot add exercises or change the grading standards of exercises at will.

TABLE I FIVE FEATURES OF THE CLOUD-BASED TEXTBOOK

Mobile cross-platform and cross-terminal. (iPad, iPad, Android, PC)	Cross platform, cross terminal and screen adaptation technology, just one production, one release, cross platform use, support iPhone/iPad/Android phone/Android tablet/PC.
Hypermedia learning	Hypermedia integrated arrangement design, text, picture, gallery, audio, video, 3D in one scene immersive learning.
Interactive learning environment	Learning, practicing, and testing are done in one scene, with fun interactive games and the ability to immediately voice, text, photos, markers, notes, and knowledge points to expand to Internet learning at any time.
Socialized learning	Students are not alone in their studies and can initiate discussions and note sharing at any time to share and exchange with fellow teachers and even students studying the same material across the country.
Big data tracks and analyzes learning behavior and academic performance	Each student's learning behavior is recorded in detail, including learning progress and duration, to help instructor carry out teaching analysis and evaluation.

Although some studies have shown that a high percentage of university students still prefer to use printed textbooks [3], it is still necessary to explore the learning effects and student perceptions of cloud-based textbooks due to the technological advances, enhanced and enriched hypermedia materials, as well as teaching strategies and improvements of new-generation e-textbooks.

IV. EMPIRICAL STUDY

The empirical study intends to investigate the effects of cloud-based textbooks as assistive materials on students' academic achievement and preferences in three areas: (1) the impact of cloud-based textbook on students' acquisition of complex skills; (2) students' perceptions and attitudes after

¹ <https://www.mosobooks.cn>

² <https://www.mosoteach.cn>

³ <https://builder.mbook.cc>

using cloud-based materials (3) Group differences in choosing cloud-based textbooks for learning.

The research team conducted a study on the learning effects of cloud-based educational materials provided for free and without considering the price value. This study was conducted with undergraduate students, and it applied self-reported questionnaires and learning data analysis. The research focuses were students' perceptions and learning effects of the cloud-based e-textbook and the population of cloud-based e-textbook users.

A. Course and Participants

This experiment uses a cloud-based textbook from the provider "Mosoink" for the Certified Public Accountant (CPA) tax law course. The specific content is shown in Figure 4.

The course was provided from May to June 2021 (a total of 8 weeks) during the 2nd semester of the 2020-2021 academic year for 160 (57 male and 103 female) sophomore accounting students at South China Agricultural University (in Guangzhou, China)'s Zhujiang College who were an average of 20 years old and lacked online learning experience.

The cloud-based textbook can be downloaded to students' devices with the publisher's app by entering their passwords and accounts. The app also provides them with learning reports after they complete each chapter or section of this textbook's teaching materials. After the teacher explains the usage and functions during class, students can voluntarily install this app and download this textbook.



Fig. 4. Overview of the cloud-based textbook for "CPA Tax law"

Among 160 students, 89 of them (28 male and 61 female) chose to use this textbook.

B. Purpose

- Explore the impact of using cloud-based textbook on student learning outcomes.
- Investigate the characteristics and preferences of students who use the cloud-based textbook, as well as their attitude and perception toward the cloud-based teaching materials.

C. Data Collection and Analysis

Shown in Fig.5., Students' academic achievements (i.e., the results of the final paper-based written exam conducted on July 7 and learning reports) were collected for analysis. The students were also asked to fill out a post-survey questionnaire via web-surveyor⁴ online by July 10. Then, we use SPSS (version 25.0) to complete the t-test and correlation analysis of the collected data (that is, 68 valid responses after removing incomplete and duplicate responses).

This survey focused on 89 students who used the cloud-based textbook. Some did not fill out the survey, did not do so on time, or provided an invalid response. It has only 68 valid responses, and the other 21 students' data was from the LMS linked to the cloud-based learning material.

The students' learning report and quiz results are depicted in Fig. 5. They can use this report to view their total learning time, textbook reading percentage, the quizzes' correction rate, maximum study time, interactive learning, the number of notes and highlights, text reading time, and video watching time.

While this data (Fig. 5) is made available to individual students for personal use, it is simultaneously linked to the LMS platform by using the cloud and also made available to teachers. This has two benefits for instructors. Firstly, it offers teachers an overall picture of their student's study progress, and alerts them to improve their patterns and strategies based on students' overall learning situation. Secondly, it proposes appropriate times to intervene to help students to develop regular study habits. For example, students who do not complete many assignments or earn low test scores during a learning period would be required to have an instructor or tutor remind them to learn more by reading texts and watch videos.

The research team collected data about the students' cloud-based textbook on the LMS in relation to learning duration and maximum learning duration.



Fig. 5. Individual learning report from cloud-based textbook

Table II summarizes the descriptive statistics based on the data collected from the learning reports for the students in

⁴ <https://www.wjx.cn>

the class. The descriptive data analysis results show that 62.37% of students whose final exam results rank in the top 30% of the class use cloud-based textbooks, compared to an average of 51.25% of students in the class and 35.42% of students whose final exam results are in the bottom 30% of the class. This data indicates that students with high final exam results prefer to learn with cloud-based textbooks.

TABLE II. THE DESCRIPTION OF FINAL EXAM RESULT

Final Exam of the semester				
Written Exam Marks		Top 30%	Bottom 30%	Class
with cloud-based textbook		62.37%	35.42%	51.25%
Item	Question Type			
Objective Question	Multiple Choice	14.85	9.53	12.2
	Multi-Select	4.82	1.83	3.2
	True/False	12	9.18	10.56
Subjective Question	Case Study	46	25	35.7
	Average Score	77.67	45.54	61.66

In order to further understand that the effects that the use of cloud-based textbooks have on cognitive and comprehension skills, a comparison was conducted of the scores that students who used this textbook and those who did not use it received for answering each type of question in the final exam.

The difficulty Index in Table III refers to the percentage of students who answered the questions correctly, see Eq (1) below.

$$Difficulty = c \div s \quad \text{Eq. (1)}$$

where c is the number of students who answer a question correctly and s is the total number of students in the class who answered the question. The *difficulty* will be a value between 0.0 and 1.0, where more difficult questions have values closer to 0.0 and easier questions have values closer to 1.0.

TABLE III. ANALYSIS OF THE LEARNING EFFECT OF USING CLOUD-BASED TEXTBOOK ON FINAL EXAM

Types (difficulty index)	With (n=89)	Without (n=71)	t	P
Multiple Choice (0.6097)	12.96±2.92	11.38±3.30	3.206	.002**
Multi-Select (0.32)	3.56±2.22	2.82±2.22	2.107	.037*
True/False (0.704)	10.74±2.17	10.37±2.41	1.027	.306
Case study (0.65)	38.74±7.87	32.51±10.05	4.379	.000**
Total Score (0.613)	66.01±11.65	57.09±14.44	4.312	.000***

*: significant difference found under $p < 0.05$ level
 **: significant difference found under $p < 0.01$ level
 ***: significant difference found under $p < 0.001$ level

Table III lists the t-test result and indicates that there is no significant difference in the received mark for the true/false question types with low difficulty index (0.704) between the students who used the cloud-based textbook for learning and who didn't. On the other hand, for both normal difficulty

question types (i.e., their difficulty index between 0.6 and 0.65) and the difficult question type (i.e., the multi-select question type), students who used the cloud-based textbook have a significantly better learning outcome. This finding is similar to the results found from previous studies [25].

In general, there is a significant difference in performance between students who learn with cloud-based textbook than those who don't, especially in case study that require more comprehension and complex and abstract understanding.

Some researchers have done research on gender differences on the perception toward e-textbooks [26, 27], which is also a focus of this research.

As shown in Fig. 6, descriptive analysis reveals that only 36.84% of male students used cloud-based textbooks to learn, while 59.22% of female students used cloud-based textbooks. This suggests that obvious gender differences in the selection of cloud-based textbook. It is worth noting that this is only a statistical analysis of usage data, not a detailed survey of usage intentions. These data are from the Learning Management System, which is linked to the cloud-based textbook.

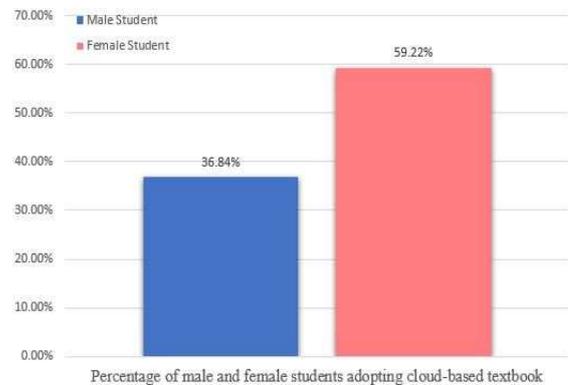


Fig. 6. Percentages of Gender difference in the use of cloud-based textbook

Based on the learning report (Fig. 5), further statistical analysis was conducted on the gender differences in their learning time and reading the percentage of the textbook. The results showed a significant difference because the p value is 0.027^* ($p < 0.05$). Furthermore, the t -value is -2.227 , the Cohen's d as the effect size is 0.368 (< 0.5), which indicates a weak effect size.

Figure 7 is a box-and-whisker plot that analyzes the ratio for students who read the cloud-based textbook. The boxes depict the overall reading ratios for half of the female (orange vertical box) and male (blue horizontal box) students – half of female students read 13% to 34%, while half of the male students read 9% to 42%.

The female students' reading ratio distribution is more concentrated than for the male students because their interquartile range (IQR) is 21%, while the male student's is 33%. Female students have a higher median value for the reading ratio (21%) compared with their male counterparts (17%). Both male and female students' reading ratio distributions are positively skewed: the whisker and half-box are longer above the median. Furthermore, three female students expressed more interest in reading the cloud-based textbook as compared to the other female students: their reading ratio was higher than the upper whisker's maximum of 54%, at 69%, 74%, and 86%.

It needs to be further explained that the learning ratio is not just about reading material or listening to watching

videos, but includes the total amount of completed exercises after completing each exercise. These data are provided to teachers through cloud teaching materials through LMS. If an individual purchases cloud teaching materials without logging in to the LMS, the teacher will not be able to see the report data due to personal privacy protection

Interestingly as sophomores, with an average age of 20 years, adolescent concentration differences between males and females are no longer a significant influencing factor. Possible reasons related to this negative performance would be study motivation, interests and differences in learning habits [28, 29,30].

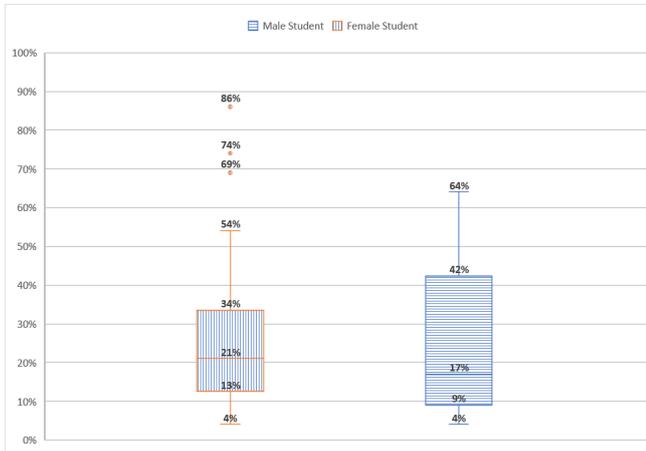


Fig. 7. Gender differences in reading the content of cloud-based textbook

Through the analysis of the 68 valid responses, the research team finds that 72.7% of the students have positive attitude toward the cloud-based textbook and want to get more opportunity to see the use of it in the future (see Fig. 8).

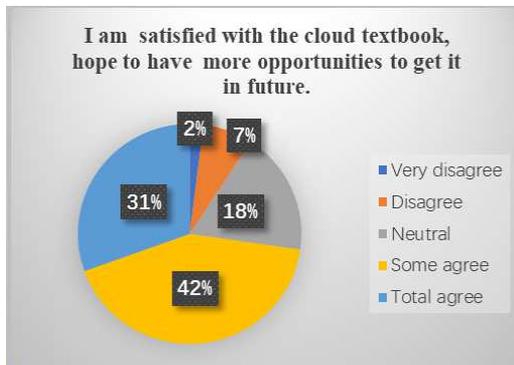


Fig. 8. Perceive of users towards cloud-based textbook

Although 89 students adopted the cloud-based materials, only 68 valid responses were collected via the questionnaire (others invalid answers were removed due to incomplete or blank). Fig. 9 shows that 51.61% (total percentage of both agree plus strongly agreement) of the respondents reacted positively to using the cloud-based textbook. However, only 20.58% (total percentage of both disagree and strongly disagree) of the respondents had a negative attitude towards using the cloud-based textbook and were hesitant about using it in the future. It is also important to note that 27.94% of respondents expressed a neutral opinion of this textbook.

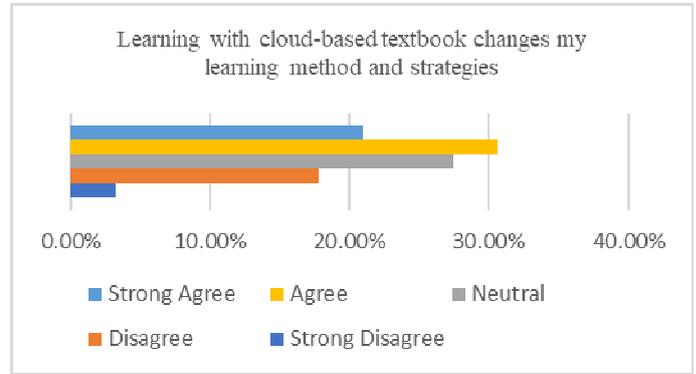


Fig. 9. The attitude towards the use of cloud-based textbook changing my learning method and strategies

V. CONCLUSION

This research focuses on the effectiveness and student perceptions of the use of cloud-based textbooks. Teachers can design interactive instructions based on the course characteristics, or can integrate multimedia and interactive exercises into the textbook. Cloud-based textbooks are no longer just PDFs for students' reading materials or for watching videos and animations. Instead, they have become a new type of textbook based on big data analysis and data fusion. These textbooks can also be used on their own as an e-textbook or embedded into an LMS platform to offer an improved and complete e-learning experience for students.

A. Summary

During this study, the positive impact of cloud-based textbooks on the learning outcome is confirmed and summarized into the following points.

- Students who used the cloud-based textbook earned significantly higher grades (77.67) than the class average (61.66) on the final written exam (Table II).
- Students who used the cloud-based textbook performed significantly better when answering normal to difficult questions that require more sophisticated understanding, calculation ability, and analytical skills (Table III), including multiple choice (difficulty index 0.6097), study cases (difficulty index 0.65), and multi-select (difficulty index 0.32) questions.
- Among the bottom 30% of students who received lower final exam marks, 62.37% of them were using traditional learning materials (i.e., printed textbooks). During this study, students did not need to pay extra fees to use the cloud-based textbook. Therefore, students choose to use a cloud-based textbook or traditional textbook based on their own motivation.
- The usage rate of the cloud-based textbook was higher among female students, i.e., 21 out of 57 (36.84%) male and 61 out of 103 (59.22%) female students who choose to use this textbook (Fig. 6).
- Female students read more of the cloud-based textbook (based on the learning percentage of the textbook) than their counterpart (refer to Fig. 7).

The cloud-based textbook has time gaps and functionality that differ from e-textbooks in earlier research. Therefore, this study's results are different. While Paxhia (2011) found that 75% of students preferred a printed textbook, this research initially had 51.25% students use the cloud-based textbook and only 49.75% students chose the traditional method.

An exciting finding is that an overwhelming percentage (73%) of students are quite satisfied after having used cloud-based e-textbook and are seeking more such e-learning tools. This is because the improved academic performance resulting from these technological innovations in teaching and learning makes them more confident in using these electronic products. Thus, a free trial period under copyright license has an irreplaceable impact on increasing students' willingness to use them in the future.

B. Limitation

This research has several limitations:

The reason why students choose to use cloud-based textbooks is unclear. The research team does not know whether it is because of this textbook's effects or since it increased students' learning motivation.

The numbers of male and female students included in the evaluation were unbalanced due to the accounting department's student population. As a result, this study's sample size for individual gender groups was insufficiently large. Meanwhile, our study is only conducted in the accounting school of an university, and has not yet involved science, technology and engineering (STEM) disciplines.

1. Although many students were willing to continue using the cloud-based textbook after their initial experience, a significant number of students remained undecided (i.e., 27.94% of respondents (among 68 valid responses). Moreover, when considering the 20.58% of the respondents (i.e., 14 out of 68 valid responses) who expressed a negative attitude towards the cloud-based textbook, then 92 (57.5%, i.e., 78 students who used the traditional method as well as 14 who ultimately had a negative attitude) students preferred the traditional learning method. In this circumstance, it would be extremely important to investigate the reasons why some students declined to express their opinion as well as consider ways of improving the cloud-based textbook to enhance its usefulness for students.
2. The research used a self-reporting questionnaire. As a result, it cannot be ruled out that some students would consider what their teacher thought and provide positive comments and opinions. However, this may not happen if students have to pay an additional fee to use a cloud-based textbook.

C. Future Work

There are several issues that need to be explored further in depth in the future.

1. Would students who perform better academically by earning higher final exam marks and better overall course grades become motivated to learn more and prefer to choose new technology and tools they are capable of using if these can improve their learning? Or is it just because the cloud-based textbook provides certain functions and features that inspire students to acquire knowledge while increasing their learning motivation and self-regulation?
2. Gender differences related to the use of cloud-based textbooks must be further studied. Why are male students reluctant to use these textbooks as compared with their female counterparts? Is it because of a lack of motivation or other factors? If so, how is it possible

to improve the cloud-based textbook or instruction strategies to convince male students to choose it?

3. It is also necessary to further investigate how to help and communicate with teachers to create and use interactive cloud-based textbooks. How to conduct teacher training, help them to obtain all of their essential equipment, and expand their knowledge of pedagogical technology analysis.

This research offers three key contributions for pedagogical innovation technology.

The first is a complete introduction of new-generation cloud-based e-textbooks focused on its functional features that include a contextualized reading experience with hyperlinks, multimedia audio/visuals, and usage information for big data analysis. This textbook is an innovative teaching tool that ranges from a simple web-based e-textbook to a cloud-based service e-book that enables multi-device data sharing and instant data analysis. At the same time, teachers can write new-generation e-books (e.g., cloud-based textbooks) that authorize them to edit and write their chapters and sections as well as collaborate with suppliers to publish them. In addition, innovative tools can help teachers design their lesson and educational programs to increase their flexibility and convenience.

Second, the present study shows that e-textbook usage has many possibilities in higher education. This confirms the learning effects of students who used the cloud-based textbook. Although only nearly half of the students chose cloud-based materials, an instant data analysis of quizzes indicated that 73% of those who used cloud-based materials for reading and online multimedia learning were willing to use more of these new generation e-books in the future, while nearly 50% of students believed that e-books changed their learning patterns. This is very positive feedback that shows the importance of students trying to use cloud-based textbooks. Regardless of whether students like these textbooks, they could change their attitude and perception by using them to enhance their academic achievement.

Third, research shows that differences in gender and academic achievement lead to differences in usage and selection of the cloud-based textbook. This 8-week pilot study showed that an overwhelming percentage of male students still did not intend to use cloud-based learning materials. Moreover, female students used the cloud-based textbook more frequently than their male counterparts in terms of the average amount of time spent to read and complete its content. This prompts the question of how to increase male students' interest in using the cloud-based textbook while enhancing their focus on learning. The next step towards achieving this goal is to develop a game reward mechanism that is embedded in the cloud-based textbook.

It is believed that the gamified contextual and animated environments stimulate all students' motivation on using the cloud-based textbook and doing more learning activities [31, 32, 33]. In the future, the content of cloud teaching materials will be further enriched (e.g., adding game plug-ins, more rewards and stimulation, etc.), and further research will be done. Further research will be implemented, which focus on the acceptance and perception of cloud-based textbook by students of different types of higher education schools in future.

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