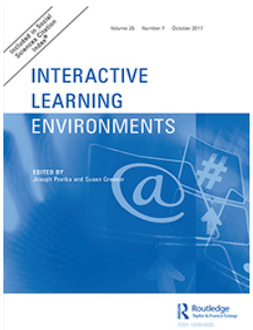

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Effects of concept-mapping-based interactive e-books on active and reflective-style students' learning performances in junior high school law courses

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ABSTRACT

Researchers have pointed out that interactive e-books have rich content and interactive features which can promote students' learning interest. However, researchers have also indicated the need to integrate effective learning supports or tools to help students organize what they have learned so as to increase their learning performance, in particular, for abstract and complex learning content such as that in law courses. In this study, a concept-mapping-based interactive e-book learning mode was proposed. To understand the learning effects, a quasi-experimental design was used to compare the learning achievement and motivation of the students learning with the proposed approach (experimental group) and those learning with conventional interactive e-books (control group) in a junior high school fundamental law course. Meanwhile, the learning achievement and motivation of the students with different learning styles were also explored. The experimental results showed that the proposed approach significantly improved the students' learning achievement, especially for the active-style students; moreover, it was found that the lead-in of concept mapping did not affect the students' learning motivation. Factors that might affect the students' learning achievement and motivation with the concept-mapping-based interactive e-book approach are discussed accordingly.

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Interactive e-book; concept mapping; learning styles; law courses; mobile learning

Introduction

Researchers have pointed out that students are generally less involved in traditional teacher-centered instructional approaches than in student-centered learning (Lai & Hwang, 2014, 2015; Pivec, 2007). In recent years, due to the increasing popularity of mobile devices such as smartphones and tablet computers, interactive e-books are becoming a well-accepted form of learning material (Woody, Daniel, & Baker, 2010). Previous studies have reported that interactive e-books can provide several features that traditional textbooks do not offer, including recording, taking photos and various interactive functions which are helpful for increasing students' attention and motivation during the learning process (Reiber, 1991; Shade, 1994; Shih, Chen, Cheng, Chen, & Chen, 2013). Besides, the way of presenting multimedia-teaching materials in e-books, including pictures and video, can significantly improve students' reading comprehension (Ertem, 2010; Lai & Chang, 2011).

Researchers have, however, pointed out the need to integrate effective educational theories or models in the development of digital learning systems and materials. They have indicated that, without providing proper scaffoldings or learning support, students' learning achievement could

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not be improved, no matter what kind of technologies are adopted (Lai & Hwang, 2015). In particular, for those abstract learning contents with complex knowledge structure, it is necessary to provide learning supports or tools to help students organize their knowledge in the student-centered learning process. Among the existing school curriculums, the terminology and knowledge of law are perceived by many students as being boring and as having abstract learning content with a complex structure (Boyle, 2002). While dealing with such learning content, traditional teaching could only offer limited help. That is, students usually have difficulty understanding the law concepts and structure, not to mention developing the competence of applying the knowledge to daily life applications.

Concept mapping is a learning approach that assists students in organizing what they have learned by representing their prior and new knowledge in a graph with concepts as nodes, and relationships between concepts as links connecting the nodes (Hwang, Wang, & Lai, 2015; Pankratius, 1990; Ruiz-Primo, Schultz, Li, & Shavelson, 2001). It is an effective knowledge construction tool for helping students enhance their metacognition (Hwang, Wu, & Kuo, 2013; Novak, Gowin, & Johansen, 1983). However, several studies have pointed out the challenges of applying concept mapping to existing curriculums; for example, Charsky and Ressler (2011) warned that, without careful learning design, embedding concept maps into learning content might be an interference rather than a support to students during the learning process. In addition, researchers have indicated that learning style might play an important role in digital learning content design. Korat and Shamir (2012) further pointed out the importance of considering students' learning styles when developing e-book content.

Considering the above, in this study, the influence of students' learning styles on their learning performance is explored. Based on the needs of the course, two learning styles, active and reflective styles, were taken into consideration in this study. Active-style learners tend to operate and experience learning by themselves, while reflective-style learners tend to think thoroughly and explore repeatedly. Therefore, it was expected that the experimental results would not only demonstrate the strategy of employing concept mapping in e-book-based learning and evaluate its effectiveness, but would also provide a reference for researchers and teachers who intend to help students with different learning styles learn better in the digital era.

Literature review

Interactive electronic books

Since the first appearance of e-books, there has been no specific definition of the term. Some scholars state that e-books only digitalize the content in books and allow readers to read electronically (Hawkins, 2000). Littman and Connaway (2004) defined e-books as a book or a series of books that are published electronically to enable readers to read the learning content via difference digital devices, such as tablets or computers. Through the advancement of computer technology, there are more and more devices that can be used as e-book readers, such as smartphones and tablet computers (Kang, Wang, & Lin, 2009).

Meanwhile, owing to the advancement of multimedia and wireless communication technologies, the content of e-books is becoming increasingly diverse. Nowadays, an e-book might contain text, pictures, images, videos, web links and even various interactive functions such as those that allow learners to click on text, pictures and videos to derive additional information, or to jump to another e-book page, functions that enable learners to take notes, record and search for information on the Internet, as well as those that enable learners to answer or respond to the questions presented in e-books. This leads to new aspects of e-books; that is, they not only provide learning content as defined for traditional e-books, but also enable interaction between learning content and learners. Thus, the term "interactive e-books" has been adopted to emphasize the provision of interactive functions in e-books, such as annotation, highlighting, bookmarks, searching and assessment (Huang, Liang, Su, & Chen, 2012).

Mana, Mich, De Angeli, and Druin (2013) further indicated that an interactive e-book not only presents learning content in diverse and interesting forms, but also plays the role of a learning facilitator by embedding the teaching strategies within the learning content. Researchers have also reported that, in different courses, an interactive e-book can bring diverse learning experiences. For example, in geography courses, the functions of Google Earth have been embedded in an interactive e-book, and in natural science courses, interactive animation has been incorporated for students to explore (Mana et al., 2013; Shih et al., 2013).

Although e-books have become a widely adopted form of learning content, few studies have been conducted to investigate how to effectively integrate teaching strategies and learning materials, not to mention the evaluation of the impacts of interactive e-books on students with different learning styles. Some previous studies have pointed out that, without careful design, students' learning processes could be interrupted owing to the use of improper interactive functions (Trushell & Maitland, 2005). Therefore, in this study, an interactive e-book development approach is proposed and evaluated to show how concept mapping can be effectively integrated into e-book content; moreover, the impacts of the proposed approach on the learning achievement and motivation of the students with different learning styles are evaluated as well.

Concept mapping

Concept mapping is a tool for representing visualized knowledge proposed by a research team in Cornell University. Scholars have recognized the process of developing concept maps, that is, concept mapping, as an effective teaching strategy for helping students organize and present conceptual knowledge using their spatial visualization ability to promote learning (Gurlitt & Renkl, 2010; Ruiz-Primo et al., 2001). Concept mapping plays the role of helping students connect their existing concepts and newly gained knowledge by visualizing the relationships between the old and new concepts, and hence engages students in meaningful learning (Novak & Musonda, 1991; Rebich & Gautier, 2005).

Novak (2002) pointed out that concept mapping used in science teaching has been seen as a knowledge construction tool to help students and experts find the connection between events, promote creative thinking, and reinforce students' knowledge structure. It has also been seen as an effective learning tool that can improve students' memorization and comprehension during the learning process (Pankratius, 1990; Ruiz-Primo et al., 2001). It is also a learning tool that enables students to clarify the connections between concepts (Özmen, Demİrcİoğlu, & Coll, 2009; Wang, Cheung, Lee, & Kwok, 2008; Zwaal & Otting, 2012) and improve their knowledge retention via the process of identifying and presenting the relationships between concepts (Patrick, 2011). For example, in the research conducted by Hwang, Yang, and Wang (2013), concept maps were embedded in a digital game in natural science courses. They found that, with the approach, not only did students' learning achievement increase, but their cognitive load was also reduced, proving that it is beneficial for students to connect what is learned to their prior knowledge.

Concept mapping can also serve as a stage for assessing students' knowledge structure (Moreno, Kota, Schoohs, & Whitehill, 2013). Teachers can ask students to develop concept maps based on a specified topic, and then examine the correctness and completeness of the concept maps developed by the students (Wehry, Monroe-Ossi, Cobb, & Fountain, 2012), allowing the teacher to identify students' incorrect concepts and correct them accordingly.

Liu and Lee (2013) applied a concept-mapping system to the learning activity of a biology course. The experimental results found that concept mapping could promote the students' learning motivation, delivery skills and learning attitudes. They also noted that if teachers do not understand students' knowledge construction processes, they would not be able to objectively assess their learning performance or give them concrete suggestions. This implies the importance of properly employing concept mapping in assessment and for the provision of feedback. It also reveals that the success of using the concept-mapping approach is not obvious. In fact, it is challenging to

properly integrate concept mapping with other learning strategies or tools (Hwang, Wu, & Ke, 2011). For example, Charsky and Ressler (2011) attempted to facilitate game-based learning with concept mapping, but it resulted in a decrease in the students' learning motivation and learning performance. The students indicated that developing concept mapping interrupted the gaming process, and so was perceived as an interference rather than as a learning support. Therefore, it can be inferred that different learning contents should coordinate with suitable learning strategies and technology-assisted approaches to generate the expected learning effects.

From the literature review above, it can be known that using concept mapping in school settings can help students build a complete and thorough knowledge structure. However, the use of the concept-mapping approach needs to be carefully designed; otherwise, it could become an interference in learning.

Learning styles

Keefe (1979, p. 1) defined learning styles as "the composite of characteristic cognitive, affective, and physiological factors" which can be perceived as stable indicators of explaining how individual learners see and interact with the learning environment. That is, learning styles represent learners' preferences or consistent behaviors in dealing with information or learning content during the learning process. Educators have proposed various learning styles to represent and investigate learners' information-processing features and behaviors from different aspects. For example, Kolb (1984) defined the accommodating, diverging, converging and assimilating learning styles, which are the combinations of the informing processing preferences for doing (Active Experimentation – AE), watching (Reflective Observation – RO), feeling (Concrete Experience – CE) and thinking (Abstract Conceptualization – AC). More specifically, the four learning styles can be determined by CE+AE, CE+RO, AC+AE and AC+RO, respectively.

Later, Felder and Silverman (1988) proposed learning styles from different perspectives, that is, sensing/intuitive, visual/verbal, active/reflective and sequential/global. Sensing-style learners tend to be concrete thinkers; they are practical and prefer to learn via facts and procedures. Intuitive-style learners tend to be abstract thinkers; they are innovative and prefer to learn with theories and underlying meanings. Visual-style learners prefer visual representations of learning material, while verbal-style learners prefer written or spoken content. Active-style learners prefer to learn by trying or doing, and enjoy learning in groups, while reflective-style learners tend to learn by thinking in depth, and prefer to learn alone. Sequential-style learners learn according to a linear thinking process with small incremental steps, while global-style learners learn according to a holistic thinking process with large leaps.

In the past decades, many previous studies have reported the effectiveness of considering learning styles in developing learning content and systems (Brown, Cristea, Stewart, & Brailsford, 2005; Chen & Chiou, 2014). For example, in the study reported by Hwang, Sung, Hung, and Huang (2013), an adaptive learning system was developed by taking sequential and global learning styles into account. By conducting an experiment, they found that the students learning with the learning style-fit approach showed significantly better learning achievement than those learning with the non-fit design. They thus concluded the potential of taking learning styles into consideration in system design.

Among various learning styles, the active/reflective style proposed by Felder and Silverman (1988) was adopted in this study. As active-style learners tend to learn by trying or doing, they might have less experience in organizing learning content than the reflective-style learners who tend to learn by thinking in depth. Therefore, it was predicted that the lead-in of concept mapping might have different effects on the students with these two styles.

Development of the e-book system based on fill-in-the-blank concept mapping

In this study, the interactive e-book system was implemented using SimMagic, a development environment published by Hama Star Company. Figure 1 shows the structure of the e-book system,

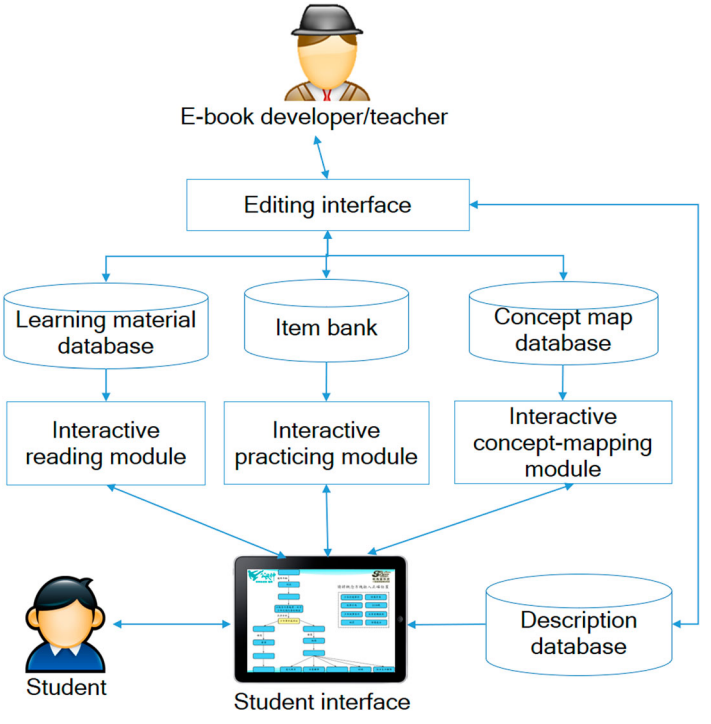

Figure 1. System structure of concept-mapping-based interactive e-books.

which consists of a student interface, an editing interface, a learning materials database, an item bank, a concept-map database, a descriptive file database and several interactive modules. When students attempt to read an e-book, the relevant descriptive file is interpreted by the student interface, and relevant interactive modules are invoked. The interactive reading module responds to the statements for presenting the learning materials in the form of text, images, videos or links, which could be a "redirection" command to jump to another e-book page or a web address. The interactive practicing module presents various types of test items, such as multiple-choice questions, fill-in-the-blank questions and matching questions. The interactive concept-mapping module presents fill-in-the-blank concepts to students and provides them with hints when they try to complete the concept maps.

There are seven units in the law course. For each unit, students need to read relevant learning materials and do practice by answering a set of test items. Figure 2 shows two pages of learning materials. The one on the left shows several links (i.e. the "+") for accessing supplementary materials; the one on the right shows the e-book page with an annotation.

Figure 3 shows illustrative examples of a fill-in-the-blank (left) and multiple answer (right) items. For the fill-in-the-blank items, students need to move the candidate answers to the correct blanks. For the multiple answer items, they need to point out all of the correct answers.

After finishing reading and practicing, the students were asked to complete a concept map by moving the candidate concepts or relationships to the blank area of the concept map, as shown in Figure 4.

Research design

Participants

A total of 71 eighth graders from two classes of a junior high school in northern Taiwan participated in this study. The average age of the participants was 14 years. One class was assigned to be the

Figure 2. Illustration of learning materials in the e-book.

Figure 3. Interface of the fill-in-the-blank and multiple answer items.

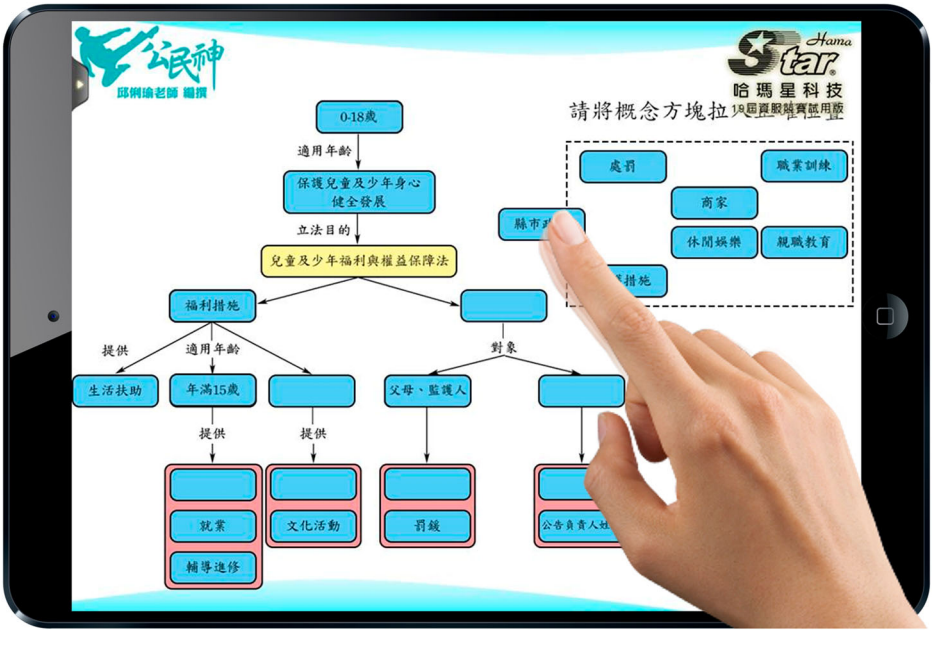

Figure 4. Interface of concept mapping in the interactive e-book.

experimental group (17 males and 18 females), while the other class was the control group (19 males and 17 females). The students in both groups were instructed by the same teacher who had more than 15 years' experience of teaching Social Studies courses.

Measuring tools

The pre-test was used to evaluate the students' basic knowledge of law before the experiment. It consisted of 20 multiple-choice items with a perfect score of 100. The learning achievement post-test consisted of 10 yes-or-no items (20%), 20 multiple-choice items (40%), 5 fill-in-the-blank items (10%), and 3 essay question items (30%), with a perfect score of 100. The tests were developed by an experienced teacher according to the curriculum outline and learning objectives of the social studies course.

The learning motivation questionnaire was modified from the measure developed by Hwang, Yang, et al. (2013). It consisted of seven items with a five-point Likert rating scheme. A higher score means higher learning motivation for the law course. The Cronbach's α value of the questionnaire was 0.87.

The learning style measure adopted in this study originated from the Index of Learning Styles (ILS) Questionnaire, developed by Soloman and Felder (2001) based on the learning styles theory proposed by Felder and Silverman (1988). The original ILS consisted of four dimensions, each of which contained 44 items. According to the needs of this study, only the 11 items of the "active/reflective" dimension were selected. Active-style learners prefer to learn by trying or doing, implying that they might not be able to organize knowledge and learning experience on their own; on the other hand, reflective-style learners tend to learn by thinking in depth, meaning that they might have better ability in interpreting and organizing what they have learned. Therefore, comparing the impacts of concept mapping on the learning performances of the students with these two styles is meaningful and important. Each item in the "active/reflective" dimension had two options: "a" means "inclining to the active-style," while "b" means "inclining to the reflective style." Felder and Spurlin (2005) reported that the internal consistency of the Active-Reflective dimension of the ILS questionnaire was 0.63.

Experimental procedure

The experimental procedure is presented in Figure 5. In the first week, the students were instructed with the basic knowledge of law for 100 minutes. They then took the pre-test as well as completing the learning motivation and learning-style questionnaires.

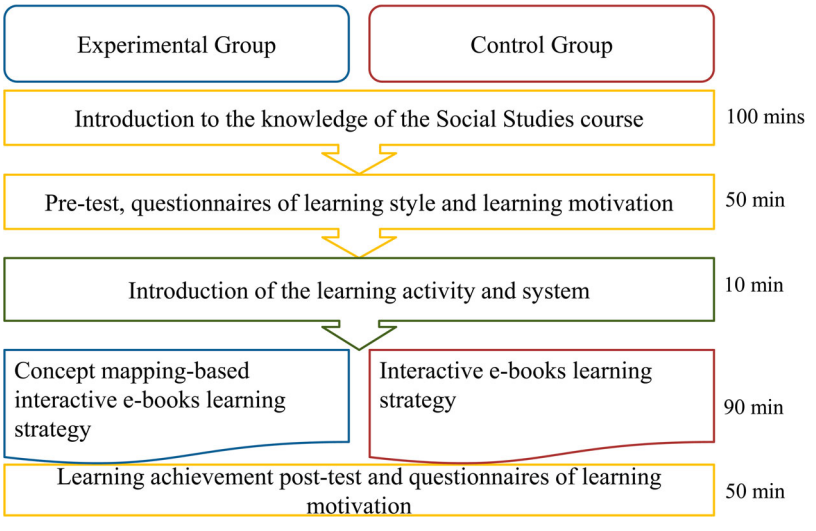

Figure 5. Experimental procedure of the experiment.

In the second week, the students learned the advanced law concepts after receiving a 10-minute orientation. The experimental group then learned with the concept-mapping-based interactive e-book while the control group learned with the conventional interactive e-book for 90 minutes. The learning materials in the two versions of the interactive e-book were identical. The only difference was that the learning sheets for the experimental group were presented in the form of fill-in-the-blank concept maps, while those for the control group were in the form of a list of learning task statements.

After the learning activity, all of the students took the post-test and the post-questionnaire of learning motivation.

Results

Learning achievements of the students with different learning styles

A two-way ANCOVA was employed using the pre-test scores of learning achievement as a covariate and the post-test scores of learning achievement as the dependent variable. In order to meet the basic assumption of ANCOVA, Levene's test of homogeneity of variance was employed and no violation was found with $F = 1.230$ ($p = .306 > .05$).

As shown in Table 1, a significant difference was found for the interaction between learning strategies and learning styles ($F = 4.73$, $p = .033 < 0.05$, *Partial* $\eta^2 = 0.067$), and hence a simple main-effect analysis was performed.

By employing the simple main-effect analysis, correlational effects between learning styles and learning strategies in different situations were found, as shown in Table 2, while the descriptive statistics of the two groups' learning achievements are reported in Table 3. A significant difference in the interactive e-book learning strategy ($F = 10.11$, $p = .003 < .01$) showed that, in the control group, the students with a reflective learning style (Mean = 69.22) performed significantly better than those with an active learning style (Mean = 53.35) in terms of learning achievement. In addition, a significant difference was also observed for the active learning style ($F = 21.06$, $p = .000 < .001$), meaning that the students with an active learning style (Mean = 70.14) in the experimental group performed better than those (Mean = 53.35) in the control group.

Table 1. Results of two-way ANCOVA analysis on the learning achievement of the two groups of students with different learning styles.

Source	SS	df	MS	*F*	*p*	Partial η^2
Covariance	8829.52	1	8829.52	62.09***	.000	0.485
Learning strategies	1686.79	1	1686.79	11.86**	.001	0.152
Learning styles	1160.37	1	1160.37	8.16**	.006	0.110
Strategies × Styles	673.07	1	673.07	4.73*	.033	0.067
Error	9385.84	66	142.21			

Note: $R^2 = 0.625$ (Adjusted $R^2 = 0.602$).
*$p < .05$.
**$p < .01$.
***$p < .001$.

Table 2. The simple main-effect analysis of students' learning achievement.

Variables	SS	df	MS	*F*	*p*
Learning strategies					
Concept mapping-based e-books	300.13	1	300.13	1.25	.271
Interactive e-books	3083.44	1	3083.44	10.11**	.003
Learning styles					
Reflective style	725.21	1	725.21	2.2	.148
Active style	4746.05	1	4746.05	21.06***	.000
Error	9385.84	66	142.21		

**$p < .01$.
***$p < .001$.

Table 3. The descriptive data of the learning achievement post-test.

	Independent variables				
Dependent variable	Learning strategies	Learning styles	Mean	SD	*N*
Learning achievement post-test	Concept-mapping-based interactive e-books learning strategy	Reflective	72.26	3.50	20
		Active	70.14	2.44	15
	Interactive e-books learning strategy	Reflective	68.22	2.67	12
		Active	53.35	3.14	24

As shown in Figure 6, interaction was found between learning strategies and learning styles on learning achievement. It was observed that, compared to the interactive e-book learning strategy, it is more beneficial for the students with an active learning style to use the concept-mapping-based interactive e-book learning strategy.

Learning motivation

The two-way ANCOVA was also invoked to analyze the post-questionnaire learning motivation ratings of the active-style and reflective-style students who learned with the two e-book approaches by excluding the effect of the pre-questionnaire ratings. As shown in Table 4, no significant difference was found either in the interaction between learning strategies and learning styles ($F = 1.04$, $p = .311$, *Partial* $\eta^2 = .016$), or in the individual factors. This suggests that the use of different e-book approaches (with or without concept mapping) did not affect the learning motivation of the students with both learning styles.

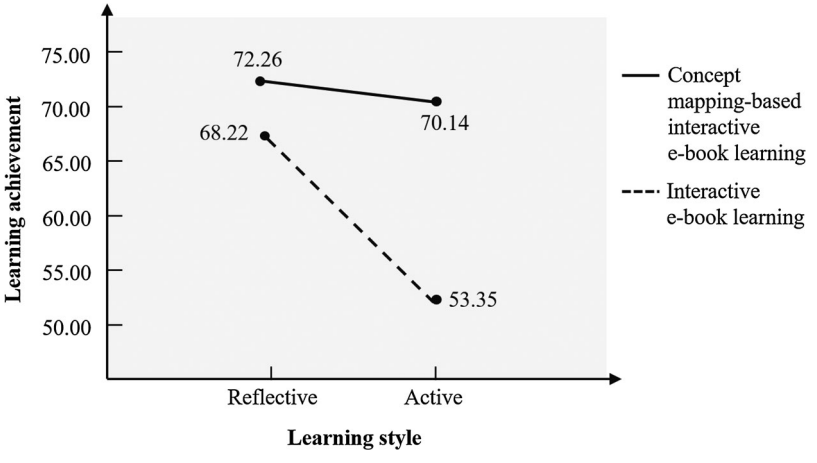

Figure 6. Interaction between the learning strategies and learning styles on the two groups' learning achievements.

Table 4. Results of two-way ANCOVA analysis on the learning motivation of the two groups of students with different learning styles.

Source	SS	df	MS	*F*	*p*	Partial η^2
Learning strategies	.001	1	.001	0.003	.956	0.000
Learning styles	.068	1	.068	0.302	.585	0.005
Strategies × Styles	.236	1	.236	1.042	.311	0.016
Error	14.927	66	.226			

Note: $R^2 = 0.528$ (Adjusted $R^2 = 0.499$).

Discussion and conclusions

In this study, a concept-mapping-based interactive e-book system was developed, and an experiment was conducted to explore its impacts on students' learning achievement and motivation in law courses. Such a result is similar to the findings of Hwang, Yang, et al. (2013), who implemented concept mapping in natural science digital-game-based learning, and reported that the students' learning achievement was significantly improved. In terms of learning motivation, no difference was found between the students who learned with the two e-book strategies and those with different learning styles. It is inferred that the effects of concept mapping are mainly on the students' learning achievement rather than on their learning motivation. In addition, all of the students showed a high level of interest in using the e-book to learn, no matter whether the concept-mapping strategy was employed or not. This suggests that presenting learning content in interactive e-book form could be an effective way of promoting students' learning motivation.

In addition, the interaction between the e-book approach and the students' learning styles was investigated as well. The experimental results showed that there was a significant interaction between the e-book approaches and learning styles on the students' learning achievement, while no difference was found in terms of their learning motivation. Furthermore, when using the concept-mapping-based interactive e-book learning strategy, students with both active learning style and reflective learning style performed better than those using the interactive e-book learning strategy. It is inferred that, to deal with the knowledge with a complex structure, students' learning achievement can generally be promoted with the help of concept mapping, which enables them to see the whole structure of the learning content. Moreover, the approach would benefit students more if their personal factors, such as learning styles, knowledge levels or preferences, could be taken into account.

Furthermore, for active-style students, it was found that the concept-mapping-based interactive e-book learning strategy was more beneficial than the conventional interactive e-book learning strategy in terms of learning achievement. On the other hand, for the reflective-style students, there was no significant difference between their learning achievements when using the two learning strategies. That is, the concept-mapping-based interactive e-book learning strategy benefited the active style more than the reflective-style students. Based on the definition of learning styles by Felder and Silverman (1988), active-style students prefer to learn via operating and experiencing instead of thinking and organizing information. This implies that they may lack experience and the ability to organize what they are learning. Therefore, it is inferred that the provision of knowledge construction tools or strategies such as concept mapping could help them to organize the derived information in an interactive process, which not only supplements their lack of knowledge organizing experience, but also matches their preference for learning via operating and experiencing. On the contrary, reflective-style students tend to think through the whole process and learn independently by exploring the new information; that is, they could be experienced in organizing knowledge by themselves. Therefore, the provision of knowledge construction tools or strategies could be less helpful to them.

As there are different dimensions of perceiving students' learning styles, such as global or sequential styles, it is worth investigating the effects of different e-book learning strategies on students with other learning styles based on the features of the learning strategies or tools adopted. For example, e-books could be designed to present learning content in a sequential order or in a knowledge map structure providing direct links to every part of the learning content. Different e-book content designs could benefit students with different learning styles, highlighting the possibility of conducting further studies in the future.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

Boyle, R. (2002). Presenting a new instructional tool for teaching law-related courses: A contract activity package for motivated and independent learners. *Gonzaga Law Review*, *38*, 1–31.

Brown, E., Cristea, A., Stewart, C., & Brailsford, T. (2005). Patterns in authoring of adaptive educational hypermedia: A taxonomy of learning styles. *Educational Technology & Society*, *8*(3), 77–90.

Charsky, D., & Ressler, W. (2011). "Games are made for fun": Lessons on the effects of concept maps in the classroom use of computer games. *Computers & Education*, *56*(3), 604–615.

Chen, B. H., & Chiou, H. H. (2014). Learning style, sense of community and learning effectiveness in hybrid learning environment. *Interactive Learning Environments*, *22*(4), 485–496.

Ertem, I. S. (2010). The effect of electronic storybooks on struggling fourth-graders' reading comprehension. *Turkish Online Journal of Educational Technology-TOJET*, *9*(4), 140–155.

Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Journal of Engineering Education*, *78*(7), 674–681.

Felder, R. M., & Spurlin, J. (2005). Applications, reliability and validity of the index of learning styles. *International Journal of Engineering Education*, *21*(1), 103–112.

Gurlitt, J., & Renkl, A. (2010). Prior knowledge activation: How different concept mapping tasks lead to substantial differences in cognitive processes, learning outcomes, and perceived self-efficacy. *Instructional Science*, *38*(4), 417–433.

Hawkins, D. T. (2000). Electronic books: A major publishing revolution. Part 1. General considerations and issues. *Online*, *24*(4), 14–28.

Huang, Y. M., Liang, T. H., Su, Y. N., & Chen, N. S. (2012). Empowering personalized learning with an interactive e-book learning system for elementary school students. *Educational Technology Research and Development*, *60*(4), 703–722.

Hwang, G. J., Wu, C. H., Kuo, F. R. (2013). Effects of touch technology-based concept mapping on students' learning attitudes and perceptions. *Educational Technology & Society*, *16*(3), 274–285.

Hwang, G. J., Sung, H. Y., Hung, C. M., & Huang, I. (2013). A learning style perspective to investigate the necessity of developing adaptive learning systems. *Educational Technology & Society*, *16*(2), 188–197.

Hwang, G. J., Wang, S. Y., & Lai, C. L. (2015). Seamless flipped learning- a mobile technology-enhanced flipped classroom with effective learning strategies. *Journal of Computers in Education*, *2*(4), 449–473.

Hwang, G. J., Wu, P. H., & Ke, H. R. (2011). An interactive concept map approach to supporting mobile learning activities for natural science courses. *Computers & Education*, *57*(4), 2272–2280.

Hwang, G. J., Yang, L. H., & Wang, S. Y. (2013). A concept map-embedded educational computer game for improving students' learning performance in natural science courses. *Computers & Education*, *69*, 121–130.

Kang, Y. Y., Wang, M. J. J., & Lin, R. (2009). Usability evaluation of e-books. *Displays*, *30*(2), 49–52.

Keefe, J. W. (1979). Learning style: An overview. In *NASSP's student learning styles: Diagnosis and proscribing programs* (pp. 1–17). Reston, VA: National Association of Secondary School Principles.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.

Korat, O., & Shamir, A. (2012). Direct and indirect teaching: Using e-books for supporting vocabulary, word reading, and story comprehension for young children. *Journal of Educational Computing Research*, *46*(2), 135–152.

Lai, C. L., & Hwang, G. J. (2014). Effects of mobile learning time on students' conception of collaboration, communication, complex problemsolving, metacognitive awareness and creativity. *International Journal of Mobile Learning and Organisation*, *8*(3–4), 276–291.

Lai, C. L., & Hwang, G. J. (2015). High school teachers' perspectives on applying different mobile learning strategies to science courses: The national mobile learning program in Taiwan. *International Journal of Mobile Learning and Organisation*, *9*(2), 124–145.
Lai, J. Y., & Chang, C. Y. (2011). User attitudes toward dedicated e-book readers for reading: The effects of convenience, compatibility and media richness. *Online Information Review*, *35*(4), 558–580.
Littman, J., & Connaway, L. S. (2004). A circulation analysis of print books and e-books in on academic research library. *Library Resources and Technical Services*, *48*(4), 256–262.
Liu, S. H., & Lee, G. G. (2013). Using a concept map knowledge management system to enhance the learning of biology. *Computers & Education*, *68*, 105–116.
Mana, N., Mich, O., De Angeli, A., & Druin, A. (2013, June). *Interactive e-books for children*. Paper presented at the proceedings of the 12th international conference on interaction design and children (pp. 593–595). New York, NY: ACM.
Moreno, M. A., Kota, R., Schoohs, S., & Whitehill, J. M. (2013). The Facebook influence model: A concept mapping approach. *Cyberpsychology, Behavior, and Social Networking*, *16*(7), 504–511.
Novak, J. D. (2002). Meaningful learning: The essential factor for conceptual change in limited or inappropriate propositional hierarchies leading to empowerment of learners. *Science Education*, *86*(4), 548–571.
Novak, J. D., Gowin, D. B., & Johansen, G. T. (1983). The use of concept mapping and knowledge vee mapping with junior high school science students. *Science Education*, *67*(5), 625–645.
Novak, J. D., & Musonda, D. (1991). A twelve-year longitudinal study of science concept learning. *American Educational Research Journal*, *28*(1), 117–153.
Özmen, H., DemİrcİoĞlu, G., & Coll, R. K. (2009). A comparative study of the effects of a concept mapping enhanced laboratory experience on Turkish high school students' understanding of acid-base chemistry. *International Journal of Science and Mathematics Education*, *7*(1), 1–24.
Pankratius, W. J. (1990). Building an organized knowledge base: Concept mapping and achievement in secondary school physics. *Journal of Research in Science Teaching*, *27*(4), 315–333.
Patrick, A. O. (2011). Concept mapping as a study skill: Effects on students achievement in biology. *International Journal of Educational Sciences*, *3*(1), 49–57.
Pivec, M. (2007). Editorial: Play and learn: potentials of game-based learning. *British Journal of Educational Technology*, *38* (3), 387–393.
Rebich, S., & Gautier, C. (2005). Concept mapping to reveal prior knowledge and conceptual change in a mock summit course on global climate change. *Journal of Geoscience Education*, *53*(4), 355–365.
Reiber, L. P. (1991). Animation, incidental learning, and continuing motivation. *Journal of Educational Psychology*, *83*(3), 318–328.
Ruiz-Primo, M. A., Schultz, S. E., Li, M., & Shavelson, R. J. (2001). Comparison of the reliability and validity of scores from two concept-mapping techniques. *Journal of Research in Science Teaching*, *38*(2), 260–278.
Shade, D. D. (1994). Computer and young children: Software types, social contexts, gender, age, and emotional responses. *Journal of Computing in Childhood Education*, *5*(2), 177–209.
Shih, B. Y., Chen, T. H., Cheng, M. H., Chen, C. Y., & Chen, B. W. (2013). How to manipulate interactive E-book on learning natural catastrophe – An example of structural mechanics using power machine. *Natural Hazards*, *65*(3), 1637–1652.
Soloman, B. A., & Felder, R. M. (2001). *Index of learning styles questionnaire*. Retrieved August 4, 2013, from the North Carolina State University. http://www.engr.ncsu.edu/learningstyles/ilsweb.html
Trushell, J., & Maitland, A. (2005). Primary pupils' recall of interactive storybooks on CD-ROM: Inconsiderate interactive features and forgetting. *British Journal of Educational Technology*, *36*(1), 57–66.
Wang, W. M., Cheung, C. F., Lee, W. B., & Kwok, S. K. (2008). Self-associated concept mapping for representation, elicitation and inference of knowledge. *Knowledge-Based Systems*, *21*(1), 52–61.
Wehry, S., Monroe-Ossi, H., Cobb, S., & Fountain, C. (2012). Concept mapping strategies: Content, tools and assessment for human geography. *Journal of Geography*, *111*(3), 83–92.
Woody, W. D., Daniel, D. B., & Baker, C. A. (2010). E-books or textbooks: Students prefer textbooks. *Computers & Education*, *55*(3), 945–948.
Zwaal, W., & Otting, H. (2012). The impact of concept mapping on the process of problem-based learning. *Interdisciplinary Journal of Problem-Based Learning*, *6*(1), 7. https://doi.org/10.7771/1541-5015.1314