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E-book of metacognitive learning strategies: design and implementation to activate student's self-regulation

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Abstract

ICT-based learning provides opportunities for teachers and students to learn digitally, as well as letting the students become autonomous learners. One of the efforts to actualize such typical learning mode is to provide digitalized learning media, such as e-Books. An e-Book of metacognitive learning strategies aimed to train students' metacognitive skills that emphasized self-regulated learning in order to make them become autonomous learners. This study was objected to describe the e-Book of metacognitive learning strategies in designing, implementing, and evaluating students' metacognitive skills in a learning process. The e-Book was designed using ADDIE development model and used during the innovative learning I course for 84 biology students at Universitas Negeri Surabaya. The data were analyzed using descriptive-qualitative approach. The results showed that the e-Book's validity was in a very good category. It also conveyed level 15 of readability according to the students and was responded very well with a positive response of 96%. Other findings depicted that the students' metacognitive learning outcomes and students' self-regulation were in a good category. Hence, the e-Books had the potential to be used in a digital learning mode as well as training students' metacognitive skills and self-regulation.

Keywords: E-book, Metacognitive strategies, Design, Implementation, Self-regulated learning

Introduction

In the digital era, Information and Communication Technology or ICT has been rapidly developed in various fields, including but not limited to the field of education. Along with its development, ICT is absolutely essential in fostering education quality (Alam & Ujjwal, 2017). For instance, the quality of the teaching and learning process can be advanced by providing students opportunities to learn and apply technology, of which it is significant to the twenty-first century education model (Lawrence & Usman, 2018; Simin, Thanusha, Logeswary, & Annreetha, 2016). Through ICT-based learning, teachers and students get more exposures to digital working performances. Al-Ansi, Suprayogo, and Abidin (2019) stated that ICT has a positive and significant impact on

the learning process in schools, where the more the use of ICT in learning, the better the student's learning outcomes.

In tertiary education level, the use of ICT can be revealed through students' activities, such as using Internet access via gadgets or other electronic devices. These activities were carried out to obtain new information and knowledge (Herman, 2013). As a result, the role of lecturers as the center of knowledge has been shifted to become facilitators and coordinators in creating an active learning environment (Amin, 2016). Lu, Lu, and Yu (2003) stated that an active learning environment can be supported by the use of learning resources in accordance to the ICT development, i.e., through the use of an electronic book (e-Book). Lin, Liu, and Kinshuk (2015) stated that there is a need to use and apply e-Book to support the classroom learning process. e-Book is a transitional textbook published in electronic form and not printed on paper (Daradkeh, Selimi, & Gouveia, 2012). Browne and Mary (2012) stated that e-Book is not only a transition from printed to digital books, but also equipped with additional features that can support learning activities, so that they can improve student's learning outcomes (Akpokodje & Ukwuoma, 2016; Suyatna, 2020; Tsai, Lin, & Lin, 2017).

The use of e-Books as learning resources can be applied to pedagogy courses, including e-books on metacognitive strategies. Metacognitive is simply defined as thinking about one's own thoughts (Jaleel & Premachandran, 2016). A student is said to have metacognitive skills if he has the ability to plan, monitor, and evaluate the learning process and outcomes (Herlanti, Hutagalung, & Sigit, 2019). Metacognitive skills play a role in forming autonomous learners through self-regulated learning. This is in accordance with the demands of the Higher Education Curriculum that emphasizes self-regulated learning (Kementerian Riset Teknologi dan Pendidikan Tinggi, 2015). Iftikhar (2014) states that there is a correlation between metacognitive and student's motivation. Metacognitive e-Book will provide easy access and a wide range of information through various content in it. So that, it can let someone choose useful information and the ability to independently monitor the learning process (Shen & Liu, 2011).

Unfortunately, to the best of our knowledge, the availability of metacognitive e-Books in Indonesian was still not widely available, including appropriate and up-to-date metacognitive e-Books in practicing metacognitive skills especially in learning biology. Many of those were metacognitive books in language learning (Haukas, Bjorke, & Dypedahl, 2018), educational psychology (Velzen, 2017), and maths (Kaune, Cohors-Fresenborg, & Nowinska, 2011). Moreover, metacognitive e-Book needed to be developed immediately since there was a high demand from students, especially during an online learning process. Such e-Book could help students learn autonomously and made them easier to master metacogntive skills in biology learning. Thus, this study aimed to design and implement e-Book of metacognitive strategies in tertiary education level and then analyze the impact of its use on students' metacognitive skills.

Literature review

e-Book is a transitional textbook published in an electronic form via Internet or disk and is not printed on paper (Daradkeh et al., 2012). It can be published in various file formats such as html, PDF, exe, and PDB, which can be accessed and downloaded using electronic devices such as computers, laptops, or smartphones (Tsai et al., 2017). It has

various advantages for users compared to printed books, including cheaper price and accessible at any time, anywhere, and in any number through gadgets, laptops, iPads, and other electronic devices (Andini, Fitriana, & Budiyono, 2018; Bunkell & Sharon, 2009; Khalid, 2014; Tosun, 2014). So, it is no wonder that users are more interested in using e-Books than the printed ones. In addition, it is usually equipped with interactive features that support learning activities (Askar, 2014; Buzzetto, Sweat, & Elobaid, 2007) such as videos, graphic contents, audiovisuals, hyperlinks, quizzes, back and forth animations, and search features. Thus, its usage can facilitate users to create a learning trail in various forms according to the learning style of each user (Yang, Flanagan, Akcapinar, & Ogata, 2018; Zajac, 2009). In designing an e-Book, the layout of the images and the materials must be considered carefully. Pages that contain too few sentences (one or two lines) and pages that contain too many symbols, images, or numbers should also be avoided (Yang et al., 2018).

Several studies have shown the effectiveness of e-Book in enhancing learning performance. Suyatna (2020) compares the effectiveness of three ICT integration models in learning including simulation, e-module, and video. The results showed that there were significant differences in learning outcomes on the use of each ICT model, where the highest learning outcomes were obtained from the use of e-modules in the learning process. Tsai et al. (2017) used e-Book in a blended learning mode to deliver learning materials. Learning activities facilitate students in using online and traditional media to provide access and comfort to students in determining the appropriate learning environment in order to achieve optimal learning outcomes. Akpokodje and Ukwuoma (2016) examined the impact of using e-Book on higher education students' learning motivation in Nigeria. As a result, the majority of students were aware of the importance of e-Book and generally accessed e-Book online for the sake of study and research. Students were motivated to use e-Book because they could be red at home, could be stored for a long time, and were easy to access so that the students improved their reading habits. Ebied and Shimaa (2015) examined the effect of e-Book on student's learning outcomes in high school level. The results showed a significant difference in learning outcomes between groups who used e-Book and those who did not. Rockinson-Szapkiw, Courduff, Carter, and Bennett (2013) examined the comparison of the use of e-Book with printed books on student's learning process at university level. The results showed that, in addition to effectively affecting cognitive learning outcomes, the use of e-Book had a higher significance in influencing affective and psychomotor learning outcomes than the printed ones, so the use of e-Book in a learning process at university level needed to be improved.

Metacognitive and self-regulation have been new interests in education (Prather et al., 2020). Metacognitive is defined as a set of knowledge that includes awareness of one's own abilities, strategies about how to learn, and choosing effective strategies according to certain learning conditions (Pintrich, 2002; Schraw, 1998). Integrating metacognitive skills with technology, including in the form of e-Book, needs to be undertaken. The goal is to form independent learners who are able to regulate their learning (self-regulated learning/SRL). SRL is a process of controlling how to learn through motivation, metacognitive, and behavioral engagement, including planning learning goals, choosing appropriate learning strategies, and monitoring the effectiveness of the chosen strategy (Prather et al., 2020; Sebesta & Elena, 2016; Zimmerman,

1990). Perciso and Karl (2017) state that ICT advancement helps create technology to improve learning environments that support metacognitive awareness and SRL. However, at the same time, it also demands higher competence compared to traditional learning modes.

Several studies have shown the effectiveness of using technology on metacognitive skills. Yu and Mary's (2017) study used an interactive e-Book to improve nursing students' metacognition. The results showed the use of interactive e-Book as an innovative learning experience needed to be conducted on a larger scale to improve metacognition so that students were aware of how they learned and how to organize their learning. Susantini et al. (2018) stated that metacognitive strategies could be used in teaching learning strategies, so that students could broaden their understanding of learning strategies and then chosen learning strategies that suited their learning styles.

Methods

This study used qualitative-descriptive research approaches to describe the design and application of the e-Book of metacognitive learning strategies. This study extended educational interventions in the form of an e-Book of metacognitive learning strategies to help students apply and develop their metacognitive skills. This study used ADDIE model (Analysis, Design, Development, Implementation, Evaluation) in developing the e-Book (Aldoobie, 2015). The rationale for adopting ADDIE model was due to the fact that the model was more compact and simpler to carry out. In addition, each stage of the model was clear from the beginning to the last. Figure 1 shows the details of the ADDIE model stages.

At the analysis phase, student's and curriculum analyses were performed. Student's analysis consisted of analysis of age (around 20 years old), learning motivation, prior knowledge (including learning theory, philosophy of education, general biology), and learning styles, while the curriculum analysis was carried out by formulating indicators on metacognitive strategy materials, compiling learning assessments, and assessment rubrics conducted by a curriculum and material development team at the Department of Biology Education. This phase was carried out so that the e-Book was produced in accordance with the characteristics of the students and the curriculum. At the design phase, the e-Book of the metacognitive strategy was drafted. The manuscript was then converted into digital form in the type of flipbook via the Flip PDF Professional application. The e-Book produced had an .exe existence that could be accessed online and offline via smartphones, tablets, laptops, or computers. At the development phase, three experts on biology education conducted validation to determine its validity or readability. Validity test was determined based on experts' judgment on three aspects of the e-Book, including content, presentation, and language. At the implementation phase, e-Book of metacognitive strategy was tested in a learning process. At the evaluation phase, the e-Book was revised. The revisions were made based on the suggestions obtained from the participants during the trial process.

Participants

During the trial activity, 84 participants who were divided into three classes were given e-Book of metacognitive strategies while attending innovative learning lectures. They

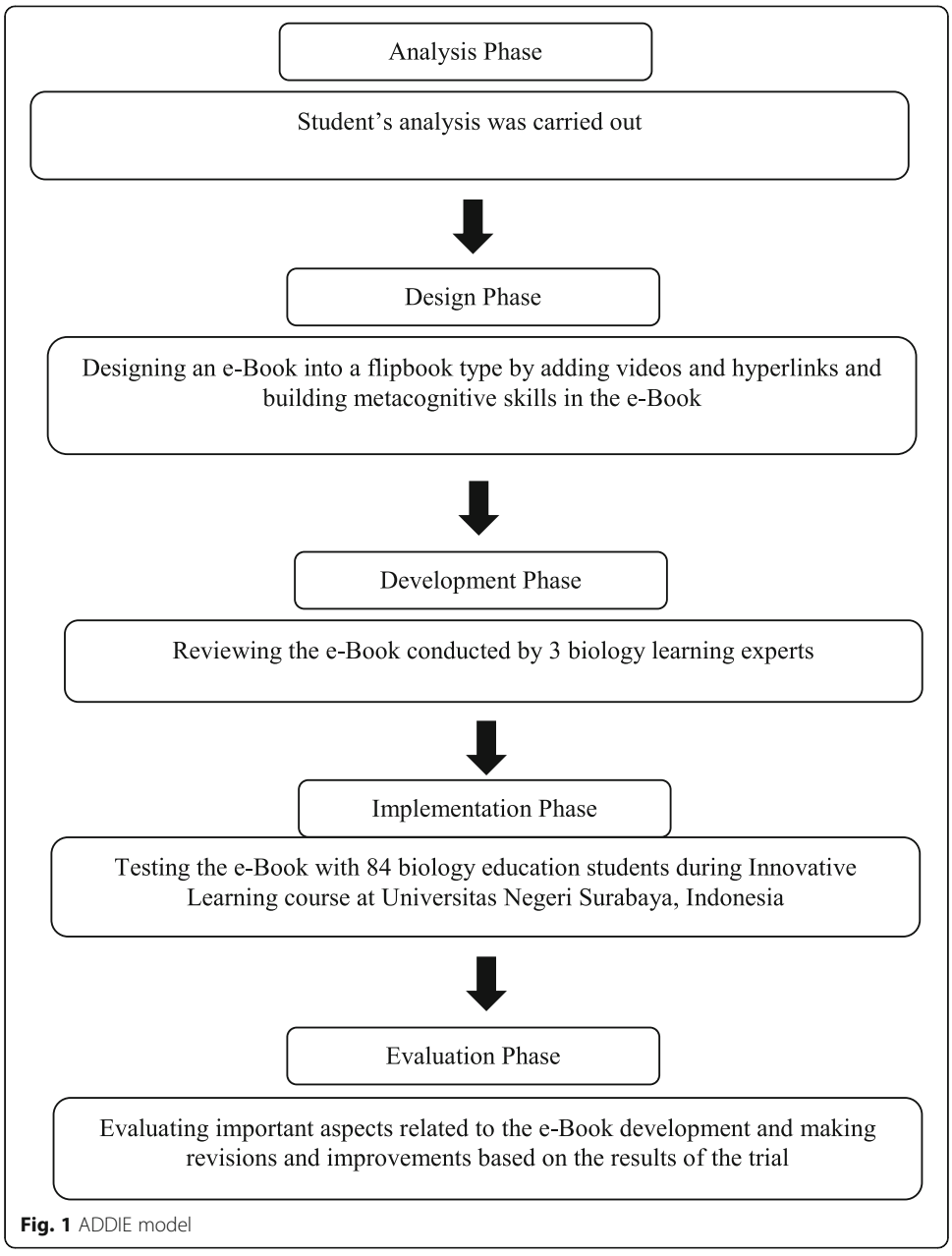

Fig. 1 ADDIE model

were chosen purposively by considering their age (around 20 years old), study times (enrolling the 3rd semester), and their prior knowledge (having learned about learning theory, philosophy of education, general biology). The trial activity was carried out for 4 weeks. During the trial activity, students were asked to work on the Self-Understanding Evaluation Sheet (SUES) individually, then took part in the lectures using metacognitive e-Book equipped with metacognitive performance. Students then worked on SUES again in groups which revealed the final knowledge after attending the lectures and gave SUES a score according to the key instructed. Students did self-reflection by comparing their prior and final knowledge as part of their metacognitive reflection skills.

Data collection

The e-Book validity data were collected using a validation sheet containing face and content validity. Experts were asked to observe and try to use the e-Book before giving an assessment. The assessment was based on expert's experience in biology learning. During the trial activity, the data on e-Book readability, student's responses, learning outcomes, and metacognitive skills were obtained. The e-Book readability data were collected using a readability test sheet. Students were asked to write a reading sample in each chapter to determine whether the readability of the e-Book was appropriate with the college level (Fitzgerald, 1981). Student's response data were collected using student's response sheets. Students were asked to provide an assessment based on their experience using the e-Book by providing *yes* or *no* answers. Students could write comments during the use of the e-Book and suggestions for the improvements. Student's learning outcomes data were collected using test sheets. The test questions consisted of seven questions (six multiple choice questions and two essay questions). The test questions were carried out after the students had attended four innovative learning lectures using the e-book as a learning resource. Student's self-regulated learning data were collected using Self-Regulated Learning Interview Schedule/SRLIS developed based on Zimmerman's social cognitive view of SRL (Zimmerman & Martinez-Pons, 1986, 1988). The researchers developed a questionnaire (α = .934) with Likert's scaling method based on the SRL category in the SRLIS interview structure in six different learning contexts and were open in nature. The researchers referred to the 14 lists of SRL strategies and adapted them to create a description of learning strategies that were appropriate to the student's learning experiences (Table 1).

Data analysis

Data were analyzed descriptive-qualitatively. The data from the validation of the e-Book were analyzed using percentages. If the results of the expert's assessment of the e-Book got a percentage of ≥75% in every aspect of the assessment, then the e-Book

Table 1 List of learning contexts and learning strategies

For each of the following learning context (left columns), please mark how frequently you used learning strategies (right columns, shaded). Always = 4, Often = 3, Sometimes = 2, Once = 1	
1 In the science philosophy course, the lecturer discusses the philosophy of science and will give a quiz at the end of the lesson. What specific methods can help you understand and remember the discussion material?	Recheck assignments Create a writing outline Make a study schedule Search over the Internet Make material notes Turn off the handphone to focus Self-rewarding Read material over and over Ask others for help Review previous exams Reread notes Study power point materials from lecturer
2 The lecturer gives the task to write a short paper on cognitive development. Paper work is done outside of class hours and grades will be accumulated for semester scores. What methods will make it easier for you to plan and finish your paper well?	
3 What specific methods do you use to complete course assignments?	
4 All lecturers provide final examinations to determine your GPA. What methods do you use to get good grades?	
5 Many students are complacent in completing assignments so that the work is not optimal. This is because many students prefer to watch movies, surf on social media, or play games when they have free times. What tricks do you use to be more motivated to complete the assignments?	
6 Some students think that it is better to do class assignments at home or in a boarding house, as well as prepare for the next lecture. What tricks do you use to improve the quality of studying at home or boarding house?	

was considered valid (Borich, 1994). The e-Book readability data in the form of discourse samples were analyzed using Fry Formulation then interpreted on Fry Graph. The e-Book was categorized as suitable for the students if the readability level was 13–15. Student's response data were measured using Guttman scale (score 0 if not appropriate; score 1 if appropriate) (Tuckman & Brian, 2012). Student's learning outcome data were measured using test results. If students got a test score of ≥75 (scale of 100), then the student's learning outcomes were in a good category. Student's learning outcomes and self-regulation were then compared to determine whether there were differences in students' metacognitive skills and self-regulation in the three classes after learning using the e-Book of metacognitive learning strategies. The statistical difference test was performed using ANOVA and Kruskal-Wallis test using SPSS software. If the value of Sig> 0.05, there was no difference in metacognitive learning outcomes and student's self-regulation in the three classes. Conversely, if the value of Sig <0.05, there were differences in metacognitive learning outcomes and student's self-regulation in the three classes.

Results

The results showed the results of the design and application of the e-Book of metacognitive learning strategies in innovative learning in terms of the e-Book validity and readability, student's responses to the developed e-Book, and metacognitive learning outcomes and student's self-regulation.

The e-Book of metacognitive learning strategies consisted of front and back pages, introduction words, table of contents, e-Book features, description of metacognitive strategies in four chapters covering (1) introduction to metacognitive learning strategies, (2) how to learn with metacognitive strategies, (3) how to teach metacognitive strategies, and (4) assessment of metacognitive strategies, as well as a glossary and bibliography. The e-Book was equipped with various features such as videos, hyperlinks, bookmarks, pop-up images, a clickable table of contents to the desired section, zoom in and zoom out content, search content, and flip content (back and forth). The e-Book was also supported with features in studying metacognitive strategies, including Before You Read, Read to Learn, After You Read, and Reflections, which were contained in each chapter. Figure 2 shows the e-Book features.

Validity

The validity test of the e-Book of the metacognitive strategy was carried out on three aspects of feasibility, namely content, presentation, and language conducted by three experts. The experts had Ph.D. title on biology education. The results of the validation showed that every aspect of eligibility had a percentage of 100%, which was categorized as very valid (see Table 2). This showed that the e-Book was very valid to be used to train metacognitive skills.

Readability

The readability test was carried out using Fry Graph formulation. Three samples were randomly selected during the limited trial that were considered representative (Fitzgerald, 1981). The analysis results conveyed the readability level was at level 15 at the

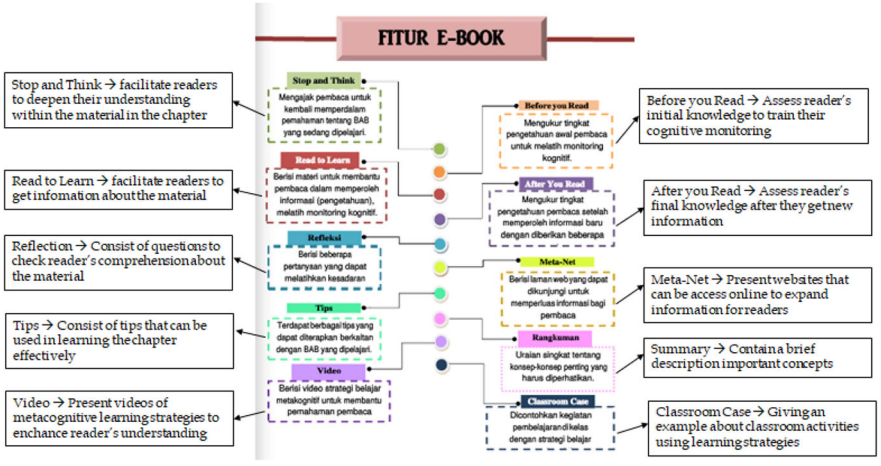

Fig. 2 The e-Book features

meeting point between the average number of sentences per 100 words with the average number of syllables per 100 words at the point (5,4; 179) (see Fig. 3). This showed that the e-Book was suitable for university student level.

Students' responses

Student's responses were obtained from filling out a questionnaire after using the e-Book that consisted of 15 questions during limited trial activities. Table 3 portrays the results of students' in which the e-Book was responded positively with the percentage of 97%.

Valuable in teaching metacognition

Student's learning outcomes in understanding metacognitive strategy were determined based on the test scores of the metacognitive strategy material. The test consisted of seven indicators. Learning strategy learning model referred to different sub-learning strategies under metacognitive learning strategy, such as underlining, note-taking, summarizing, writing logbook, mind-mapping, PQ4R (Preview-Question-Read-Reflect-Recite-Review), and KWL (Know-What, Learned). Table 4 shows the indicators of the test questions.

Figure 4 shows the student's learning performance in three classes. The class average score on each indicator was different in the three classes. However, as a whole, it was obtained an average score of 76, which was categorized as good.

The student's learning outcomes were statistically tested to determine whether there were differences in metacognitive learning outcomes in the three classes. The statistical test was carried out by ANOVA test (see Table 5).

Table 2 Results of the validity test of the developed e-Book

Validity aspects	Percentage (%)	Category
Content/material	100	Very valid
Presentation	100	Very valid
Language	100	Very valid

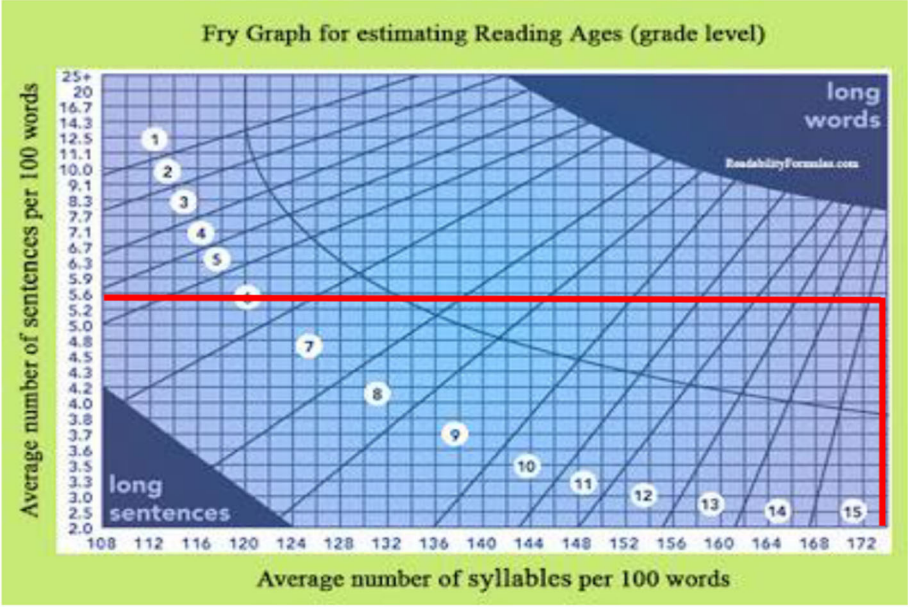

Fig. 3 The results of the e-Book readability test

Table 3 The results of the student's responses on the use of e-Book of metacognitive learning strategies

No.	Questions	Percentage of positive responses (%)
1.	Is the layout of the e-Book of metacognitive learning strategies attractive?	100
2.	Are there any instructions explaining the characteristics of the e-Book and its features?	100
3.	Can the existence of videos help you understand the contents of the e-Book?	93.3
4.	Does the material order of the e-Book make it easier to understand the contents?	100
5.	Is the language in the e-Book informative and easy to understand?	93.3
6.	Is the language in the e-Book progressive (the material is presented more extensive)?	80
7.	Does the material presented stimulate curiosity?	100
8.	Does the table of contents work properly (clickable to go to a specific section)?	100
9.	Do the features of *Before You Read, Read to Learn, After You Read* along with the reflection train your metacognitive skills?	100
10.	Can the Meta Net feature add information to your metacognitive learning strategies?	93.3
11.	Can hyperlinks on the Meta Net features work properly when connected to the internet?	93.3
12.	Can the tips feature make it easier to learn about metacognitive learning strategies?	100
13.	Is this e-Book easy to use both online and offline?	100
14.	Does this e-Book make you more motivated in learning metacognitive strategies?	100
15.	Overall, is this e-Book good?	100
Average		**97**

Table 4 Indicators of metacognitive questions

Question Number	Indicators
1	Identifying the principal of the learning strategy learning model
2	Identifying the characteristics of the learning strategy learning model
3	Identifying theories that support the learning strategy learning model
4	Ordering the learning strategy learning steps
5	Analyzing theories that support the learning strategy learning model
6	Describing the characteristics of the learning strategy learning model
7	Creating learning strategy learning scenarios based on problems

Table 5 shows that the significance value was .199, meaning that there was no difference in students' knowledge about metacognitive strategy in the three classes. This also reminded that students' knowledge about metacognitive strategy was consistent among students in the three classes.

Student's self-regulated learning data were obtained based on the results of filling out a modified SRLIS questionnaire. Students completed the questionnaire related to the learning strategies they used in six learning contexts. There were 14 categories of learning strategies. However, there were only three learning strategies most often applied by the students. Table 6 shows the results of the questionnaire.

In accordance with Table 6, the learning strategies students used the most in each learning context were different. Overall, there were seven learning strategies most often used by students in the six learning contexts, namely making material notes, searching via Internet, rereading notes, double-checking assignments, studying lecturers' PPT, making a study schedule, and reviewing previous exams. The data of the SRLIS questionnaire were then statistically tested to determine whether there were differences in the ability of self-regulation in the three classes. The statistical test was performed by using Kruskal-Wallis non-parametric test because the data were not normally distributed (see Table 7).

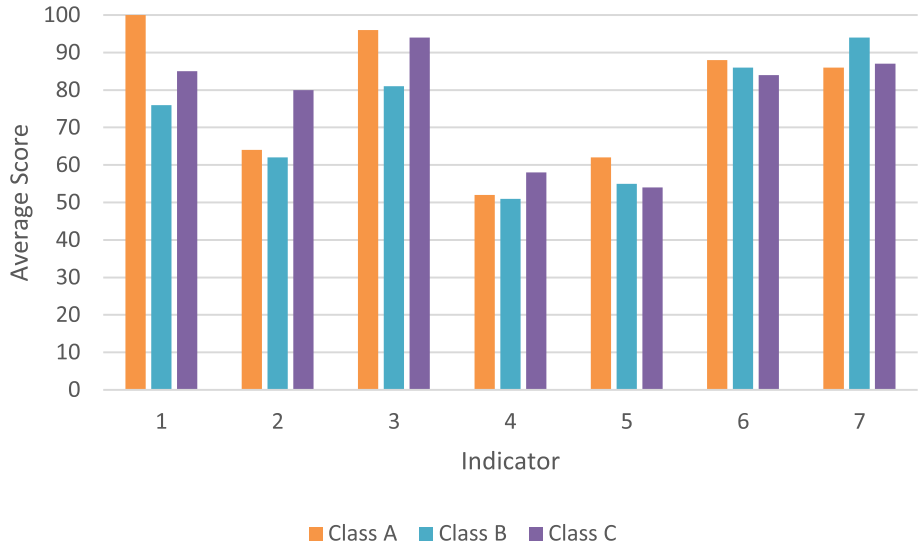

Fig. 4 Student's learning outcomes in understanding metacognitive strategy

Table 5 Anova test results on student's learning outcomes in understanding the knowledge about metacognitive strategy

	Sum of squares	df	Mean square	*F*	Sig.
Between groups	369.605	2	184.802	1.647	.199
Within groups	9087.348	81	112.189		
Total	9456.952	83			

Table 6 Frequency of learning strategies used by students within 6 different learning contexts using each of the 14 SRL learning strategies (most used)

Learning context	Frequency of learning strategy the students used the most (%)		
	Class A	Class B	Class C
In the science philosophy course, the lecturer discusses the philosophy of science and will give a quiz at the end of the lesson. What specific methods can help you understand and remember the discussion material?	Making material notes (69.0) Searching via Internet (55.2) Rereading notes (48.3)	Making material notes (67.7) Searching via Internet (40.0) Rechecking assignments (33.3)	Making material notes (71.4) Searching via Internet (42.8) Reviewing a previous exam (35.0)
The lecturer gives the task to write a short paper on cognitive development. Paper work is done outside of class hours and grades will be accumulated for semester scores. What methods will make it easier for you to plan and finish your paper well?	Searching via Internet (65.5) Making material notes (65.5) Rechecking assignments (51.7)	Making material notes (69.0) Rechecking assignments (50.0) Searching via Internet (45.1)	Making material notes (71.4) Studying lecturer's PPT (47.6) Rereading notes (42.8)
What specific methods do you use to complete course assignments?	Making material notes (69.0) Searching via Internet (55.2) Rereading notes (48.3)	Making material notes (70.0) Searching via Internet (48.4) Rechecking assignments (43.3)	Making material notes (65.0) Rereading notes (47.6) Studying lecturer's PPT (47.6)
All lecturers provide UAS to determine your GPA. What methods do you use to get good grades?	Making material notes (75.9) Searching via Internet (65.5) Rechecking assignments (65.5)	Making material notes (72.4) Rereading notes (54.8) Studying lecturer's PPT (51.2)	Making material notes (66.7) Rereading notes (65.0) Studying lecturer's PPT (65.0)
Many students are complacent in completing assignments so that the work is not optimal. This is because many students prefer to watch movies, surf on social media, or play games when they have free time. What tricks do you use to be more motivated to complete assignments?	Rereading notes (72.4) Making material notes (62.1) Rechecking assignments (58.6)	Making material notes (64.3) Studying lecturer's PPT (46.4) Searching via Internet (42.8)	Making material notes (71.4) Rereading notes (55.0) Studying lecturer's PPT (55.0)
Some students think that it is better to do class assignments at home or in a boarding house, as well as prepare for the next lecture. What tricks do you use to improve the quality of studying at home or boarding house?	Making material notes (62.1) Rereading notes (62.1) Rechecking assignments (58.6)	Making material notes (69.0) Studying lecturer's PPT (48.3) Making a study schedule (43.3)	Making material notes (71.4) Rereading notes (58.0) Studying lecturer's PPT (50.0)

The test of students' self-regulation was carried out using a non-parametric test namely Kruskal-Wallis test because the data distribution in the three classes was not normal (Sig. .001, .007, .001, <.05; α = .05). Table 7 shows a significance value of .921 >, so it could be concluded that there was no difference in students' self-regulation abilities in the three classes. This showed that students' self-regulation was consistent in all three classes.

Discussion

e-Book is a form of ICT integration in a learning process in the digital era. Lin et al. (2015) stated that the use of e-Book deserves further research because it leads students to a new concept of learning—a smart learning environment. The use of e-book can enhance students learning experience because it increases flexibility and allows relatively cheap and fast access (Nie, Armellini, Witthaus, & Barklamb, 2017). Several studies have shown the effectiveness of e-Book in learning (Akpokodje & Ukwuoma, 2016; Ebied & Shimaa, 2015; Rockinson-Szapkiw et al., 2013; Suyatna, 2020; Tsai et al., 2017), including the effectiveness of using technology on metacognitive skills (Altiok et al., 2019; Feyzioglu et al., 2018; Susantini et al., 2018; Yu & Mary, 2017).

In this study, the e-Book of metacognitive strategy material designed was validated by three biology education experts on three aspects of validity, including content, presentation, and language. All validation aspects obtained feasibility percentage of 100%. This means that the e-Book is very valid to be used in practicing metacognitive skills. The content aspect covered three sub-aspects, including the correctness of the metacognitive strategy concept, the suitability and recency of features, and the suitability of the metacognitive aspects in the e-Book. Metacognitive aspects are facilitated through four features, namely Before You Read, Read to Learn, After You Read, and Reflection features. The four features are contained in the e-Book in each chapter. Veenman, et al. (2006) stated that metacognitive consists of two aspects namely thinking and reflecting about what is known and self-regulation of how to manage knowledge in the learning process. The reflection thinking aspect is facilitated by Before You Read feature that measures the level of the reader's prior knowledge to practice cognitive monitoring and Read to Learn feature that helps readers obtain information. Meanwhile, the self-regulation aspect is facilitated by After You Read feature (self-reflection aspect) that measures the level of reader's knowledge after obtaining new information through the e-Book and reflections containing several questions related to the material learned. Thus, the four aspects of metacognitive skills can be trained through the e-book developed. This is also supported by the results of student's responses in point 9 "Can the features before you read, read to learn, after you read, and reflection practice your metacognitive skills?" (Table 3) with a positive response of 100%.

The e-Book is equipped with features that support user's understanding in addition to the four features above, including the Stop and Think feature, Tips, Summary,

Table 7 Kruskal-Wallis test results of students' self-regulation

	Learning strategies
Chi-square	.165
df	2
Asymp. Sig.	.921

Classroom case, Meta Net, hyperlinks, and videos (Fig. 2). The presentation of these features has been consistent in the e-Book because according to Wiersma and Tovstiadi (2017) inconsistent presentation will affect the level of ease in obtaining information, thus, it must be avoided. Tri-Agif, Noorhidawati and Ghalebandi (2016) state that easy usage of e-Book is one of the factors of continuity of its use. The easy usage of the e-Book has been facilitated by various features in the e-Book. This is supported by the results of student's responses in point 13 "Is this e-Book easy to use both online and offline?" (Table 3) with a positive response percentage of 100%. In addition to making it easier for users to obtain information, consistent features in the e-Book also motivate students to learn metacognitive learning strategy material. This is supported by the results of student's responses in point 14 "|Does this e-Book make you more motivated in learning metacognitive strategies?" (Table 3) with a positive response percentage of 100%. Motivation is an important component in learning. Motivation in learning which is characterized by harder efforts has an impact on increasing learning outcomes (Slavin, 1987), so there is a positive correlation between motivation and learning outcomes (Lin, Chen, & Liu, 2017; Sivrikaya, 2019).

The linguistic aspect in the e-Book obtained 4 validation results in a very valid category (Table 2). The readability aspect consists of using language that is easy to understand and informative sentences, using terms that are easy to understand, consistent, and supporting the delivery of concepts, and according to the level of development of the reader adjusted to the level of readability using Fry Graph. The level of readability of a reading affects the level of reader's understanding (Crossley, Skalicky, & Dascalu, 2019; Crossley, Skalicky, Dascalu, McNamara, & Kyle, 2017), so that a text must have a readability level that is appropriate to the reader so that information is easy to read and understand (Jie, 2012). The level of the developed e-Book readability is at the meeting point of 5.4; 179, so that it fits a student-level reader at level 15 (Fig. 3). Thus, the e-Book is suitable for use by students because they are easy to read and understand. This is also supported by the results of student's responses in point 5 "Is the language in this book informative and easy to understand?" And, in point 6 "Is the language in this book progressive (the material is presented more extensive)" (Table 3) with a percentage positive responses were 93.3% and 80%, respectively. The e-Book of metacognitive learning strategies as a whole is responded positively by students with a percentage of 97% (Table 3). This indicates that students are motivated in learning using the e-book, thereby increasing student's involvement and active participation in a learning process (Fisher, Hoffman, Casey, & Cox, 2015).

Designing and implementing the e-Book of metacognitive learning strategies can be done to train students' metacognitive skills and self-regulation. The students' metacognitive skills were in the good category with an average score of 76. The metacognitive achievements obtained based on learning outcomes are shown in Fig. 4. Each treatment class has a varying average value. However, after being statistically tested using ANOVA, it is found that there is no difference in students' metacognitive skills in the three classes (Table 6). This means that the use of the e-Book has the same effect on students' metacognitive skills in all three classes. Miharja, Hindun, and Fauzi (2019) show a significant correlation between metacognitive skills and learning outcomes, because metacognitive skills will optimize thinking processes so that they are effective in understanding a phenomenon. Elbasri, Haddi, and Allali (2018) also show a relationship

between metacognitive and student's success. This is indicated by the existence of a metacognitive effect on student's learning outcomes that reflects the level of pedagogical understanding by students. However, Laskey and Hetzel (2010) report that students' metacognitive skills are often inadequate for continued academic success, because student's learning outcomes at the end of the semester have decreased compared to learning outcomes at the beginning of the semester. This is because metacognitive skills take time to develop (Zimmerman & Martinez-Pons, 1986). This implies that the use of metacognitive learning strategies needs to be taught continuously so that it can optimally support student learning success.

Metacognitive skills can be assessed using different measurement procedures and methods, adjusted for the metacognitive component being measured (Ozturk, 2017). One way to measure aspects of self-regulation is through the Self-Regulated Learning Interview Schedule (SRLIS). SRLIS (Zimmerman & Martinez-Pons, 1986, 1988) is developed to assess students' choice of self-regulated learning strategies when faced with a learning context, including in-class discussions, completing assignments, studying for UAS, and how to study at home. Through SRLIS, the researcher summarizes the three learning strategies most often used by students in the six learning contexts shown in Table 5. In total, there are seven of the 14 learning strategies that students use most often, namely making material notes, searching via Internet, rereading notes, rechecking assignments, making study schedules, studying lecturer's PPT, and reviewing previous exams. To find out whether there are differences in the SRLIS results, a statistical test is carried out and it is found that there is no difference in students' self-regulation abilities in the three classes (Table 7). This means that the use of the e-Book has the same effect on students' self-regulation in the three classes. Sebesta and Elena (2016) use SRLIS to find out which learning strategies students use most during exams and which strategies are associated with higher learning outcomes. The results indicate that students with higher test scores used certain cognitive and metacognitive strategies significantly more often than other students whose scores were lower. This shows that students who are able to determine their own learning strategies and apply them continuously will affect their learning outcomes.

Students' metacognitive skills and self-regulation after taking innovative learning course using the developed e-book are categorized as good. The results show consistency of students' metacognitive skills and self-regulation in the three classes, which means that all students have the same metacognitive skills and self-regulation. Rowe and Jennifer (2013) state that educators must apply self-regulated learning designed in e-learning to support autonomous learners. One of the manifestations is through the use of e-Book as what this study has done. Cetin (2017) shows that SRL and metacognitive correlate with each other. This is because an important component of SRL is metacognitive which is the ability to monitor and control cognitive processes (Efklides & Panayiota, 2020). Thus, using the e-Book metacognitive strategy can train students' metacognitive abilities and self-regulation to form SRL.

Limitations and future research

This study is limited to the description of the design and implementation of the e-Book of metacognitive strategies in an innovative learning course. Aspects in designing the e-

Book encompass validity, readability, and student's responses. Meanwhile, the aspect of implementing the e-Book is the effectiveness of the e-Book in training students' metacognitive skills and self-regulation. This study only describes the profile of students' metacognitive skills and self-regulation after using the e-Book, no correlation test is conducted to determine whether metacognitive skills affect student's self-regulation. Therefore, there is a need for further research to examine the correlation between metacognitive abilities and self-regulation.

Conclusion

This study concludes that the e-Book of metacognitive strategy has been created. The e-Book fulfills the content, presentation, and language readability based on the expert's judgment, which is in accordance with the college-level reader level and is responded very well by the students. The e-Book is equipped with features that facilitate metacognitive skills, including Before You Read, Read to Learn, After You Read, and Reflection. There is consistency in student's learning outcomes and self-regulation in all classes. Thus, the e-Book of metacognitive strategies can be used in digital learning to practice metacognitive skills and self-regulation.

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Authors' contributions

Endang Susantini designed and carried out the research studies. Rinie P Puspitawati participated in the discussions related to the data collection and analysis. Raharjo drafted the manuscript. Husfina L Suaidah contributed to the review and discussion. The authors read and approved the final manuscript.

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Availability of data and materials

The full data cannot be disclosed or attached due to the confidential agreement between the researchers, participants, and relevant stakeholders involved in succeeding the present study. The whole e-book and materials are stored in the university because of the existing university data policy. Therefore, the data and materials are not applicable.

Declarations

Competing interests

The authors declare that they have no competing interests.

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