

# Development of Self-learning Economics App for Secondary School Students in Malaysia Based on Information Processing Model

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**Abstract** – According to the recent development in capabilities of smart mobile devices, their growing penetration rate among students, and the positive impacts of mobile apps on students' motivation and performance, it is possible to take advantage of these devices to design an app for learning Economics. The aim of this project is to develop the Economics mobile app for secondary school students in Malaysia which can offer ubiquitous self-learning among students. The design is based on information processing model that emphasizes cognitive processes in learning. This paper discusses the development of the app which is named EconsF4.

**Keywords** – Economics mobile app, information processing model, cognitive process.

## 1. Introduction

In this age of mobile and digital technology, students are using smart mobile devices for every purpose. They use smartphones or tablets for communication – sending messages, sharing information; entertainment – listening to music, watching videos, playing games; on-line buying and

selling; and also education – information searching, on-line discussion, recording class attendance and etc. Smart mobile devices which are equipped with mobile applications, or known as mobile app, make the informations more easily available. Every mobile app has a distinctive feature which offers its own set of services. Users can get the information using their fingertips anywhere and anytime.

As far as education is concerned, mobile app has many advantages such as portability, timeliness, self-paced learning and can motivate learning. The small size of smartphones, which nowadays become something that cannot be left behind when students go anywhere, actually make smartphones a tool for them to access any subject information anywhere and anytime. In the early stage of app development, Shuler [1] forecasted that applications on smart mobile devices have the potential to become the new means of providing educational content to students.

In addition, with mobile app, students can learn in their own way. Concerning the traditional classroom concept, students have to follow the content and the time, which are scheduled by the teachers. However, the situation is different with mobile app. They can plan their own content and schedule their time to study. According to Mehdi pour and Zerehkafi [2] and Jou et al. [3], mobile app is able to promote learning interest and provide significant positive impacts on learning performance.

Many apps have been developed for teaching and learning specific subjects such as Science [4], Mathematics [5], and Languages [6]. Apps are also designed for children with special needs, such as autism [7],[8] and dyslexia [9]. In Malaysia, however, the app for teaching and learning Economics for secondary school is not yet available.

Due to recent development of capabilities, smart mobile devices, their growing penetration rate among students, positive impacts of mobile apps on students' motivation and performance, it is possible to take advantage for these devices to design an app for learning Economics. The aim of this project is to develop an Economics mobile app for secondary

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school students in Malaysia which can offer ubiquitous self-learning to the students. The design is based on information processing model which emphasizes cognitive processes in learning. Cognitive process comprises selection, maintenance rehearsal, elaboration and organization.

## 2. Mobile App

Mobile apps are add-on software for mobile devices, such as smartphones and computer tablets [10]. Apps are generally small, individual software units with limited functions. By using mobile apps, learning can be done ubiquitously without time and space constraints [11]. Many educational apps were designed for specific learning approaches such as collaborative learning and constructivist learning [12],[13],[14]. This type of apps enables students to share information and interact with peers.

Apps are also designed for self-learning. Self-learning is neither location constrained nor time-bound. This approach utilizes the advantages of a mobile app which accommodates and supports personal agency of learners in a way that a learner can decide when, where and how they will learn [15]. The concept of self-learning in designing an app was adopted by Deng and Trainin [16], Wang [11] and Moo Chan et al. [6]. Deng and Trainin [16] and Wang [11] explained how mobile apps can be used to enhance vocabulary acquisition, while Moo Chan [6] developed a mobile app for learning the Mayan Language. It is found that self-learning app increased students' usage educational apps, cultivated students' self-learning habit, provided ubiquitous learning environment and developed students' confidence in learning [11].

## 3. Information Processing Model and Cognitive Process

The Information Processing Model was introduced by Atkinson and Shiffrin in 1968 [17]. This model explains that a human brain works like a computer [18]. Humans not only receive stimuli from the environment, they also process the information that they receive to store them in long-term memory, and recall them back when they need.

Information processing model consists of three memory stores; sensory memory, working memory or short term memory and long term memory. Sensory memory is the first information store in the memory system. It receives external information or stimulus in various forms such as sight, hearing, odor, taste and feeling. It is capable of receiving large amounts of information at any time, but its ability to store information is only limited to one to three seconds [18],[19]. Thus, only certain

information will be selected and sent to working memory [20]. Selection of information is based on one's perception and attention.

Working memory is the second information store in the memory system. According to Taylor [21], working memory is the store that processes information, also known as workbench of the memory system. Information from working memory is then transferred to long-term memory for permanent storage [19]. The information in the long-term memory will be recalled when it is needed. The process involved in transferring information from one store to the other store is known as cognitive process [22].

The cognitive process is mental activity performed by individuals to process stimuli from the environment. Different cognitive processes are involved when information is received and transferred from one memory store to another memory store until it is stored in long-term memory. The information will later be recalled when it is needed.

As explained earlier, firstly, our sensory memory receives various informations from the environment. It selects information that catches our attention, what is important and forgets what is unnecessary. Selection is the first cognitive process that our memory does. Selection process depends on individuals' attention. According to Woolfolk [18], what we pay attention to, is guided to a certain extent by what we already know and what we need to know. For instance, when starts a lesson, a teacher can begin with eye-catching or start displaying actions in order to draw attention. Furthermore, bright colors, underlining, highlighting written or spoken words, calling students by names, variety in tasks and teaching methods, surprising events, lighting or pacing can all be used to gain attention.

Selected information is moved from sensory memory to the working memory. In order to retain information in working memory, the information must be kept active by repeating the information in the mind. This process is called maintenance rehearsal. Previous studies show that rehearsals improve working memory capacity in order to retain information [23].

The information from working memory is then processed for long-term retention in long-term memory. The transfer is done through elaborative rehearsal, which is integrating the information that we are trying to remember with existing information that we already know from our long-term memory. Integration process involves elaboration and organization. Elaboration is expanding the meaning of the new information by connecting it with already existing knowledge. This can be done by explaining information in our own words, creating examples,

explaining to peers, drawing out relationship or applying information to solve problems [18],[24]. Meanwhile, organization is arranging the information into a specific structure. Organization can be done, for instance, by classifying information in a table or explaining the relationship of information by using a mind map. A study by Gobert and Buckley [25] found that students integrate information when they process and arrange the information that they learned by creating a conceptual model. This process has increased their knowledge retention.

In summary, cognitive processes to retain information in long-term memory comprise selection, maintenance rehearsal, elaboration and organization. These processes increase knowledge retention in long-term memory.

#### 4. Methods

This project designed Economics Mobile App for Secondary School students in Malaysia. The designing of this app is to offer an alternative source and medium of learning besides classroom and textbooks. It focuses on ubiquitous self-learning where a student can use this app to study and revise Economics subject anytime and anywhere they prefer. The design is based on information processing model. The app was designed for both Android and iOS operating systems, so that students who have Android or iOS based devices can all use this app.

The development of this app is divided into three phases:

##### *Phase 1 – Identifying user needs*

Users of this app are secondary school students in Malaysia who take Economics subject. Economics is a core subject for students in the commerce stream, and an elective subject for students in other streams. Students learn this subject for two years, i.e. in Form Four and Form Five, and they sit for the national examination at the end of Form Five. This subject is taught in Bahasa Melayu, thus the app is designed in Bahasa Melayu.

##### *Phase 2 – Exploring cognitive processes practiced by the students in processing Economics content*

Qualitative study was conducted to explore the cognitive processes practiced by students in processing Economics content. Data was collected through face-to-face semi-structured interview and document analysis. Documents that were analyzed were students' lecture notes, and their own reference notes. The research participants were 12 senior students who have already taken this subject and completed the secondary school. The participation is on voluntary basis.

Table 1 summarizes the findings of cognitive processes, where the data are categorized into four processes, which are selection, rehearsal, organization and elaboration. For each category of cognitive process, data are classified into various cognitive activities. The findings of cognitive processes and activities are consequentially embedded in the design of the app to assist students in processing the Economics subject content.

Table 1. Cognitive processes and cognitive activities

Cognitive process	Cognitive Activities
Selection	<ul style="list-style-type: none"> <li>• Identify key words</li> <li>• Distinguish between main idea or main topics and sub topics</li> <li>• Identify text structure</li> </ul>
Rehearsal	<ul style="list-style-type: none"> <li>• Repeat verbally</li> <li>• Read many times</li> <li>• Redraw the diagrams</li> </ul>
Elaboration	<ul style="list-style-type: none"> <li>• Identify text structure</li> <li>• Integrate opposite information</li> <li>• Integrate and elaborate information by using pictures and symbols</li> <li>• Integrate and elaborate information by using key words</li> <li>• Integrate and elaborate information by doing exercise and answering questions</li> <li>• Integrate and elaborate information by identifying different examples</li> </ul>
Organization	<ul style="list-style-type: none"> <li>• Identify text structure</li> <li>• Organize the content by using framework</li> <li>• Organize the content by using table</li> <li>• Organize the content by using mind map</li> </ul>

##### *Phase 3 – Developing mobile app for learning Economics*

The app is developed using Android and iOS operating systems. It is designed in Bahasa Melayu, the language that is used in teaching this subject at schools. The content is based on the school curriculum and it is delivered in the form of texts, images and sounds and embedded cognitive process elements.

#### 5. Output – The Design of Economics App

This Economics app is named EconsF4. It has five sections – Economics Notes, Own Notes, Tips, Video and Quiz as shown in Figure 1. The design of the app embeds the characteristics of cognitive processes to assist students in processing the information. There are four main cognitive processes involved, which are selection of stimuli by sensory memory, maintenance rehearsal by working memory and elaboration and organization to transfer the information to long-term memory.



Figure 1. A screenshot example of sections in EconsF4

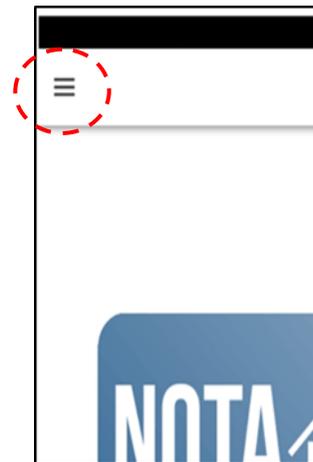


Figure 3. A screenshot example of home button

### 5.1 Selection of Important Information

When trying to help students identify and select important information such as main ideas and important content, this app uses colors, font size and pictures as distinguishing elements. For instance, different colors and different font sizes are used to distinguish main topics, sub-topics and explanation, while pictures or visual objects are used to attract and capture students' attention as shown in Figure 2.



Figure 2. A screenshot example of elements for selection process

### 5.2 Rehearsal of Economics Concepts and Content

Rehearsal is the process in which students actively repeat the information. This app helps students rehearse the Economics content by putting the home button on every page. Students can simply click the button and go back to homepage where they can choose again the topics and sub-topics that they want to reread. The home button is shown in Figure 3.

Rehearsal process will also occur if students write what they read. This app has Own Note Section as shown in Figure 4 where students can write their own notes or write whatever content that they read. They can also draw diagrams in the text.



Figure 4. A screenshot example of Own Note Section

### 5.3 Elaboration of Economics Concepts and Content

This app elaborates economic concepts and content by integrating them with images, symbols, colors, examples and structural elements of the text. Figure 1 shows how the information is integrated with colors, where different sections at the homepage are labelled with different colors. Meanwhile, elaboration can also be done based on the structural elements of the content. Economics content is expository content; therefore, its content can be categorized into description, sequence, compare/contrast, cause/effect and problem/solution [26]. Figure 5 shows contrast type content, where it lists the differences between needs (barang keperluan) and wants (barang kehendak).



Figure 5. A screenshot example of contrast content as elaboration element and table as organization element

In the terms of functioning the app, every topic is linked directly to the content page. By clicking on the topic, students will be directed to the explanation on the specific page. In addition, elaboration process occurs when explanation comes together with examples. For instance, the concept of substitute goods is elaborated with examples such as personal car and taxi, rice and bread. This explanation is also accompanied with pictures as shown in Figure 6.



Figure 6. A screenshot example of using pictures as elaboration element

Besides that, elaboration process also occurs when students utilize their knowledge to answer questions. This app has a Quiz Section for students to test their knowledge and understanding as shown in Figure 7.

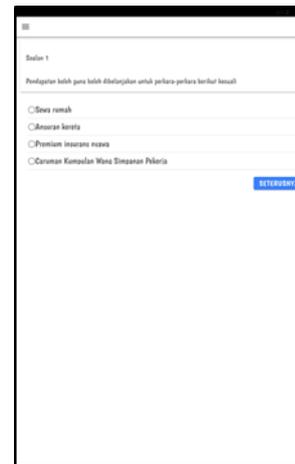


Figure 7. A screenshot example of Quiz Section

### 5.4 Organization of Economic Concepts and Content

Organization is the process of arranging the concepts and content into specific structure or categories and identifying the relationship between one piece of content and another. In this app, contents are organized by arranging it into a specific structure such as the Table of Content as shown in Figure 8. The main topics are identified and followed by the list of sub-topics.

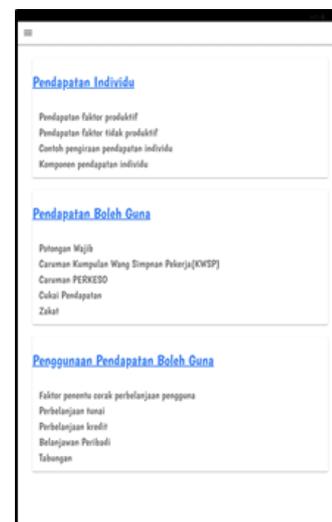


Figure 8. A screenshot example of table of content

Contents can also be organized by using diagrams and tables. Figure 9 and Figure 5 are examples of how information is organized by using infographic and tables respectively.



Figure 9. A screenshot example of infographic as organization element

## 6. Conclusion

Smart mobile devices are widely used by students nowadays. They can search and obtain information ubiquitously. In this study, the Economics app, EconsF4 is designed for the ubiquitous self-learning of Economics subject for secondary school students in Malaysia. The app incorporates cognitive process elements in order to assist students in processing Economics content for long-term retention. In addition, the cognitive process elements that are embedded in the app are also aimed to assist students to recall easily the information when needed.

EconsF4 uses elements such as color, font size and pictures to indicate different types of information for selection process. These elements influence students' attention and guide them in choosing information for further process. Furthermore, functions of home button, hyperlink and Own Note Section are used for rehearsal process. Home button will bring students to the homepage in which students can go to the table of contents to select the topic or sub-topic that they wish to reread. The topic or sub-topic is hyperlinked to the respective pages. With Own Note Section, students can rehearse the information by writing their own notes and redraw the related diagrams they have already learned.

Meanwhile, for elaboration process, EconsF4 expands the information by integrating them with images, symbols, colors, examples and structural elements of the text. In addition, students can also expand their understanding by answering questions in the Quiz Section. Similarly, structural elements are

also applied for organization process. Apart from structural elements, tables and infographic are also used for the same purpose.

At this stage, the development of EconsF4 is partially completed. The next step is to evaluate the app. The usability study and assessment of students' attitude towards the app will be conducted. Data from the evaluation process will be used to improve the app before it can be released to the students for their use.

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