

The role of isolation principle in the design of mobile learning app to promote learners navigability and understanding of programming problems

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Summary

The current design of mobile applications do not fully supports learners' learning of complex problems. For example, learning programming in mobile has always been considered as a critical issue in which it lacks of the effective pedagogy to support the representation of a learning content. Such lack could hinder learners' interest to learn with mobile due to the imposed amount of cognitive load needed for processing information in mobile. Thus, we proposed applying the isolation principle into the design of mobile apps to simplify learners' learning of programming by facilitating their mental processing of the learning contents. An isolated pedagogy is proposed to simplify the fragments of complex learning task. A total of 45 undergraduate students were asked to use the mobile learning app. Then, a questionnaire was administrated to all the participants to assess their perception about the app navigability and understanding of programming problems. The result showed that majority of students found the app to provide the required elements for them to freely navigate and understand the taught concept. It is assumed that structuring the learning contents into isolations would result in a better understanding than the unstructured one.

Key words:

Multimedia principles, interface design, learning outcomes, mobile design.

1. Introduction

The amount of mental efforts in order for students to learn effectively about a subject matter at deeper levels of understanding requires a complex coordination of cognitive processes and affective states [1]. The learning process may impose high or low cognitive demands that commonly consists of inference generation, causal reasoning, problem diagnosis, conceptual comparisons, and coherent explanation generation. These elements are complemented by the learners' state of aptitude that deals with their mental capability to handle a complex situation. In mobile learning environment, there appears to be much to do with the engineering of learning task in order to reduce the cognitive load required for processing information when learning in small screen. This is because complex learning tasks usually demand extra cognitive load from learners to attain a certain learning goals. These cognitive demands are driven by the difficulties of having learners processing learning content

due to the unstructured fractions or pieces of information. Learning complex task or attempting to solve a programming problem in mobile context has received little attention in the literature. Therefore, the researcher here attempt to solve current problems associated with the representation of programming problems by stimulating an effective representation of the learning content. This is believed to provide a better way for learners to deal with the complexity of information [2].

Providing a constructive pedagogy for representing knowledge for mobile-learning applications has been regarded as an emergent need for improving students learning of complex concepts. As such, previous studies addressed the lack for advancing both tacit and explicit concepts into the design of mobile applications [3]. Thus, this study aims at providing a novel solution to the design problems of learning content in a complex situation by proposing the isolated pedagogy likely to regulate students' cognitive load, hence, improve understanding of the programming task.

On the other hand, the process for providing an isolated representation of mobile content would empower students' tacit knowledge by articulating the pedagogical design elements to meet their mental model for processing programming information. The development of pedagogical representation based on the isolation of programming problem into fragments would results in a positive experience especially when the isolations are intends to describe the different kind of knowledge needed to achieve a reliable practice in a technology enhanced learning environment. Potential utilization of this study would offer a holistic pedagogical design that can assess current learning of programming by allowing students to extract the structure of practicing knowledge into a meaningful form in mobile device.

Review of the literature

Previous studies have illustrated various ways for advancing learners' understanding of the learning task in accordance to the design of the environment, functionalities, and structuration. It is evident from the literature that

students learning of programming courses requires sufficient properties to be imposed into the environment. This is assumed to stimulate students' programming assignments which also depends on the learning platform and the way of representing its segments [4]. However, this is not the same when students learn with their mobile devices, which are limited to the interactive elements for facilitating one's control and focus to the content [5, 6]. This multiplatform approach gives us the opportunity to introduce students to different programming models [7, 8]. On the other hand, Terras and Ramsay [9] identified some problems associated with the current design of mobile applications in terms of information processing difficulties due to the imposed effect of the design. This is believed to hinder students' excitement to learn as it allow them to skip or pay less attention to the task they engage with. According to Gedik, et al. [10] the process associated with the design of mobile learning may comply some challenges due the lack of proper pedagogy for motivating students to learn the content.

Park [11] highlighted the lack of research for the aim of providing suitable solutions to the current design problems in mobile devices especially in the context of mobile learning. The author addressed such lack to the unavailability of proper instructional design guidelines based on a solid theoretical framework for mobile learning. Meanwhile, other researchers like Tillmann, et al. [12] asserted the needs for a new mechanism to be developed in order to enhance the current learning practices of programming, and thus the teaching of programming. They stated that such practices could be developed to directly embed instructional effective elements into the design of mobile devices. The authors reasoned their suggestion for using mobile to learning programming to that smartphones provide the instant gratification for students. Moreover, other researchers like Mahmoud and Dyer [13] also reported the needs for proper design framework based on the integration of BlackBerry devices into the introductory programming course. Based on these, it is believed that engaging students in a programming learning task using their mobile would allow them to work on more interesting and exciting assignments and projects in upper-level courses. However, the articulating of the representation may require more attention to ensure students understanding of the concept begin taught by exposing them to a new and rapidly advancing computing area. Parsons, et al. [14] stated that learning applications that offer a reliable sources of information to learn about concept in mobile may consider the design issues which could distract learners from attaining the cognitive needs. This can be achieved by mixing some metaphor related concepts with the mobile learning contexts. Based on all these observations, the researcher considered the design of mobile application based on the isolation of learning contents in a way that can

meets students' mental needs to learn programming task. This study aims at achieving the following:

- i. Design an isolated pedagogy to learn programming language in mobile.
- ii. Evaluate the impact of isolated mobile learning content on students' navigability and understanding of programming problems.

The scope of this study was mainly on students who undertake programming courses at University of Tabuk. This study was also focusing on the learning subject of object oriented programming taught to first year students. The course materials were designed in isolated way by structuring the code and its description into segments that can students' focused attention to the content.

2. Mobile design

The design of the mobile app was based on the association between previous studies' recommendations on the effectiveness of structuring the interface. The structuration of the interface was achieved by isolating the headings and subheadings in a way that students can easily recognize and link the ideas between different segments. For example, brief information about the topic is provide to help students understand the task followed by graphical illustration of the concept and detailed explanation of the main phases. The main phases were segmented into smaller concepts under one main concept. This was assumed to make it easier for students to link and understand the taught concept. Figure 1 shows an example of using the structuration in the design of mobile user interface.



Fig. 1 Mobile user interface based on the isolation principle

3. Method

With the current challenges associated with advancing the learning of programming, it become evident that current efforts are not projected to aid the learning process instead it projected to the training programming. This imply that focusing on the learning practices without articulating the learning elements in accordance to the learners' cognitive capabilities may hinder their understanding of programming. Therefore, this study considered the use of quantitative method for examining the effectiveness of the proposed mobile app. A questionnaire was used to gather students' responses on aspects related to their perception of app's navigability and their understanding of programming problems.

3.1 Participants

The effectiveness of the proposed mobile app was examined by using a questionnaire distributed on 45 undergraduate students. All students were undertaken a programming course. A convenience sampling method was used to select the study participants. We asked all the selected participants to use the proposed mobile app after the university lesson as a scaffolding tool to promote their learning of programming. A two weeks learning of certain topics were accomplished by all the students. Then, a questionnaire was distributed to assess their perception about the navigability of the app and ability to understand problems.

3.2 Instrument

The items for assessing students' navigability were adapted from Corritore, et al. [15] while items for understanding problems were adapted from Tillema and van der Westhuizen [16] Table 1 show students' navigability and problem understanding. A Five-Likert Scale was used to assess the level of agreement on the given items.

Table 1: Students' navigability and problem understanding

Navigability	
1.	The app provides multiple search features (e.g., search engine, menu bar, go-back-and-forward button, etc.) to obtain the target information.
2.	The app page that I am looking for can be reached through multiple pathways.
3.	There are multiple ways to access the app page that I am looking for and/or return to shopping menus.
4.	It is very easy to locate what is needed in this app.
5.	The app keeps me oriented as I learn.
Problem understanding	
1.	The problems being discussed were authentic and realistic
2.	The discussion was fruitful and interesting
3.	I was able to recognize the issues dealt with from my own practice
4.	The discussion was relevant and productive
5.	I felt we dealt with problems that mattered

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6. I was already aware of most of the issues being discussed
 7. I frequently participated in the ideas of the discussion
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4. Results

A total of 45 participants took place in this study (45 male with age vary from 19-22 years old). The descriptive statistic results presented in Table 2 describe students' perceptions about the potential of using isolation principles in promoting the navigability and understanding of programming problems in mobile. Based on the Skewness and Kurtosis values, it can be said that responses on all items were normally distributed. The result showed that majority of students agree about the effectiveness of isolation principles to provide them with multiple search features to obtain the target information (Mean=4.67 and Std=0.91). Students also found the app to provide them with a fixable way to look for pages through multiple pathways (Mean=4.35 and Std=0.64) In addition, the result revealed that students were able to locate what is needed in this app (Mean=4.32 and Std=0.74) whereas others expressed that the app keeps them oriented as they learn (Mean=4.14 and Std=0.88).

Moreover, students' understanding of programming problems were also found to promote their learning outcomes by engaging them frequently in the ideas of the discussion (Mean=4.85 and Std=0.94). They also asserted that the discussion provided was fruitful and interesting (Mean=4.68 and Std=0.90) in which they were aware of most of the issues being discussed (Mean=4.53 and Std=0.94). Students also found the app to enable them to recognize the issues dealt with from their own practice (Mean=4.50 and Std=1.08). From these, it can be concluded that majority of students found that isolating the programming concepts would effectively improve their navigability and enhance their understanding of programming problems.

Table 2: Descriptive statistics of students' navigability and problem understanding

Navigability	Mean	Std. Deviation	Std. Error	Skewness	Kurtosis
1.	4.67	.91	.02	-.78	.38
2.	4.35	.64	.07	-.32	.60
3.	3.98	.42	.05	-.84	.57
4.	4.32	.47	.02	-.25	2.33
5.	4.14	.88	.08	-1.39	1.09

Problem understanding					
4.21	1.01	.05	-.71	-.10	
4.68	.90	.01	-1.10	1.02	
4.50	1.08	.05	-.53	.51	
3.90	.94	.07	-.62	-.02	
3.98	.57	.09	-.12	.84	
4.53	.94	.04	-.50	-.13	
4.85	.94	.08	-.30	-.81	

5. Discussion

The presentation of learning materials in isolated manner would promote learners' cognitive abilities to process information efficiently [17]. This study found that embedding the isolation principle of multimedia into the design of mobile application would help learners to better understand the programming problems and facilitate their navigability. The result showed a high agreement among students on how breaking down the concept into small pieces would improve their learning by understanding these pieces separately. As such, it is believed that reengineering of mobile apps for teaching programming language can consider the isolation of concepts with more sources of information that can be understood in parts. This study is believed to support some insights from previous studies related to the use of isolation principle in the design of interface, for example, it support the argument of Al-Samarraie, et al. [18] and Al-Samarraie, et al. [19] on the benefits that blended learning provides to students' learning experience by when using isolation and distinctiveness for promoting learners preferences. It also promote the role of multimedia principles in empowering students' learning outcomes suggested by Narciss, et al. [20] and Lehtinen [21] for promoting active and elaborated learning activities in a learning environment. Based on the mentioned literature, it can be said that the proposed work provide a better way and structure for students to process and understand the piece of information. In addition, the comparison result with previous work shows a potential effect of isolation principles use in mobile learning design. On the other hand, this study has some limitations, for example, the number of students was limited to 45 students only. Meanwhile, the use of isolation was mostly on certain programming tasks. Therefore, future studies can be carried out to extend the findings of the present work by considering larger sample size and additional learning tasks.

6. Conclusion

This study provide the necessary insights for promoting students learning of programming with the isolating principle. The result would offer new insights to the current engineering of user interface of mobile applications. For example, students may be able to better learn about certain programming scenario based on the isolation of code into segments. Such practice would maintain one's focus to the task. On the other hand, segmenting the code into a dialogued chunks can stimulate students' control of the objects begin represented in smartphone devices.

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