The Effects of Cognitive Styles on the Use of Hints in an Online Test

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Abstract: *Feedback can give learners effective help. To this end, this study developed an Online Test System, where various hints were provided for learners so that they could get sufficient feedback. However, feedback may increase learners' cognitive load. Thus, there is a need to consider learners' individual differences. Among a variety of individual differences, cognitive styles have been paid attention recently. Accordingly, this study examined relationships between the use of hints and learning performance from a cognitive style perspective. The results indicate that Serialists spent more time completing the tasks. Additionally, Holists more frequently used the hints than Serialists. On the other hand, students who more used synonym hints could obtain higher post-test scores.*

Keywords: cognitive styles, Online Test, Hints

1. Introduction

Unlike traditional educational settings, current, learners can utilize lots of digital learning tools. Moreover, they can utilize the Internet or mobile devices to break the limitation of time and space. This is because these digital learning tools provides a lot of feedback, which could give learners effective help (Duffy & Azevedo, 2015). Feedback is one of effective learning tools because it not only provides positive learning outcomes but also can inspire learners' potential. Wang, Schneider & Valacich (2015) indicated that diverse feedback can let learners produce more ideas. Researchers have reported that providing feedback can not only improve learners' motivation, but also affects their learning performance (Samantha & Elizabeth 2015). Belcadhi (2016) found that feedback can effectively accelerate learning, reduce the reflection time so that even low-achieving learners could make significant improvement. In brief, such feedback works as effective tools to help learners take a deep learning approach (Yang, 2016). However, feedback may present a huge amount of information so that learners may easily experience cognitive load (Liu, 2010). Accordingly, their learning motivation and performance were reduced (Brunken, Plass, & Leutner, 2003). Furthermore, there is a lack of research into relationships between the use of feedback systems and learners' individual differences. Among various individual differences, current research ignored the effects of cognitive styles on the use of feedback. Chen & Macredie (2010) showed that learners' cognitive styles affected how learners selected and chose navigation tools when they using web-based learning (WBL) system.

In other words, cognitive styles play an important role. Among a variety of cognitive styles, differences between Holists and Serialists have been paid attention recently. According to Jonassen & Grabowski (1993), Holists emphasize on the content of comprehensive framework while Serialists focus on the details of the contents. In addition, Clewley, Chen, & Liu (2011) also indicated that the Holists preferred to use hyperlinks whereas Serialists favored to use the Previous/Next buttons. The aforementioned findings suggested that Holists and Serialists have different behavior. However, these findings focused on the WBL system only and ignored other technology-based learning tools. Among various technological learning tools, mobile devices have become popular because they may not only enhance learners' self-learning, but also increase their satisfaction (Liaw , Hatala, & Huang, 2010). Furthermore, mobile learning broke the limitation of geographical boundaries (Gulati, 2008) so that teaching and learning can be anywhere (Cavus, 2011). Therefore, this study aims to investigate how cognitive styles and feedback influenced student learning in the context of mobile learning.

2. Methodology Design

To effectively achieve the aforementioned aim, this study developed an Online Test System, where various hints were provided for learners so that they could get sufficient feedback. In addition, an empirical study was conducted to examine relationships between the use of hints and learning performance from a cognitive style perspective. The research design of the empirical study is described below.

2.1. Development of An Online Test System

We developed an online test system, which was implemented with a 10-inch android mobile device because its display screen has a proper size. The online test system targeted to help students learn Academic English, which is important to research students because it can help them develop an international perspective. The test was delivered in the form of 30 multiple-choice questions, which were designed by an English expert. Each question was provided with three options, one of which was correct. If a wrong option was selected, five points would be reduced.

To reduce the student's frustration, the online test provides various hints, which can be broadly divided into two types: synonymies and Chinese translation. Based on the delivery of such hints, there are three versions. One version provided multiple hints (i.e, the MH condition, Figure 1), another version did not contain any hints (i.e., NH condition, Figure 2), and the other version only included Chinese translation (i.e., CH condition, Figure 3). Students were allowed to use hints without any limitation.

Figure 1. MH condition   *Figure 2*. NH condition   *Figure 3*. CH condition
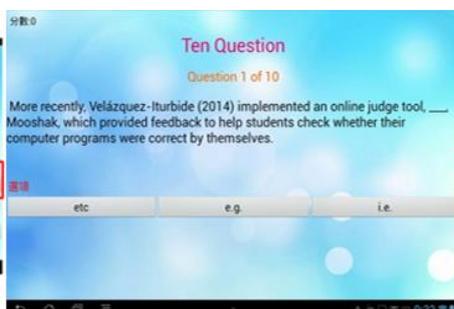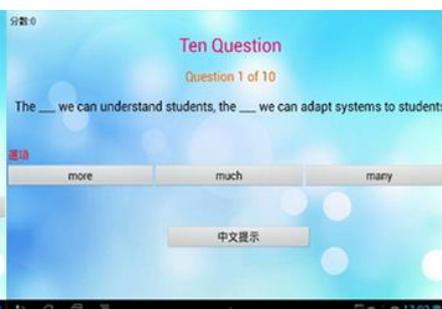
2.2. Study Preferences Questionnaire

Several instruments can be applied to measure Holism/Serialism. The Study Preferences Questionnaire (SPQ) was develop by Ford (1985) and can do a relatively quick and easy measure of Holist and Serialist biases. The SPQ included 17 items. In each item, students were provided with two sets of statements. They were asked to indicate their degree of agreement with either statement or to indicate no preferences. As the SPQ has been used in several studies (e.g., Ford and Chen, 2000), it was chosen for this study, which identified Holists and Serialists by using criteria suggested by the original producer: (a) if users agree with over half of the statements related to Holists, they are identified as Holists; (b) if users agree with over half of the statements related to Serialists, they are then considered as Serialists.

2.3. Experiment Procedures

Participants were 23 students at the National Central University in Taiwan. All participants had basic computing and Internet skills necessary to interact with the online test. They all had general English abilities but knew very few things about academic English. In this study, we use a Quasi-Experimental Design to investigate the impacts of hints on the use of an online test from a cognitive style perspective. Therefore, the independent variables of this study are cognitive styles and the use of hints while the dependent variables are learning performance and learning behavior.

Prior to conducting the experiment, the participants were given a series of academic English courses. During the experiment, they initially needed to take the SPQ. The results from the SPQ indicated that the sample consisted of 12 Holists and 11 Serialists. Subsequently, students were requested to interact with the aforementioned three versions of the online test, i.e., the MH condition, the NH condition, and CH condition. Each condition took 15 minutes. In each

condition, students needed to complete an exercise, which included 10 questions. How they completed the exercised was recorded in a log file to identify their learning behavior, including the frequencies and time of using various hints and total time spent for interacting with the online test. Finally they needed to complete a post-test. The scores from the post-test and exercise were employed to measure their learning performance.

2.4. Data analysis

An independent t test was applied to identify Holists and Serialists' differences, in terms of learning performance and learning behavior. Furthermore, a pair-t test was applied to analyze differences between each condition, in terms of the time spent and the use of hints. Additionally, Pearson's correlations were also applied to analyze relationships between the hints used in each condition and post-test scores so that the usefulness of hints could also be discovered.

3. Results and Discussion

3.1. The effects of hints on the performance and time

As mentioned in Section 2.1, students were provided with three conditions, i.e, the NH condition, MH condition and CH condition. The results indicated that Holists and Serialists performed similarly in each condition (p>.05). On the other hand, we also examined the effects of these three conditions on the time spent using for completing the tasks. There were no significant differences between Holists and Serialists, regardless of any conditions (Table 1). Accordingly, we further analyzed how Holists and Serialists reacted to these three conditions. The results showed that Holists reacted to these three conditions (p>.05) similarly while Serialists showed different reactions to these three conditions (p<.05). More specifically, Serialists in the NH condition significantly took more time to complete the tasks than those in the MH condition (p<.01) Additionally, Serialists in the CH condition significantly spent more time for completing the tasks than those in the MH condition (p<.05). However, no significant difference (p>.05) was found between Serialists in the NH condition and those in the CH condition. These findings suggested that Serialists more relied on the hints than Holists. The lack of hints might make Serialists spend much more time completing the tasks. In other words, Serialists needed additional support, which echoed the results shown in Chen and Chang (2014)

Table 1. Time used in each condition (*p* <.05)

Variables	Groups	N	M	SD	p
MH	Holists	12	176.42	48.52	.070
	Serialists	11	136.64	51.34	
NH	Holists	12	193.42	85.61	.871
	Serialists	11	199.36	87.92	
CH	Holists	12	179.08	74.60	.366
	Serialists	11	210.18	86.76	

3.2. The effects of cognitive styles on the use of hints

There was a significant difference between Holists and Serialists in the MH condition, in terms of the frequencies of using the hints. More specifically, Holists more frequently used the hints than Serialist (p<.05). We further analyze the frequencies of using each type of hints. The results indicated that no significant difference was found for the frequencies of using Chinese hints while Holists more frequently used synonym hints than Serialists. In other words, Serialists less frequently used hints, especially synonym hints. On the other hand, the results from Pearson's correlations indicated that Serialists' performance in all conditions was related to the frequencies of using Chinese hints (p<.05) as well as those of using synonym hints (p<.05). Therefore, Serialists should be encouraged to use hints more frequently, especially for synonymy hints.

Moreover, we found that the post-test score was significantly associated with the frequencies of using synonym hints (p<.05), instead of Chinese hints (p>.05). More specifically, students who more used synonym hints could obtain

Wu, Y.-T., Chang, M., Li, B., Chan, T.-W., Kong, S. C., Lin, H.-C.-K., Chu, H.-C., Jan, M., Lee, M.-H., Dong, Y., Tse, K. H., Wong, T. L., & Li, P. (Eds.). (2016). *Conference Proceedings of the 20th Global Chinese Conference on Computers in Education 2016*. Hong Kong: The Hong Kong Institute of Education.

higher post-test scores. These results implied that the synonymy hints are more helpful to the students than Chinese hints, in terms of post-test scores. This might be because synonymy hints could assist students to deliver their thoughts with multiple ways while Chinese hints could help them understand the Chinese meanings of vocabularies only. Thus, there is a need to encourage students to use synonymy hints, with which they could effectively express their ideas.

4. Concluding Remarks

This study aims to investigate relationships between the use of hints and learning performance from a cognitive style perspective. The results indicated that Serialists spent more time completing the tasks and Holists more frequently used the hints than Serialist. Furthermore, students who more used synonym hints could obtain higher post-test scores. Thus, these results implied that the synonymy hints are more helpful to the students. However, this study has several limitations. Firstly, the sample is small so further works need to use a bigger sample to verify the findings presented in this study. Additionally, future research should consider other cognitive styles to obtain more comprehensive results.

Acknowledgements

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