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This paper used a Virtual Companion System (VCS) to examine how specific design variables within virtual learning companion affect the learning process of learners as defined by the cognitive continuum of field-dependent, field-independent and field-mixed learners in LINE app for m-learning. The data were collected from 198 participants in a training project that used virtual learning companion as an adjunct to classroom instruction. The study considered to what extent the three guidance methods offered by the VCS would affect the learning outcomes of participants with three different types of cognitive styles. Each of the three guidance methods available within the VCS was designed to conform to the specific needs of field-independent, field-dependent, or field-mixed participants. The results showed that participants who received a "guidance method" matching their "cognitive style" presented a significant improvement in their learning performance.

Keywords: Virtual learning companion, cognitive style, guidance method, learning performance

INTRODUCTION

Social media and digital technology have had a profound impact on education. In conjunction with the Internet, these technologies and programs have transformed every aspect of education. Their ability to present information, in an array of media or formats has meant that the form in which information is presented to the learner can be tailored to meet the specific needs of that learner. It has also established an environment in which learners can assist each other in real-time through P2P programs or interact with chatbots in the virtual world (Hsieh, 2011). The effectiveness of employing Peer-to-Peer (P2P) social media system, such as LINE, WhatsApp, WeChat, in learning activities has become a common thread in the education vis-a-vis digital technology discourse (Hsieh, 2011; Kinzie, Whitaker, & Hofer, 2005; Hsu, 2007).

The role of a Virtual Learning Companion (VLC) that can be accessed at any time and from almost any location is, and will become an increasingly important component of many educational projects, whether they be based on traditional classroom instruction or completely removed from a formal educational setting. VLCs that incorporate P2P functions in their design will come far closer to meeting the needs of their users than those that don't. It must be noted that the significance here is not simply the provision of extra material to a learner, nor form in which that information is presented. The key is the psychological benefits that accrue from P2P interaction. In this form the learner increases their learning efficacy by engaging with a peer

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State of the literature

- Contemporary researchers suggest that instructors need to learn a different set of teaching skills for teaching online. The instructors not only impart knowledge but equally they have to provide learners with adaptive assistance and guidance so that they learn more efficiently.
- Given the equivocal results, more research effort should be directed toward examining the extent to which instruction approaches are better fitted to one type of learner or another.

Contribution of this paper to the literature

- This study uses the FI, FD and FM categorization to understand the influence of VLC design on a learner's success. The program VLC used for the study offers three distinct learning modes. Each mode corresponds to the psycho-cognitive requirements of FI, FD or FM learners.
- Results show that participants who received a "guidance method" matching their "cognitive style" presented a significant improvement in their learning performance.
- When a VLC allows learners to tailor the mode in which learning occurs to the method that suits their cognitive style they will see an increase in both the amount that is learned and their outcome in the learning process.

virtual learning companion, or a peer, over the Internet in addition to their interaction with their instructor (Chan & Baskin, 1988, 1990)

Regardless the effectiveness of VCLs, researchers (Åkerlind & Trevitt, 1999) have also recognized that new teaching formats or tools such as a VLC are often introduced without sufficient thought to

the learners' cognitive and affective preference. Hung, Bailey and Jonassen (2003) mentioned that learners may experience frustrations during the transition from an accustomed learning approach to a different one. This frustration is almost inevitable for learners who are uncertain of their roles, their duties and the evaluation methods in their new learning processes at the early stage of transition (Jost, Havard & Smith, 1997), but learners' discomfort lessens as they become familiar with the new approach and their responsibility in the learning process (Schultz-Ross & Kline, 1999).

Adapting new instructional methods or tools to suit individual cognitive differences is likely to reduce the psychological stress and impediments to learning that are implicit in any transition(Graf, Liu, & Kinshuk, 2010; Hall & Bannon, 2006; Hunt, Thomas, & Eagle, 2002). By meeting the cognitive needs of individual learners the transition itself becomes less arduous and learners are more likely to find satisfaction with the new approach. Individual cognitive differences among learners mean that no one instructional approach or tool is appropriate for the array of individual cognitive styles. Contemporary researchers suggest that instructors need to learn a different set of teaching skills for teaching online (Brower, 2003; Easton, 2003). The instructors not only impart knowledge but equally they have to provide learners with adaptive assistance and guidance so that they learn more efficiently (McFadzean & Nelson, 1998; McFadzean, Somersall, & Coker, 1999; McFadzeav & McKenzie, 2001). Drummond (2000) believed that one of the main reasons that situations in which opposite learning effects came into play was the disregard of individual cognitive differences. Dunn and Dunn (1994) found that when the instructional approaches fit individual cognitive differences, it improved not only the learner's learning performance but also their attitude toward learning. Any well-designed VLC must be matched to individual cognitive differences so as to increase both the efficacy and the satisfaction of the learning experience (Hsieh, 2011).

A well-known of individual cognitive difference is the construct of field dependence and independence (FD&I) (Dillon & Gabbard, 1998). FD&I describes learners along a continuum such that individuals at one end are considered to be field-dependent (FD), and individuals at the other end field-independent (FI). Individuals who fall in the middle of the continuum are characterized as field-mixed (FM) (Liu & Reed, 1994). The ramifications, however, of FD&I on the performance of learners interacting with new technologies to accomplish a learning task are not well established, and the results of research studies are still inconclusive (Davis, 1991; Dillon & Gabbard, 1998), and, at times, contradictory. Given the equivocal results, more research effort should be directed toward examining the extent to which instruction approaches are better fitted to one type of learner or another. Undoubtedly, the consideration of individual differences in the studies of P2P social media system may provide not only guidance on how instruction approaches can best be targeted at specific types of learners in the P2P social media system environment, but also clear indications of how instruction approaches fit learners' cognitive styles and better performance can be achieved.

LINE (http://line.naver.jp/en/) is a new communication app which allows you to make voice calls and send messages whenever and wherever you are. LINE has more than 120 million users worldwide and is used in over 230 countries (AppBrain, 2013). LINE has been ranked no. 1 in the free app category in 40 countries including Japan, Taiwan, Hong Kong, Thailand, Singapore, and more. Therefore, this study uses a chatbot system designed by Hsieh (2011), as VLC in LINE app on android platform. Created specifically

for this study, VLC can enhance traditional classroom instruction by offering the instruction approach that is ideally matched to the learner's individual cognitive style. An experiment was conducted in this study by dividing the participants into three groups, namely, field-dependent, field-independent or field-mixed cognitive styles to ensure the appropriate use of our VLC system.

LITERATURE REVIEW

Virtual learning companion (VLC)

It has been more than two decades since virtual learning companions were advocated as an educational adjunct by Chan and Baskin (1988). The concept that a third actor, one beyond the traditional roles of instructor and learner, can be a valuable asset in an e-learning environment is not new. But the advent of the internet, its access to knowledge and the instant communication it allows, has brought to fruition the idea of a VLC. A VLC gives unparalleled opportunity for a learner to enhance their learning experience through a dedicated software program. These programs create a learning environment that is not bound by the limits of time or space. A learner can find guidance, knowledge and the support and the insight derived from interaction with fellow learners.

Quantitative evidence of the value of VLCs as an adjunct to traditional classroom instruction was first produced by Webb in 1982. He discovered that the guidance and information supplied among learning companions can increase learning performance. Contemporary research conducted by Hsu et al., (2007) has illustrated that the interaction afforded by VLCs increases learners' concentration, engagement, and attention by encouraging learners to become more immersed in their studies. Software that gives additional information, additional resources or material review, by itself does not take full advantage of the technology that can assist learning. An integral aspect of a comprehensive VLC must include the ability to interact with other learners. A sense of isolation and the attendant negative learning effects that can arise are common among users of extra-classroom software that doesn't incorporate a mode that allows interaction with other learners. Hong (2002) and numerous other studies (Hiltz & Wellman, 1997; Rovai, 2002; Rovai & Wighting, 2005) have shown that without interaction with other learners satisfaction levels decrease substantially. The positive relationship between satisfaction levels, based on the interaction of fellow learners using a VLC in an e-learning environment, and levels of learning have been established (Arbaugh 2002). A great deal of research (El-Bishouty, Ogata & Yano, 2007; Kim & Baylor, 2006; Hooper, 1992; Slavin, 1995) has illustrated that the human interaction, support and interpretation facilitated by P2P modes integrated into VLCs dramatically increase the quality of learning, both in terms of gains in knowledge and the satisfaction of participants. People learn in a multitude of ways. While the foundation of learning in our educational system will long remain the standard classroom with an instructor and her charges, VLCs will increasingly constitute a significant component in the pantheon of learning forms. VLCs represent the interface between technology and cognitive psychology. They require a computer and access to the internet, but are unconstrained by place or time. A rudimentary program will offer review components and even supplementary material. But, simply providing more static information or even access to further information via the Web, only derives a slight value from this technology. A key component to a viable VLC is the interactive mode that allows learners to exchange and share knowledge. The success of a learner's learning is often a function of the learner's sense of community within the learning environment. A sense of isolation and solitary effort can engender decreased satisfaction which in turn can negatively affect the desire to study and consequently the results of those studies. Facilitating extra-classroom, online learner interaction gives access to other minds engaged in the same educational pursuit, but of greater import it creates a sense of community that increases the satisfaction with the learning project and thereby increases the quality and the bounds of the learning.

Advances in the understanding of cognitive psychology vis-a-vis structured learning environments have also informed the design of VLCs. The manner in which people intake and comprehend information is not universal. That cognitive style varies from learner to learner means that a VLC that gives the greatest benefit to learners must offer a variety of modes that correspond to various cognitive styles. It has been thoroughly documented that (Renzulli, 1994, Dunn & Dunn, 1994) when the format of instruction is matched to the learner's cognitive style, learners are able to make greater strides in comprehension. This in turn enhances the learner's positive attitude toward the learning project. These two elements, heightened gains in understanding and elevated satisfaction levels, become mutually reinforcing. She and Fisher (2003) stated that the fundamental element in a learning environment is the relationship between instruction methods and learners' cognitive styles. The large body of research that has explored the impact of instruction format on learning success has informed the approach to instruction that educators adopt in a traditional classroom setting. This understanding is equally crucial in the design of a VLC. A VLC that offers users a choice of modes that best matches their cognitive style

will allow each learner the chance to excel within a given educational project.

Cognitive style

The concept of cognitive styles, though a hypothetical construct, has been a practical tool for research in many fields that touch on education and learning. Researchers have posited a number of definitions to help clarify the concept and thereby delineate its application to research and learning theory. Messick (1984) defined cognitive styles as "characteristic self-consistencies in information processing that develop in congenial ways around the underlying personality trends". Witkin, Moore, Goodenough and Cox (1977) referred cognitive style to the individual differences in perception, thinking, problem solving and learning. It is the special individual style or method used when engaging in cognitive activities (Witkin & Goodenough, 1981; Riding & Cheema, 1991; Morgan, 1997). One major measurement often utilized within contemporary research concerned with both theoretical and applied education/learning is that of field-independence and field-dependence. This particular distinction of cognitive styles was initially suggested by Witkin et al. in 1954 and was also referred to as psychological differentiation (Witkin et al., 1962) or field articulation. Using this concept to differentiate between cognitive styles has been helpful in designing the fundamental characteristics of advanced educational technologies (Chinien & Boutin, 1992/1993). This division of cognitive styles uses The Embedded Figures Test (EFT) as the standard categorization tool used to distinguish the degree of field independency or field dependency of a given study's participants (Messick, 1962). Field in/dependency categorization locates learners between two extremes of a continuum. Those located at either end of the spectrum are characterized as FD or FI, while learners in the middle are characterized as FM (Liu & Reed, 1994). Field independency refers to the learner's ability to separate the relevant from the irrelevant in a presented field of information. The less a person is influenced by irrelevant field elements, the closer they approach the FI end of the spectrum and are more likely to utilize an analytical approach to process information. Participants that fall under the other end of the spectrum are more influenced by irrelevant elements and considered more global or FD (Wu, 1987). It should be noted that these cognitive distinctions are in no way related to intelligence. They represent simply the manner in which a learner processes information. It is not a reflection of the ability to understand the information

Chapelle and Roberts (l986) found that FI learners are not as influenced by social orientation or extrinsic motives as FD learners, and find greater learning success in educational environments that are shed of extraneous inputs. This type of learner employs an analytical approach to the processing of information and enjoys independent study. Where FI learners function best, in terms of learning, in environments unencumbered by extraneous inputs, FD learners require a positive external environment, gregarious social orientation and extrinsic motives. The latter prefer global and collaborative learning, and enjoy the peer guidance which can reduce learning anxiety and foster greater learning interest. Garger and Guild (1984) also found that FD learners prefer a learning environment in which they can interact and discuss with others, and that FI learners prefer a teaching method that is purely a dissemination of the facts.

In short, cognitive style is the individual's form of perception during information processing and is equally apparent in the manner in which an individual approaches and solves a given problem. It is a non-intelligence personal characteristic but it can significantly influence the process and thereby the results of learning. Any comparative discussion of learning performance should consider the influence of cognitive styles.

METHOD

Experiment Design

Microsoft Technology Associate certification examination (Exam-98349) (Microsoft, 2011) used in this study, as the basis for the instruction goals and the learners' examination outcomes as a measurement tool. The experiment consisted of three steps. Firstly, learners received a prior knowledge test of Exam-98349 (Prior-test) and computerized EFT to determine their cognitive styles. Secondly, learners were divided according to their cognitive styles and were then randomly assigned to one of three guidance methods of VLC. They were then introduced to the VLC system in Microsoft certification training project. This project was tough by the same instructor and learners were asked to use the VLC system after class. Finally, learners took the official examination of Exam-98349 (Official-exam) held at Certiport test center.

Experiment System

The VCS is designed around a Question and Answer (Q&A) format by Hsieh (2011). If a user chooses an incorrect answer to a given question, VCS provides three modes, a lecture mode (Figure 1), a discussion mode (Figure 2) and a mix mode (Figure 3), that will help users to find and comprehend the correct answer. The lecture mode supplies information and content related to the question that was erroneously answered.

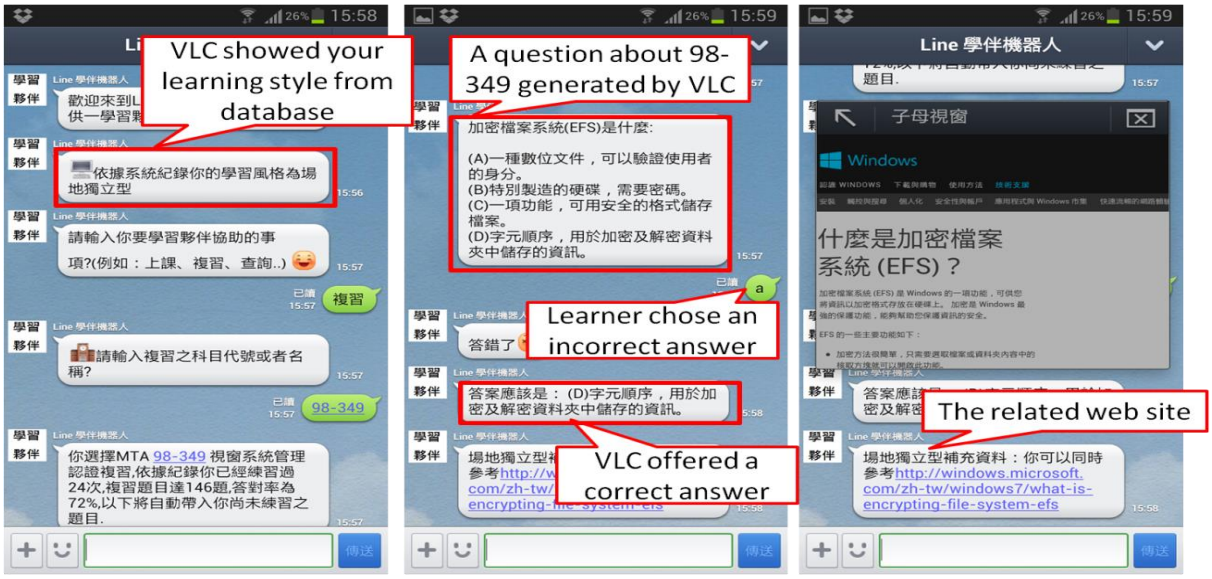

Figure 1. Lecture mode guidance of VLC

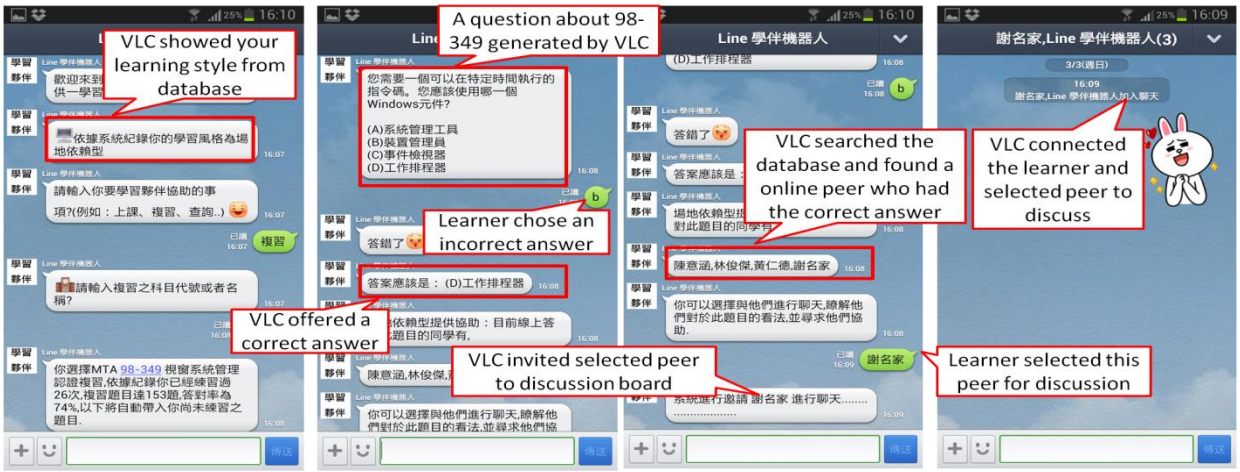

Figure 2. Discussion mode guidance of VLC

Figure 3. Mix mode guidance of VLC

The discussion mode provides peer discussion opportunities when learners give erroneous answers. The mix mode combines the lecture mode and discussion mode when learners give erroneous answers.

The Participants

The experiment was conducted at a university in southern Taiwan. Five classes comprised of 198 four

different graders and taught by the same teachers participated in this study. They were selected from the learners who had participated in the Microsoft certification training project and had not taken the official Microsoft certification examination before. 54.21% of them were male students and 45.79% were female students; 24.11% of the students were 19 years or younger, 27.03% of the students were 20 years old, 23.11% of the students were 21 years old, and 25.75% of the students were 22 years or older.

At the beginning of the experiment, participants took the EFT to classify their cognitive styles. Because the EFT identifies cognitive styles along a continuum which is scored between the ranges of 0 (FD) to 32 (FI) depending on the number of figures traced correctly, this study has followed the statistical procedure of using the upper and lower one third of the EFT scores to identify extreme FD and FI participants (Spanier & Tate, 1988). Sixty-six participants who took the EFT are considered FD (their EFT scores are located at the lower one third and their average score is 5.46). Another group of 66 participants are considered FI (their EFT scores are located at the upper one third and their average score is 20.79). The remaining 66 participants (one third of the whole group) who took the EFT are considered FM (their EFT scores are located at the middle one third and their average score is 15.21). Each cognitive style learners were randomly assigned to the three guidance methods of VLC.

RESULTS AND DISCUSSIONS

The Effect of Prior Knowledge Test

In order to examine if their prior knowledge of Exam-98349 was significantly different, a self developed question was adopted as a prior-test. The prior-test grades of the three cognitive styles were analyzed by one-way ANOVA to determine if the cognitive styles had significantly different prior knowledge related to the knowledge of Exam-98349 as shown in Table 1. The result shows that their prior knowledge was not significantly different (F=0.074, p-value=0.928). That is, the three cognitive styles of students had equivalent knowledge of Exam-98349 before participating in the learning activity.

Learning Performance of Official Exam

Descriptive statistics of learners' Exam-98349 scores on the prior-test and official-test were shown in Table 2. Since this study discusses how, if any, the variables of different guidance methods offered in a VLC and the variables of learners' cognitive styles affect learning performance that is mean score of official-test. Hence,

Table 1. Descriptive statistics of students' prior knowledge of Exam-98349

Cognitive styles	N	Prior-test mean / S.D.	F
FD	66	28.750/4.410	0.074
FI	66	28.689/4.462	
FM	66	28.971/4.393	

Table 2. Descriptive statistics of students' learning performance on the Prior-test and official-exam

Cognitive styles	Guidance methods of VLC	N	Prior-test mean / S.D.	Official-exam mean / S.D.
FD	Discussion mode	22	29.209/4.452	76.391/8.101
	Lecture mode	22	28.300/4.622	70.582/6.886
	Mix mode	22	28.741/4.312	74.818/8.586
FI	Discussion mode	22	28.895/4.414	70.577/6.879
	Lecture mode	22	28.100/4.666	77.409/5.270
	Mix mode	22	29.073/4.449	71.491/8.984
FM	Discussion mode	22	29.077/4.334	74.155/7.861
	Lecture mode	22	28.936/4.455	74.418/6.105
	Mix mode	22	28.900/4.591	77.823/5.302

Table 3. Two-way ANOVA on learners' learning performance

Source	SS	df	MS	F
Cognitive styles	181.906	2	90.953	1.743
Guidance methods of VLC	33.433	2	16.717	0.320
Cognitive styles × Guidance methods of VLC	1153.211	4	288.303	5.524***

***p<0.001,

we used cognitive styles and guidance methods of VLC as independent variables; and learning performance as dependent variable to conduct the two-way ANOVA, as shown in Table 3.

The results shown in Table 3 illustrate that both the main effects of cognitive styles (F=1.743, p-value=0.178) and guidance methods of VLC (F=0.320, p-value=0.726) were not statistically significant. This means that learners with different cognitive styles or guidance methods of VLC did not in themselves produce a significant difference within learning performance. However, the effect of the interaction between cognitive styles and guidance methods of VLC was significant (F=5.524, p-value<0.001). These results showed that the cognitive styles or guidance methods of VLC had an interactive effect on learning performance.

In order to further understand the interactive effect between cognitive styles and guidance methods of VLC, this study used simple main effect as the post-hoc analysis, as shown in Table 4. It showed that the learning performance of FD learners in discussion mode, lecture mode and mix mode was significant different (F=3.190, p=0.048). The Fisher's Least Significant Difference (LSD) showed that the learning performance of FD learners in discussion mode (Mean=76.391) was higher than in lecture mode (Mean=70.582) (p=0.017).

The learning performance of FI learners in discussion mode, lecture mode and mix mode was also significant different (F=5.827, p=0.005). The post hoc test of LSD showed that the learning performance of FI learners in lecture mode (Mean=77.409) was higher than in discussion mode (Mean=70.577) (p=0.003) and mix mode (Mean=71.491) (p=0.008).

In addition, when the learning mode of the VLC was discussion mode, the learning performance of FD, FI and FM learners was significant different (F=3.248, p=0.045). The LSD test results showed that learning performance of FD learners (Mean=76.391) was higher than that of FI learners (Mean=70.577) (p=0.014).

Table 4. Summary of simple main effect analysis for learning performance

Source	N	Mean	S. D.	F-value	Post-hoc (LSD)
Guidance methods of VLC					
FD	66	73.930	8.152	3.190*	Discussion > Lecture*
FI	66	73.159	7.723	5.827**	Lecture > Discussion**, Lecture > Mix**
FM	66	75.465	6.627	2.172	
Cognitive styles					
Discussion mode	66	73.708	7.892	3.248*	FD > FI*
Lecture mode	66	74.136	6.653	6.873**	FI > FD***, FM > FD*
Mix mode	66	74.711	8.109	3.627*	FM > FI*

$^{*}p<0.05$, $^{**}p<0.01$

Table 5. Descriptive data and ANOVA of the learning performance

Groups	N	Prior-test mean / S.D.	Official-exam mean / S.D.	F-value
Matched[a]	66	28.736/4.524	77.208/6.295	17.165***
Mismatched[b]	132	28.837/4.355	72.674/7.693	

$^{***}p<0.001$

a. **Matched Groups**: *The students who received the matched guidance method. That is, the group of students with FD style received the "discussion mode" guidance method. Those who are characteristic with FI style received the "lecture mode" guidance method. And, those who are characteristic with FM style received the "Mix mode" guidance method.*

b. **Mismatched Groups**: *The students who received the mismatched guidance method. That is, the group of students with FD style received the "discussion mode" or "Mix mode" guidance method. Those who are characteristic with FI style received the "lecture mode" or "Mix mode" guidance method. And, those who are characteristic with FM style received the "discussion mode" or "lecture mode" guidance method.*

Table 6. Descriptive data and ANOVA of the learning performance

Groups	N	Prior-test mean / S.D.	Official-exam mean / S.D.	F-value	Post-hoc
Matched[a]	66	28.736/4.524	77.208/6.295	11.595***	Matched>Partial-matched**
Partial-matched[b]	88	28.957/4.314	73.721/7.551		Matched>Non-matched***
Non-matched[c]	44	28.598/4.477	70.580/6.802		Partial-matched>Non-matched*

$^{*}p<0.05$,$^{**}p<0.01$,$^{***}p<0.001$

a. **Matched Groups**: *The students who received the matched guidance method. That is, the group of students with FD style received the "discussion mode" guidance method. Those who are characteristic with FI style received the "lecture mode" guidance method. And, those who are characteristic with FM style received the "Mix mode" guidance method.*

b. **Partial-matched Groups**: *The students who received the partial-matched guidance method. That is, the group of students with FD and FI style received the "Mix mode" guidance method. Those who are characteristic with FM style received the "Lecture mode" or "Discussion mode" guidance method.*

c. **Non-matched Groups**: *The students who received the non-matched guidance method. That is, the group of students with FD style received the "Lecture mode" guidance method. Those who are characteristic with FI style received the "Discussion mode" guidance method.*

When the learning mode of the VLC was lecture mode, the learning performance of FD, FI and FM learners was also significant different (F=6.873, p=0.002). The LSD test results showed that the learning performance of FI learners (Mean=77.409) was higher than that of FD learners (Mean=70.582) (p=0.000), and the learning performance of FM learners (Mean=74.418) was higher than FD learners (Mean=70.582) (p=0.042).

When the learning mode of the VLC was mix mode, the learning performance of FD, FI and FM learners was also significant different (F=3.627, p=0.032). The LSD test results showed that learning performance of FM (Mean=77.823) was higher than that of FI (Mean=71.491) (p=0.011).

These results are similar to the findings of Garger and Guild (1984) and Hsieh (2011). Based on these studies' suggestions regarding the matching of cognitive styles and guidance methods of VLC, the combination of cognitive styles and guidance methods of VLC was classified into matched/mismatched groups. Learners who were in the matched group were FD learners who were guided by using discussion mode, FI learners who were guided by using lecture mode and FM learners who were guided by using mix mode. Learners assigned to the mismatched group were FD learners who were guided by using lecture or mix mode, FI learners who were guided by using discussion or mix mode and FM learners who were guided by using discussion or lecture mode, as shown in Table 5.

Learners' learning performance was compared in terms of the matched/mismatched combination of cognitive styles and guidance methods of VLC. A one-way ANOVA was used to test the matched/mismatched groups. The result suggested that learners involved in the matched groups had significantly better learning performance than those in the mismatched groups (F=17.165, p<0.001). That is, matching the cognitive styles of learners with the associated guidance methods will significantly improve the learners' scores of Official-exam within a VLC learning context.

In the mismatched groups, the FD and FI learners who were guided by using mix mode and FM learners who were guided by using discussion or lecture mode may partially match their cognitive style. Therefore, we further divided mismatched groups into partial-matched groups and non-matched groups, as shown in Table 6. A one-way ANOVA was also used to test the matched/partial-matched/non-matched groups. The result suggested that learners involved in these three groups had significantly different (F=11.595, p<0.001). The results of LSD test showed that the matched groups were higher than partial-matched group (p=0.003), the matched groups were higher than non-matched group (p<0.001) and the partial-matched groups were higher than non-matched groups (p=0.019).

That is, matching the cognitive styles of learners with the associated guidance methods will significantly improve the learners' learning performance than the other two groups. Even partially matching the cognitive styles of learners with the guidance methods will also significantly improve the learners' learning performance than the non-matched groups.

CONCLUSIONS

This study uses the FI, FD and FM categorization to understand the influence of VLC design on a learner's success. The program VLC used for the study offers three distinct learning modes. Each mode corresponds to the psycho-cognitive requirements of FI, FD or FM learners. The results obtained through this study strongly confirm previous studies that consider the role of VLC design on learning success (Hsieh, 2011; Kraus, Reed and Fitzgerald, 2001). When a VLC allows learners to tailor the mode in which learning occurs to the method that suits their cognitive style they will see an increase in both the amount that is learned and their outcome in the learning process. These two elements are mutually reinforcing and in tandem account for some of the elevation. The concept of bolstering learning by understanding the diversity of cognitive styles and then meeting these needs through corresponding teaching styles is not limited to educational technology. The import of the forms that information transfer assumes has been studied in traditional classroom settings. Dunn and Dunn (1994) found that when the instruction and teaching resources correspond to learners' unique cognitive styles, their learning performance will be elevated and their attitude toward learning become more positive. For the study, participants were relegated to one of three categories matched, non-matched or partially-matched. In actual use the student, regardless of cognitive style, would use any modes to learn. When the student simply wanted to verify a fact they would use the lecture mode, and when they required more clarification they would choose the P2P mode.

While the FI/FD/FM spectrum is a significant and recognized tool, there are many other subtleties of cognition that affect learning. Gender, age, cultural background and IQ all impact the manner in which we learn. Further studies in a variety of areas will all inform the development of educational practices and the design of next generation VLCs.

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