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A Study of Learning Attitude and Motivation under Different Learning Object Recommendation Strategies from Learning Style Perceptive

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Abstract: In this paper, we investigate, the learning attitude, motivation and learning perceptions (including the Satisfaction for learning mode, technology acceptance, mental effort and mental load) of two groups of learners who studied with two different modes of a learning support systems. Group A of 31 students studied with Open Mode which provides learners with both visual and verbal learning objects while group B of 34 students studied with Style-Matching Mode which provides visual learners with only visual learning objects and verbal learners with only verbal learning objects. The learning attitude, motivation, and learning perceptions of these two groups are investigated and analyzed from learning style perspective.

Keywords: personalized learning, learning attitude and motivation, learning style, mental effort, mental load

1. Introduction

To provide personalized learning scenarios in response to learner characteristics, adaptive systems (Essalmi et al., 2010; Filippidis & Tsoukalas, 2009; Hwang et al., 2012) incorporate various elements into their design. Essalmi et al. (2010) identified 16 most commonly used personalization parameters which includes knowledge level, motivation level, learning styles, media preference, and so on.

In this paper, from perspective of Visual/Verbal learning style, we investigate learning attitude, motivation and learning perception under the following two different strategies for learning object suggestion in a customizable language learning support system: (a) present both visual and verbal styles of learning objects and let learners freely choose; (b) suggest the learning objects whose types match learners' learning styles. By the analysis of the learner data, we intend to reveal the differences between these two strategies and explore a learning object recommendation strategy which could improve learning performance more effectively in the target course.

2. Related Work

2.1. A Customizable Language Learning Support System

To enable personalize learning, a customizable language learning support system (CLLSS) has been developed (Wang et al., 2013). For supporting learning in response to the learner's knowledge structure, a "course-centered ontology" (i.e. an ontology based on a specific course) for the description of domain knowledge network was presented and a "individual-class-individual" ontology design was applied to the construction of a course-centered ontology for an existing Japanese grammar course (Wang et al., 2014). A preliminary evaluation (Wang et al., 2013) and a further study from perspectives of learning styles, habits (Wang et al., 2014) and motivation (Wang and Mendori, 2015) have been conducted to evaluate the effectiveness of the "knowledge comparison function" which is intended to support learners to better understand every knowledge point (KP) by the comparison with its related KPs. In this

research, a **KP** is defined as "*a minimum unit which can independently describe the information of one knowledge* "; a KP can be acquired by practice or can be understood by its own expression. A KP in the target grammar course is called **grammar point** (**GP**). On the other hand, a teaching method ontology considering learning style and media preference is also adopted in CLLSS as the foundation for metadata creation of learning objects. One **learning object** (LO) in this study, was designed *either to provide an explanation of one GP or one relation between two GPs, or to provide a practice that encourage learners to apply some grammar rules which involved a GP or some GPs*. For each target GP, two kinds (verbal and pictures or diagrams) of exposure with explanation, and at least two verbal practices and two visual practices, were prepared by two expert teachers (details were described in (Wang and Mendori, 2013)). However, how reasoning mechanism in CLLSS analyzes the learner's characteristics and how to suggest types of LOs in response to individual profile are still unsolved yet.

2.2. Felder-Silverman Learning Style Model

There are over 70 learning style models in the literature (Coffield et al. 2004). Different models are used by various adaptive systems to classify learners into supposedly distinct groups or to assign learners graded scores on single or multiple dimensions (Pashler et al., 2009). Specifically, the differences in visual-verbal dimension is suggested by many cognitive style models (Cooper, 1997; Felder & Silverman,1988; Felder & Henriques, 1995; Kirby et al.,1988; Richardson; 1977; Riding, 1991), especially the widely adopted Felder-Silverman learning style model (FSLSM) which carefully formulates visual-verbal differences. In this study, Index of Learning Styles (ILS) are used to assess cognitive styles of the participants. ILS is an instrument designed based on FSLSM, which defines four dimensions of learning style: Active/Reflective, Sensing/Intuiting, Visual/Verbal, and Sequential/Global, and its current version was suggested to be reliable, valid and suitable (Felder and Spurlin, 2005) for capturing learners' behavioral tendencies. The details of these four dimensions were described by Wang et al. (Wang and Mendori, 2013)).

For designing a better strategy of LO recommendation to balance the learner's motivation and improve learning effectiveness, we conducted an experiment which focuses on the Visual/Verbal dimension of FSLSM to investigate the learning performance differences under two modes of CLLSS: Open Mode, which provides the learners with both visual and verbal LOs, and Style-Matching Mode, which provides visual learners with only visual LOs and verbal learners with only verbal LOs. In previous work (Wang and Mentori, 2013), it is found that Students who studied with Open Mode, had more difficulty to focus on study compared to those who were provided with only the LOs matching their learning styles under Style-Matching Mode while both using CLLSS to study target GPs. However, no significance was found in other learning perceptions. In this paper, we will further analyze learning attitude/motivation and the satisfaction for learning mode.

3. Participants and Experimental Procedures

The learner data, which were collected from 65 first-grade undergraduates from three Chinese universities, are analyzed in this paper. Before the experiment, those students of Japanese major from 3 different classes already studied Japanese for six month. In previous classroom teaching, they only received verbal teaching methods and hardly received any visual explanation or practice. In the preparatory phase, a questionnaire was conducted to collecting learning style distribution. The adopted measuring tool in this phase was a questionnaire written in Chinese, translated from ILS questionnaire of 44 questions (Soloman and Felder, 2001). Given visual/verbal dimension as an example, based on the responses to its related 11 items, participant would be identified as having strong, moderate or mild preference for visual or for verbal. Learner with strong or moderate preference for one category normally is stably exhibiting consistent learning behavior. Conversely, learner with mild preferences would be expected to shift their preferences in learning activities readily.

All the participants including 12 male and 53 female students were voluntarily to fill in ILS questionnaire. To minimize group composition differences, students from each class were assigned to be experimental group A and B based not only on their learning styles in Visual/Verbal dimension but also their learning achievement in last semester's final exam. Fig.1 illustrates learning styles profiles of participants in each groups based on their responses to ILS questionnaire. Group A (26 visualizers and 8

verbalizers) studied with Open Mode which provides learners with both visual and verbal LOs while group B (24 visualizers and 8 verbalizers) studied with Style-Matching Mode which provides visualizers with only visual LOs and verbal LOs.

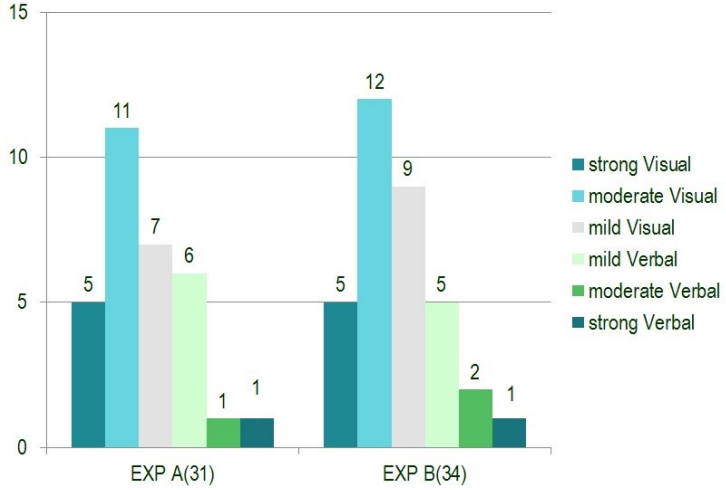

Figure 1. Participant profiles from the learning style (Visual/Verbal dimension) perceptive.

Both groups were required to fill an attitude/motivation questionnaire including 14 items before and after a 90-mins learning activity. These 14 items written in Chinese were designed based on measure tools of other researches (Hwang and Chang, 2011; Pintrich and DeGroot, 1990) with some modifications. Participants were instructed to respond to each item on a 6 point scale (1-3: strongly to slightly disagree, 4-6: slightly to strongly agree). On the basis of the Factor analysis results, two scales were constructed: the attitude towards Japanese grammar learning (AJG, 7 items, a=0.905) and the motivation towards Japanese language learning (MJL, 7 items, a=0.895, includes expectancy in the Japanese course and the perceived intrinsic value of the course). Besides the attitude/motivation questionnaire, after the learning activity students also took another questionnaire which involved 13 items related to learning perception after the post-test. Factor analysis of these 13 items revealed 4 distinct scales: technology acceptance measures (2 items, a=0.630), mental effort (2 items, a=0.790), mental load (2 items, a=0.777), the satisfaction for learning mode (7 items, a=0.854). In all the calculations of this paper, the mean of items in a scale will be used to represent the ranking of that scale.

4. The Analysis and Discussion of experimental results

The first question of this paper is if the participants had any change in their attitude and motivation after the learning activity. Table 1 shows the t-test results of the participant's responses to the attitude/motivation questionnaire before and after the learning activity. It is found that after the learning activity, students in both groups had significant improvements in both their attitudes towards Japanese grammar learning (Open Mode: $t= -4.09$, $p< .001$; Style-Matching Mode: $t= -5.55$, $p< .001$) and their motivations towards Japanese language learning (Open Mode: $t= -3.14$, $p< .01$; Style-Matching Mode: $t= -4.47$, $p< .001$). However, the ANCOVA results suggest that no significant difference in their attitude and motivation changes between these two groups.

Table 2 and 3 further describe the correlations between learning attitude/motivation and learning styles before and after the learning activity. As shown in Table 2, the stronger visual preferences identified by ILS a learner had, the lower learning motivations towards Japanese language learning($r = - 0.316$) she/he hold. This situation mainly is because all the students only received verbal types of explanation and practices in regular classes. For the visual learners, only received style-unmatched learning materials will increase their frustration and lower their learning motivation. As shown in Table 3, after the learning activity, those who studied with open mode, had a balance motivation from learning style perceptive, especially in visual dimension ($r =0.018$). However, despite the small amount of data, for those who studied with Style-Matching mode, more visual they were identified by ILS, the lower learning motivation they were still inclined to had ($r = - 0.277$). These results suggest that compare to Style-Matching mode, Open mode provided an environment which can balance learning motivation more efficiently.

Table 1: The t-test result of the pre- and post- attitude/motivation questionnaire rankings.

	Group		Mean	S.D	t-test	ANCOVA
AJG	Open(31)	Pre-AJG	4.76	0.72	-4.09***	(Levene's Test: sig=0.509) F=0.468 Sig=0.497
		Post-AJG	5.10	0.71		
	Style-Matching (34)	Pre-AJG	4.80	0.67	-5.55***	
		Post-AJG	5.19	0.54		
MJL	Open(31)	Pre-MJL	4.76	0.70	-3.14**	(Levene's Test: sig=0.677) F=1.622 Sig=0.208
		Post-MJL	5.10	0.51		
	Style-Matching (34)	Pre-MJL	4.92	0.65	-4.47***	
		Post-MJL	5.31	0.54		

**p< .01 ***p< .001

Table 2: The correlations among AJG/MJL and learning styles before the learning activity.

	Active	Sensing	Visual	Sequential
Pre-AJG(65)	-.233	0.083	-0.211	0.080
Pre-MJL(65)	-0.148	-0.023	-0.316*	0.168

*p< .05

Table 3: The correlations among AJG/MJL and learning styles after the learning activity.

Group		Active	Sensing	Visual	Sequential
Open (31)	Post_AJG	-0.070	0.295	-0.116	0.197
	Post_MJL	0.159	0.237	0.018	0.223
Style-Matching (34)	Post_AJG	-0.238	0.076	-0.085	-0.145
	Post_MJL	-0.073	-0.192	-0.277	-0.067

The second research questions concerned which individual differences caused learning perception differences in these two groups. In this paper, we consider learning styles and learning attitude/motivation before the learning activity as individual differences. As shown in Table 4, for those who studied with Open mode, the stronger visual preferences they were identified by ILS, the higher satisfaction they perceived for the learning mode (r = 0.472); the higher motivation they had before the learning activity, the lower mental effort they perceived (r = - 0.472). For those who studied with Style-Matching mode, the higher attitudes they had before the learning activity, the lower mental effort they perceived(r = - .386); however, their learning perceptions have no significant relations with their learning styles.

Table 4: The correlations among learning perceptions and individual differences.

Group	Perception		Active	Sensing	Visual	Sequential	Pre-AJG	Pre-MJL
	Scale	Mean						
Open (31)	Satisfaction	4.61	.093	.024	.472**	-.070	.124	-.124
	Tech-Accep	4.85	-.184	-.038	.102	-.196	.081	-.191
	Mental Effort	3.16	-.001	.231	.019	.161	-.333	-.472**
	Mental Load	2.13	-.019	.229	-.016	.030	-.041	-.026
Style-Matching (34)	Satisfaction	4.83	.112	.040	.104	.248	.240	.287
	Tech-Accep	5.03	-.157	.103	.135	-.043	-.101	-.012
	Mental Effort	3.15	0.147	-.101	.177	-.243	-.386**	-.239
	Mental Load	1.90	0.156	-.176	-.112	-.289	-.242	-.178

**p< .01 Tech-Accep: Technology acceptance

The third research questions concerned what affects the variation of learning attitude and motivation. Table 5 shows the Pearson's correlation coefficients computed between the rankings of attitude and motivation scales before and after the learning activity. As predicted, the learner's AJGs were associated with MJLs in both groups no matter before (Open Mode: r =0.643; Style-Matching Mode: r =0.798) or after (Open Mode: r =0.612; Style-Matching Mode: r =0.697) the learning activity.

Furthermore, for Open mode group their Post_AJGs were only positively related to Pre_AJGs while for Style-Matching Mode group their Post_AJGs were positively correlated with Pre_AJGs (r =0.792) and Pre_MJLs(r =0.561). On the other hand, Post_MJLs were positively correlated with Pre_AJGs (Open Mode: r =0.486; Style-Matching Mode: r =0.518) and Pre_MJLs (Open Mode: r =0.522; Style-Matching Mode: r =0.649) for both groups. However, there could be other factors implicated in the variation of learning attitude and motivation. Therefore, relations between participants' learning attitudes/ motivations and learning perceptions need to be further investigated.

Table 6 reveals the correlations among AJG, MJL and learning perception indicates. For students who studied with Open Mode, no significant differences was found between Post_AJGs/MJLs and learning perceptions. Therefore, as reveals in Table 5, their Post_AJGs were only related to Pre_AJGs. Althought Table 5 also shows that Post_MJLs were positively correlated with Pre_AJGs and Pre_MJLs, regression analysis (R =0.522) further reveals that Post_ MJLs only were significantly related to Pre_ MJLs. In the other hand, for those who studied with Style-Matching Mode, Table 6 shows that their Post_AJGs and Post_MJLs were both related to their rankings of Satisfaction scale. As described in Table 5, they also were both related to Pre_AJGs and Pre_ MJLs. Regression analysis revealed that Post _AJGs (R =0.852) were significantly related to Pre_AJGs and the rankings of Satisfaction scale and Post_ MJLs (R =0.774) were significantly related to Pre_ MJLs and the rankings of Satisfaction scale. In summary, for both groups, learners' attitude and motivation were directly affected by their prior attitudes and prior motivations, respectively; however, for Style-Matching group, their perceived satisfaction for the learning mode also directly affect their attitude and motivation.

Table 5: The correlations among AJG and MJL.

		Pre_AJG	Pre_MJL	Post-AJG	Post-MJL
Open (31)	Pre_AJG				
	Pre_MJL	.643**			
	Post_AJG	.794**	.259		
	Post_MJL	.486**	.522*	.612**	
Style-Matching (34)	Pre_AJG				
	Pre_MJL	.798**			
	Post_AJG	.792**	.561**		
	Post_MJL	.518**	.649**	.697**	

*p< .05 **p< .01

Table 6: The correlations among AJG, MJL and other learning perception indicates.

Group		Satisfaction	Technology acceptance	Mental Effort	Mental Load
Open (31)	Post_AJG	0.301	0.143	-0.136	0.044
	Post_MJL	0.214	-0.174	-0.083	0.170
Style-Matching (34)	Post_AJG	0.511**	0.054	-0.184	-0.324
	Post_MJL	0.619**	0.012	0.019	-0.150

**p< .01

5. Conclusion

From the perspective of learning style, this paper conducted an experiment for evaluating different strategies for LO recommendation in language learning support system (called CLLSS). Since this experiment focus on the Visual/Verbal dimension of learning style, two modes were provided by CLLSS in this experiment: Open Mode, which provides learners with both visual and verbal styles of LOs, and Style-Matching Mode, which provides visual learners with only visual LOs and verbal learners with only verbal LOs. The discussion about research questions is concluded in there:

(1) After the learning activity, students in both groups had significant improvements in both their attitudes towards Japanese grammar learning and their motivations towards Japanese language learning. Compare to Style-Matching mode, Open mode provided a learning environment which can balance the learning motivation more efficiently.

(2) For those who studied with Open mode, the stronger visual preferences they were identified by ILS, the higher satisfaction they perceived for the learning mode; the higher motivation they had before the learning activity, the lower mental effort they perceived. On the other hands, for those who studied with Style-Matching mode, the higher attitudes they had before the learning activity, the lower mental effort they perceived; however, no significant relations between learning perceptions and learning styles is found.
(3) For those who studied with Open Mode, their learning attitude towards Japanese grammar can be predicted from their prior attitude and their motivation towards Japanese Language can be predicted from their prior motivation. However, for those who studied with Style-Matching Mode, their attitudes and motivations were not only positively correlated with their prior attitudes and prior motivations, respectively, but also directly related to their perceived satisfaction for learning Mode.

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