Do College Students Adapt to Personal Learning Environment (PLE)? A Single-Group Study

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Abstract. Home-based online learning is a typical application of personal learning environment. Understanding the adaptability and characteristics of college students in the personal learning environment (PLE) can effectively tap the potential of online courses and provide valuable references for learners' online and lifelong learning. In this single-group study, 80 college students received a 90-min self-regulated learning training. In pre- and post-class evaluations, media multi-tasking self-efficacy, perceived attention problems, self-regulation strategies and learning satisfaction are used as key variables in online learning to assess their personal learning environment adaptability and characteristics. Using descriptive statistics and one-dimensional intra-group variance to analyze the data, it was found that: Learners have a moderate degree of attention deficit in their personal learning environment, which is manifested in three aspects: perceived attention discontinuity, lingering thought, social media notification.; Under simple training or natural conditions, students have poor adaptability in the personal learning environment, and their behavior perception and behavior adjustment levels have improved, but they have not yet reached expectations; Participation in online learning has significantly increased the application of learners' self-regulation strategies, especially the application of behavior strategies.

Keywords: Personal Learning Environment (PLE) · Online learning · Self-regulated learning · Single-group design · Attention deficit

1 Introduction

In order to actively respond to the negative impact of the new crown epidemic on education, the Ministry of Education of China has issued a response to "No suspension of classes", effectively solving the problem of "No suspension of classes" for college students. The biggest impact of the epidemic on students is the transition from studying at school to online learning at home. Adapting to the home online learning environment is the key to ensuring the quality of learning. Personal learning environment (PLE) is a combination of tools created under the concepts of openness, interoperability, and learner control (Siemens 2008). Since the new semester, under the guidance of teachers, many

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Chinese college students have built a personal learning environment with online learning platforms, social software, cognitive tools and home environment as key components. As an educational emergency, whether students can effectively construct and adapt to their personal learning environment and provide students with high-quality learning resources is a concern of the whole society. Studies have shown that live teaching in online learning at home is full of conditions, and students' low efficiency has caused various doubts and complaints (Song et al. 2020).

Online learning opens the door to lifelong learners, who tend to use online learning to satisfy personal or professional interests (Alonso-Mencía et al. 2019). Home-based e-learning is the epitome of lifelong Learning, which learners experience knowledge acquisition and construction in a personal learning environment. The development of technology has enhanced the accessibility of lifelong education. Martínez-Martínez et al. (2019) believe that guiding students to use Web 2.0 for lifelong learning can make it easier for them to build personal learning spaces, access and update their learning materials, and reduce the difficulty of current and future lifelong learning. Alonso-Mencía et al. (2019) believe that the importance and complexity of self-regulation is essential to online learning, and it is related to tapping the potential of online courses and supporting participants to develop lifelong learning. Therefore, how to enable students to better participate in online learning at home is a problem related to the long-term perspective of lifelong learning. Research on the adaptation status and basic characteristics of the personal learning environment of college students during the epidemic, and discover the influencing factors that hinder their participation in online learning, is a problem for self-directed learning. Ability training and future lifelong learning service design have forward-looking value.

2 Related Work

2.1 Research on the Connotation of Personal Learning Environment

At the level of connotation characteristics, scholars have put forward the concept, connotation and application value of personal learning environment. The idea of personal learning environment was brewed on the basis of the development of ubiquitous computing and social software. The concept was originally derived from the discussion of Virtual Learning Environment (VLE). Scott Wilson (2005) first adopted the Future VLE chart. Describes a preliminary model of the personal learning environment. At present, there still does not have a precise definition of the concept of personal learning environment. Existing studies mostly regard the personal learning environment as a collection of learning tools (Siemens 2008), individual perception of environmental forms (Downes 2005), and learning philosophy (Graham Attwell 2006) and the integration of applications and services (Graham Attwell 2007).

Kompen et al. (2019) proposed the reorganization and reconstruction of learning models and learning resources based on PLE, which is considered as a potential means to realize personalized learning. Learners use appropriate learning tools for self-directed and personalized learning. The integration of social media facilitates learning interaction and informal communication between students (Gillet 2013; Kop and Fournier 2014). Recent studies have shown that as a concept and an emerging practice, the personal learning environment is not only a technology-driven and student-centered learning innovation, but also a challenge and subversion to the concept of traditional knowledge (Castañeda et al. 2019). From the perspective of application value, the personal learning environment is a paradigm that supports digital learning, enabling learners to define, develop and configure learning spaces and experiences by themselves, and provides a choice for community members to choose learning scenarios.

2.2 Research on the Model and Framework of Personal Learning Environment

At the level of model and framework, scholars have proposed personal learning environment models and integrated frameworks from multiple perspectives in order to achieve the goal of technology enhanced learning (TEL). In the dimension of building the personal learning environment model, Scott Wilson (2005) regards the personal learning environment as the coordinator of various services and agents, and pioneered the Future VLE reference model. Afterwards, researchers studied the connotation of personal learning environment from the perspectives of tools, methods, concepts, and scenarios, and successively proposed multiple reference models such as "Ray's PLE", "Reference PLE", and Symbaloo EDU (Downes 2006; Markvan Harmelen 2006; Graham Attwell 2006; Siemens 2008). The proposal and application of these models have enhanced people's understanding of the characteristics and utility of the learning environment, and promoted the development of online learning.

Patterson et al. (2017) proposed that an effective personal learning environment should be a combination of technology, learning mode, and other teaching factors based on a comprehensive analysis of existing personal learning environment models. Bassani et al. (2018) analyzed the advantages of web2.0 to support the construction of learning environment, and constructed a personal learning environment model based on social applications from two levels of tool technical characteristics and tool applicability. In terms of the integration of personal learning environment, researchers believe that it is necessary to adopt a personalized and diversified learning framework based on self-direction and self-management to strengthen the role and responsibility of individuals in organizing, customizing, and reshaping the learning environment (Asuncionet et al. 2010; Johnson et al. 2011; Fiedler et al. 2011). The above models mostly take the "teacher center" as the perspective, emphasizing the integration and integration of learning resources, tools, and services, reflecting the importance of the interaction between learners and the learning environment.

2.3 Applied Research on Personal Learning Environment

At the level of teaching application, scholars pay attention to the preconditions of personal learning environment application, namely, teaching preparation and learning preparation. In the dimension of teaching preparation, the personal learning environment provides rich scenarios for teaching model innovation and evaluation. For example, as Fiedler (2011) pointed out, the personal learning environment may play a role in the transformation of a single, centralized system that dominates and still dominates formal education, and the personal learning environment can not only be used by allowing the use of new methods and methods, and it can help prepare learners for a smooth transition to a changing workplace. Learning theory also believes that the relationship between learners and the environment is the most important medium for creating the teaching and learning process. This process requires the use of traditional and virtual spaces at the same time, and is composed of tools, information sources and activities used by each student for their training to determine the relationship between them (Tomé et al. 2019).

In the dimension of study preparation, the personal learning environment puts forward new requirements for students' study preparation. For example, Kuhn (2017) believes that in order to achieve digital fluency and allow students to benefit from being active in the digital field, students should have an attitude toward technology, an understanding of technical capabilities in an academic context, and the skills to effectively use technology for learning. Jobs. Posner et al. (2012) believe that attention precedes cognitive information processing, and how learners maintain focus and engagement is the basis for cognitive activities. This reminds us that learners realize and intentionally regulate their attention is the key to achieving concentration. In response to this, a survey of 696 Taiwanese students found that the relationship between students' perception of attention problems, self-regulation strategies, and academic performance in a personal learning environment (Wu et al. 2015); and students' academic performance is negatively correlated with perceived attention problems, and positively correlated with self-regulation strategies in the personal learning environment (Wu et al. 2019). In addition, a study by Espinosa et al. (2019) on Spanish college students found that although they have digital abilities when studying college students, they still play a more traditional role. The above research analyzes the opportunities and challenges faced by teachers and students in adapting to the personal learning environment, which provides a theoretical basis for the construction and application of a personal learning environment from the perspective of omni-media ecology.

The personal learning environment is the natural form of autonomous learning. Perception, behavior, evaluation and feedback based on the personal learning environment are important indicators of learners' autonomous learning ability. However, current research focuses on the construction and application of personal learning environment. The focus is on the effectiveness of the autonomous learning model, but little attention is paid to the performance and dynamic changes of individual learners in adapting to the personal learning environment, which makes it difficult to achieve true personality improved learning and learning literacy. Especially for the future lifelong learning that everyone must face, it is more necessary to provide forward-looking and instructive learning strategies. This study adopted a single-group design method to ensure the reliability of the subject experiment (Gay and Airasian 2003) through the use of reliable scales, repeated measures, and detailed descriptions of experimental conditions (eg., measurement conditions and treatment properties). The study of adaptive performance and dynamic characteristics of individual learning environment will provide more operational suggestions for current online learning and future lifelong learning.

3 Method

3.1 Design and Setting

This research was conducted on undergraduates from Shandong Youth University of Political Science (www.sdyu.edu.cn) from February to June 2020. It is a single-group study. After confirming their participation in the research, the students received a 90 min training session. In order to give students time to experience and reflect on their online learning, the training is arranged in the fourth week after the start of the course. The evaluation will be conducted at the follow-up time points at the beginning of the course and the end of the course (Interval of 4 months).

3.2 Participants

Participants are sophomores majoring in hotel management. Affected by COVID-19, participants continued to participate in home-based e-learning for 4 months. The planned class hours during the semester were 128 h), So for the first time they experienced a long period of online learning, after excluding external factors such as work pressure, it is closer to the scene of lifelong learning or on-the-job learning. In addition, students also conducted long-term information retrieval around the course needs. The training is mainly conducted by distance teaching, with a total training duration of 90 min. All participants gave their written informed consent after receiving a complete description of the study.

The demographic characteristics of the participants are shown in Table 1. The majority of participants are female (77.5%), rural college students (72.5%), students are less involved in online before COVID-19, 90% of students have less than 10 courses experience, and 92.5% of them study online for less than 15 h per week, but during the epidemic period, the weekly online study hours of students have increased significantly, with 25% of students saying that the weekly online study time exceeds 15 h. It can be seen that the epidemic has forced students to be exposed to the personal learning environment and generated more online learning experiences.

Table 1. Baseline characteristics of participants (n = 80).

Variable	Value
Age, mean (SD)	21.31(0 .773)
Sex, n (%)	
Male	18(22.5%)
Famale	62(77.5%)
Registered permanent residenc, n (%)	
Rural	58(72.5%)
City	22(27.5%)
Background, n (%)	
Online learning experiences before coVID-19	
None	1(1.3)
[1–3]	31(38.8%)
[4–6]	29(36.3%)
[7–10]	11(13.8%)
>10	8(10%)
Weekly online learning hours before coVID-19	
[1–5]	39(48.8%)
[6–10]	20(25%)
[11–15]	15(18.8%)
>15	6(7.5%)
Weekly online learning hours after coVID-19	
[1–5]	7(8.8%)
[6–10]	26(32.5%)
[11–15]	27(33.8%)
>15	20(25%)

3.3 Self-directed Learning Training

See Table 2 for an overview of the training program. The training content mainly includes the basic concepts of Self-directed learning, habitual behaviors, the relationship between attention and learning, as well as self-regulation methods and time management skills. In addition, teachers also guided students to conduct attributional training for attention problems and learning effects (Weiner 1985; Wu et al. 2017), so that students can consciously associate the success or failure of attention monitoring with self-esteem.

Participants are encouraged to practice the training content outside of class and complete related homework. Before the follow-up evaluation after the training, participants were asked to submit their completed assignments and also received feedback from the researchers. The training program is conducted through video conferences. The training

is taught by a PhD in educational technology. He has received learning and skills training in professional courses such as educational psychology, learning science and technology, and has more than 10 years of experience online teaching experience. Moreover, his research field are digital learning environment and learning behavior analysis.

Table 2. Overview of brief self-directed learning training.

Session	Agenda	Content
1	Introduction	Introduce the purpose and main content of the training
	What is self-directed learning?	The concept and elements of self-directed learning The difference self-directed learning and traditional learning
	The impact of attention and habitual behavior on online learning	Distracting and inappropriate habitual behavior Effects of distraction and habitual behavior on learning engagement
2	Methods of self-regulation	The way and method of self-regulation in learning; Schedule setting, self-rewarding and punishing, online interaction and learning community
	Attribution of learning outcomes	The relationship between Learning expectations and outcomes; The basic skills of negative emotion regulation and positive emotion maintenance
	Review and design action plans	Reviewing and summarizing the day's session; Setting an action plan (homework)

3.4 Instruments

This research mainly evaluated the learning behaviors and results of students' media multitasking, metacognitive skills and learning satisfaction after receiving training during online learning at home. The research tool for media multitasking self-efficacy was the MMSE scale proposed by Wu et al., which had 5 questions. Sample questions included "I can learn and do non-learning activities at the same time, and learn effectively". And "I can talk with my friends by video or audio while learning (such as QQ, WeChat), and I can also study effectively". Responses were rated on a 6-point Likert scale with 1 indicating not confident at all, and 6 very confident. Factor loadings ranged from 0.705 to 0.838 with internal consistency of 0.848.

The learning satisfaction research tool used a scale developed by Alqurashi (2018). Learning satisfaction was measured by four items. Sample questions included "Generally, I am very satisfied with my online learning experience." and "Generally, online learning has deepened my understanding of my learning style." Responses were rated on a Likert scale with 1 indicating extreme disagreement and 5 extreme agreement. Factor loadings ranged from 0.770 to 0.914 with internal consistency of 0.866.

The research tool for meta-attention skills was the OL-MARS scale proposed by Wu et al. (Wu et al. 2015, 2019). All questions on the scale were prepared for college students participating in online learning. In view of the cultural background differences between Taiwanese students and mainland students, the relevant expressions of the OL-MARS scale and the MMSE scale had been revised. For example, the social software such as Facebook mentioned in the original scale had been unified to WeChat and QQ. Then confirm with the team of professor Wu, the scale developer, to improve the reliability and validity of the measured items. Finally, OL-MARS scale included perceived attention problems (PAP) (15) and self-regulation strategies (SRS) (9), responses were rated on a Likert scale with 1 indicating extreme disagreement and 5 extreme agreement. Among them, PAP scale includes perceived attention discontinuity (PAD) (8), lingering thought (LT) (4) and social media notification (SMN) (3). Specifically, PAP subscale was measured by eight items. Sample questions included "I will open QQ or WeChat when I have to do my homework." and "While I was studying, I would unconsciously maintain the software or application system of the computer".

LT subscale was measured by four items. Sample questions included "When I use the Internet for my projects or studies, I unconsciously pay attention to what is happening at home." and "When I study online, I play my phone unconsciously." SMN subscale was measured by three items. Sample questions included "When I see or hear notifications from social media, I can't wait to check them." and "When studying, I can immediately notice the information from instant messaging software (e.g., WeChat or QQ)." Factor loadings of PAD scale ranged from 0.532 to 0.789 with internal consistency of 0.784.

SRS scale included behavioral strategies (BS) (6) and outcome appraisal (OA) (3), responses were rated on a Likert scale with 1 indicating extreme disagreement and 5 extreme agreement. Specifically, BS subscale was measured by six items. Sample questions included "When I use a computer to study, I use some strategies to help me focus on my work." and "While studying, I logged out of my social media account or shut down instant messaging software (e.g., WeChat and QQ)". OA subscale was measured by three items. Sample questions included "If I focus on what I should be doing when I use a computer (e.g., writing a paper, studying or searching for information), I will feel happy and proud." and "When I use the computer to study, I will feel guilty if I delay what I should do". Factor loadings of SRS scale ranged from 0.499 to 0.874 with internal consistency of 0.783.

3.5 Analysis

According to the research design of Yoshinaga et al. (2018), In this study, one dimensional intra-group analysis of variance (ANOVA) corrected by Greenhouse-Geisser was used to analyze the scores of adaptability index (MMSE PAD SRS SAT) before and after class. If the analysis of variance shows that there is a significant change, a paired

Bonferronicorrected t test is used for post-hoc testing. In order to further explain the data, in addition to the significance test of the null hypothesis, η^2 is used as the effect size of the independent variable in the analysis of variance, which is used to express the percentage of the variance of the dependent variable explained by the independent variable. According to Cohen (1988), the small, medium, and large effect sizes are 0.01, 0.06, and 0.14, respectively. Due to the small sample size in this study, all statistical tests are two-tailed tests, and α values less than 0.1 are considered statistically significant. Statistical analysis is mainly performed using SPSS 22 (Table 3).

Table 3. Changes in primary and secondary outcomes (n = 80)

	pre		post		F	p	η^2
	M	SD	M	SD			
MMSE	2.805	1.0487	2.71	0.95	0.72	0.399	0.009
PAD	2.77	0.50	2.86	0.55	1.27	0.26	0.02
PAP	2.77	0.43	2.85	0.45	2.10	0.15	0.03
LT	2.98	0.50	3.03	0.53	0.55	0.46	0.01
SMN	2.55	0.65	2.66	0.65	2.12	0.15	0.03
SRS	3.00	0.52	3.13	0.56	3.34	0.07	0.04
BS	2.83	0.50	2.95	0.61	2.87	0.09	0.04
OA	3.18	0.68	3.31	0.61	2.33	0.13	0.03
SAT	3.33	0.75	3.42	0.72	0.91	0.34	0.01

From the descriptive statistics of measurement indicators, students have many types of attention deficit behaviors in their personal learning environment. The frequency from high to low is lingering thought (M = 2.98, SD = 0.5) and perceived attention discontinuity (M = 2.98, SD = 0.5). = 2.77, SD = 0.43) and social media notification (M = 2.55, SD = 0.65). From the perspective of the source of attention deficit, lingering thought is the learner's attention to changes in the state of their favorite media or matters of concern during learning. It represents the learner's implicit attention deficit, and it has no obvious behavior performance, but it can always affect the state of online learning; perceived attention discontinuity and social media notification are learners' self-awareness of factors and behaviors that may interfere with attention in the learning environment, which is relatively obvious in online learning. According to Wu (2015), perceptual attention dispersion is related to the learner's executive control system, and is the learner's consciousness of choosing and processing things that are not related to learning.

In order to deeply understand learners' adaptability differences and dynamic changes, we will continue to conduct a comparative analysis of their self-efficacy, perceived attention problems, and self-regulation strategies before and after class. In addition to the decrease in self-efficacy of media multi-tasking self-efficacy, perceived attention problems (eg., PAD, LT, SMN) and Outcome appraisal have shown a certain degree

of improvement. However, the one-dimensional analysis of variance within the group showed that time did not have a statistically significant effect on the above variables. It is worth noting that time has a significant impact on self-regulation strategies ($p < 0.1$), and its subsidiary index behavioral strategies is significantly higher than the outcome appraisal, and has reached statistical significance ($p < 0.1$). As an important dimension for evaluating online learning results, this study found that the post-test ($M = 3.42$, $SD = 0.72$) of student learning satisfaction is higher than the pre-test ($M = 3.33$, $SD = 0.75$), which indicates that the duration of online participation can be increased satisfactory, but unfortunately it did not reach statistical significance ($p = 0.34$).

From the perspective of the effect of independent variables, the effect size (0.04) of the influence of time on self-regulation strategies is close to the medium effect, which shows that learning time can only explain 4% of the differences in students' self-regulation strategies. The underlying factors are worth digging deeper. Time has a small effect on other variables, and follow-up research should explore the mechanism of action between variables based on structural relationships.

4 Discussion

4.1 Learners Have a Moderate Degree of Attention Deficit in Their Personal Learning Environment, Which is Manifested in Three Aspects: Perceived Attention Discontinuity, Lingering Thought, Social Media Notification

This conclusion is another verification of Wu's (2017) meta-attention theory. According to the research of Frasson and Chalfoun (2010), cognitive processes related to learning include attention, memory and reasoning, and positive emotions contribute to the improvement of these cognitive processes. If students are unable to concentrate during online learning, it will damage their learning engagement and advanced thinking ability. According to the process model of emotion regulation (Gross 1998), attention distribution or redirection of a person's attention in the process of emotion regulation can affect his/her emotions, which is a key factor to ensure high learning participation and high efficiency. Regarding emotion regulation strategies, Burić et al. (2016) believe that shifting attention from the event that caused unpleasant emotions to another object or topic can achieve self-regulation of learning emotions. In the practical application of teaching, some research on teaching design shows that when teachers design gamified activities to challenge students and keep them in the flow (high concentration) area, students will keep their participation throughout the course (eg., Zhu et al. 2017; Antonaci et al. 2018).

4.2 Under Simple Training or Natural Conditions, Students Have Poor Adaptability in the Personal Learning Environment, and Their Behavior Perception and Behavior Adjustment Levels Have Improved, but They Have not yet Reached Expectations

Participants in this study are sophomore students. They grow up in a digital environment. Before the study, we assumed that the research subjects have good online self-directed

learning ability. After no or a small amount of training, they should learn from online learning, gaining similar effects, but failed to achieve what we wanted. The research conclusions of Aagaard (2015) may provide us with a reliable explanation. He believes that students are attracted to social media mainly through habitual distraction, and thus are seduced by the media and visit social media. The above research shows the widespread use of social media by college students and their vulnerability to such interference. However, as the personal learning environment is becoming a necessary space for college students or lifelong learners to continue their learning, how to promote them to better adapt to and integrate into the personal learning environment is urgent, and this should be the necessary digital literacy for future learners. Moghimi et al. (2020) believe that statistics on interruptions and delays in learning and their negative effects on academic performance require action-regulation strategies that students can use to manage their academic performance and happiness. Their research shows that the action-regulated SOC model can help explain college students' performance and learning satisfaction. Through self-efficacy beliefs, there is a positive indirect relationship between optimization (rather than selective choice) and good learning outcomes. In terms of the explanatory power of the research model, corresponding to the meta-analysis of Wiradhany and Koerts (2019), this study found that a large part of the difference in media multitasking behavior is still unexplained, and it also found a high degree of heterogeneity in the topic of attention regulation.

4.3 Participation in Online Learning has Significantly Increased the Application of Learners' Self-regulation Strategies, Especially the Application of Behavior Strategies

In early research, Weiner (1985) believed that there are two basic paradigms for self-regulation: behavioral strategies and Outcome appraisal. The former is the behavioral effort taken by learners to reduce the distraction that may be caused by external factors, and the latter is a class of typical psychological strategies of learners, which can associate the perceived success or failure of learning with positive or negative emotions, thereby affecting learning behavior. According to the analysis of meta-attention by Wu et al. (2019), learners control the perceived online learning behavior and results, which are usually divided into two ways: explicit and implicit. Among them, the explicit strategy is a behavioral strategy, which is characterized by behavioral control of network usage, such as denying website access and deleting equipment used for network connection; implicit strategy is psychological strategy, which is to achieve success or avoid feelings of guilt. Obviously, the latter has a strong concealment, and behavior adjustment as a direct reflection of past behavior and results, we can predict students' study efforts and goal expectations based on this.

5 Conclusions and Limitations

In the work, we explored the adaptability and dynamic characteristics of college students' online learning through a single-group design. Although they have been trained once in the research cycle, the results are not ideal. Continuous research on the adaptability and laws of lifelong learners' personal learning environment appears to be very necessary.

The limitations of this article are: on the one hand, the research cycle is short and the amount of collected data is not rich enough. This study lasted only 4 months, which has a certain impact on the systematic and in-depth insight into the dynamics of students' adaptation. On the other hand, this study only uses descriptive statistics and intra-group analysis of variance, and does not reveal the relationship and comprehensive effects between the research variables. Therefore, the conclusions drawn by the study are relatively basic. Subsequent research can strengthen the research on this topic by optimizing training design, increasing evaluation frequency and multiple analysis methods, enhancing the digital learning resilience of university online learners and lifelong learners, and making pleasant and effective learning a part of a happy life.

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