A Study on the Relationship between Non-English Majors' Perception of Learning Environment Affordances and English Learning Engagement

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Abstract. This study aims to explore how non-English major college students' perception of learning affordances affects their English learning engagement through a questionnaire survey, providing a theoretical basis and practical guidance for improving the learning environment and promoting personal development. A stratified sampling method was used to select 173 non-English major students from a university in Jiangsu Province as the research subjects. The survey results showed that there is no significant difference in the perception of learning environment affordances among different grades, nor different majors. Learners who spent longer time on the online English learning platforms showed a higher level of perception of all learning affordances. The perception of the supportive role of the learning environment can effectively promote learning engagement. Specifically, the physical affordances perception and interpersonal perception have a significant promoting effect on learners' cognitive engagement, behavioral engagement, and emotional engagement. However, resource affordances perception has a positive impact on cognitive engagement and emotional engagement, but no influence on behavioral engagement. What's more, the functional affordances perception has no effect on any dimension of the learning engagement. This study not only reveals the differential mechanisms of affordance perception across digital ecosystems but also empowers teachers to accurately identify students with "low affordance perception" and develop tiered intervention strategies. Furthermore, it fosters students' metacognitive abilities, encouraging them to actively transform environmental affordances into deep learning behaviors.

Keywords: English Learning Affordances; Perception of English Learning Affordances; English Learning Engagement; Non-English Major College Students.

1. Introduction

This paper aims to explore how the perception of learning environment affordances affects non-English majors' English learning engagement. Data were collected through questionnaires and analyzed by SPSS. The research results will provide a theoretical basis and practical guidance for optimizing the learning environment and improving students' learning engagement, which is of great significance for improving the effect of college English blended teaching.

2. Research Background

With the advancement of the Education Informatization 2.0 Action, the English learning environment in Chinese universities has formed a new "online-offline" dual-track ecology. Non-English major students show significant differentiation in learning behaviors in digital environments such as smart classrooms and MOOC platforms: some students can make full use of the technical affordances provided by the environment (such as intelligent feedback, virtual language partners), while more students fall into the dilemma of "abundant technology but insufficient engagement". How to comprehensively explore the affordances of ecological elements such as teaching resources, teaching methods, teaching subjects, and teaching environment for students under the blended teaching model, and solve the "ecological imbalance" problem of "insufficient affordances" in current college English blended teaching in universities through scientific instructional design and practice has become an urgent task. In the context of the rapid development of digital education, the interaction

mechanism between learning environment affordances and learning engagement has become a key breakthrough to improve foreign language learning efficiency.

3. Literature Review

3.1 Research on Learning Affordances

American psychologist Gibson first proposed the functional concept of "affordance" to explain the interaction between organisms and the environment. Later, scholar Van Lier integrated the sociocultural theory and ecological linguistics perspective, redefining it as "the adaptive relationship established between specific elements in the environment and learners" (Van Lier, 2000)[17]. The "ecological affordances" of English second language learning refer to the positive or negative affordances that learners perceive learning resources and interaction opportunities, interpret them, and then take actions to transform them into positive or negative influences on English learning (Qin Lili,2020)[15].

To explore the multiple perceptions of ecological affordances, researchers have tried to classify the forms of it. Hartson(2003)[9] divided technical environment affordances into cognitive affordances, physical affordances, sensory affordances, and functional affordances, revealing the rules that the learners adopted different interaction modes by. Kirschner (2004)[10] extended affordances to collaborative learning environments, arguing the technological, educational, and social features.

Domestically, Li Tongtong et al. (2016)[13] proposed designing online learning environments from five aspects: physical, functional, cognitive, sensory, and structural affordances. Li Anhong (2020)[12], from an ecological relationship chain perspective, also proposed four dimensions: cognitive, sensory, physical, and functional affordances. Zhu Tingting (2023)[18], from an empirical perspective, explores the impact of the English classroom environment on student learning, using classroom participation, task orientation, teacher-student relationships, and student responsibility as four dimensions. Qin Lili et al. (2023)[16], starting from elaborating the definition and theoretical connotations of "ecological sustenance", attempted to comprehensively explore learners' perception, interpretation, and actions towards it, forming an interactive cycle framework of affordance "perception-interpretation-action".

3.2 Research on Learning Engagement

The concept of learning engagement first appeared in the 1930s, initially referring to the time and effort learners put in to achieve learning goals. As research deepened, the definition has evolved, with Cai Xinian (2024)[4] noting it is now divided into four distinct categories. Based on the unique attributes and characteristics of foreign language courses, the investment construct has been expanded from the three-dimensional model of "behavior - cognition - emotion" widely accepted in the field of educational psychology to a four-dimensional model of "behavior - cognition - emotion - social"(Guo Yan, 2024)[8]. Although the academic community has not yet fully unified its definition, it is generally recognized that it includes three basic dimensions: emotional participation, behavioral performance, and cognitive activities, and that these dimensions mutually influence and act jointly, with the three-dimensional theory still dominant (Cai Xinian, 2024)[4]. Relevant studies have confirmed that the degree of learning engagement can not only reflect the quality of the learning process but also effectively predict academic achievements.

3.3 Research on the Correlation between Learning Environment and Learning Engagement

Research on the impact of the learning environment on learning engagement can be divided into the following three categories: First, the impact of the physical learning environment on learning engagement. The affordance theory points out that the existence of the environment and its impact on behavioral performance and psychological emotions are not absolute but depend on individual internal factors (Van Lier, 2000)[17]. The empirical evidence could be found. Chen Zhenzhen

(2019)[5]designed smartphone-based activities for college English listening and speaking courses and conducted a two-semester teaching experiment across four classes. The results showed that in the smartphone-assisted classroom environment, students' behavioral engagement, emotional engagement, and cognitive engagement all improved, indicating smartphones can be an effective tool to enhance foreign language classroom efficiency.

Second, the impact of the social-psychological learning environment on learning engagement had been manifest. Ben-Eliyahu's (2019)[2] research indicates that learning ability is context-specific, emphasizing not only individual internal psychological processes but also being rooted in environmental or interpersonal contexts. Specifically, her work suggests learners' emotional engagement is driven by setting challenging goals, but when faced with emotional barriers due to the gap between goals and abilities, they require behavioral optimization.

Third, the impact of the online learning environment on learning engagement also had been confirmed. Cai Chen (2021)[6] introduced environmental factors into English learning engagement research, exploring the interaction mechanism between engagement and mobile environmental affordances. Her study specifically investigated the relationship between non-English major college students' perception of mobile environmental affordances and their English learning engagement during autonomous learning. Findings confirmed that in online learning environments, college students' perceptions of the learning environment significantly affect their learning engagement. Further research by Cai Chen (2023)[7] found that physical, functional, and interpersonal affordance perceptions directly predict online learning emotional engagement. Mei Lei's (2021)[14]doctoral research also focused on the impact of college students' online learning environment perception on learning engagement.

These studies collectively contribute to understanding how various environmental aspects shape college students' learning engagement.

3.4 Review of Previous Literature

From the review of previous literature, it can be seen that the methodologies of existing studies have developed in a diversified way, from early questionnaires to multi-modal data fusion such as eye-tracking (e.g., potentially Alizadeh, 2024)[1].The research scope has been deepened locally, and differentiated intervention strategies have been proposed for groups such as rural students and normal university students (e.g., Bian Xiaohong, 2020; Li Jing, 2022)[3][11]. Significant progress has been made in defining and measuring affordances and learning engagement, and in establishing links between specific environmental factors (physical, social-psychological, online) and engagement components.

However, there are also some limitations: including insufficient research dynamism, with 90% of studies adopting cross-sectional designs and lacking long-term tracking of environmental affordance changes. There is also a phenomenon of technological alienation, as research on digital environments tends to overemphasize technology efficacy while neglecting the synergistic role of humanistic care. Future studies need to strengthen the exploration of causal mechanisms between environmental affordances and learning engagement, as well as construct dynamic regulatory models.

4. Research Design

4.1 Research Questions

Based on the perspective of ecological affordance theory, this study focuses on examining the characteristics of non-English majors' perception of learning support and their learning engagement under the blended learning model, and then analyzes the internal relationship between the two. In view of this, the following two research questions are put forward:

1. Does the perception of learning environment affordances have a positive impact on non-English majors' English learning engagement?

2. How does the perception of learning environment affordances influence non-English majors' English learning engagement?

Based on these two research questions, the researchers refined the following research hypotheses:

H1a: Physical affordances will positively affect behavioral engagement.
H1b: Functional affordances will positively affect behavioral engagement.
H1c: Resource affordances will positively affect behavioral engagement.
H1d: Interpersonal affordances will positively affect behavioral engagement.
H2a: Physical affordances will positively affect cognitive engagement.
H2b: Functional affordances will positively affect cognitive engagement.
H2c: Resource affordances will positively affect cognitive engagement.
H2d: Interpersonal affordances will positively affect cognitive engagement.
H3a: Physical affordances will positively affect emotional engagement.
H3b: Functional affordances will positively affect emotional engagement.
H3c: Resource affordances will positively affect emotional engagement.
H3d: Interpersonal affordances will positively affect emotional engagement.

4.2 Research Subjects

This study selected non-English major students from two universities in Jiangsu Province as the research subjects. Both universities adopted the "welearn" English learning platform developed by Shanghai Foreign Language Education Press in college English teaching to carry out blended teaching. This study collected data through an online questionnaire platform. All questionnaires were completed anonymously, and participants' privacy information was strictly protected to ensure data security. A total of 126questionnaires were recovered, including 35males (27.78%) and 91females (72.22%). The basic information of the research subjects is shown in Table 1.

4.3 Instruments

Table 1. Basic Characteristics of the Survey Respondents

Variable	*Categories*	*Number of people*	*Frequency*
Major	*Liberal Arts*	79	62.7
	Science	26	20.63
	Engineering	10	7.94
	Business	5	3.97
	Others	6	4.76
Gender	*Male*	35	27.78
	Female	91	72.22
Grade	*First-year*	19	15.08
	Second-year	23	18.25
	Third-year	58	46.03
	Fourth-year	26	20.63
Study Time on Platform	*1-2 hours*	54	42.86
	3-5 hours	37	29.37
	6-10 hours	22	17.46
	More than 10 hours	13	10.32

The main tools used in this study are two questionnaires: one is the "Blended Learning Environment Affordance Perception Scale", and the other is the "English Learning Engagement Scale". The former is adapted from Cai Chen's (2023) "Online Environment Affordance Scale", with some items deleted and adjusted. The questionnaire adopts a 5-point Likert scale. The questionnaire examines four dimensions: physical affordances, functional affordances, resource affordances, and interpersonal affordances, with 5 questions in each dimension. The "English Learning Engagement

Scale" is a self-designed questionnaire, which examines three dimensions: cognitive engagement, behavioral engagement, and emotional engagement, also using a 5-point Likert scale.

4.4 Data Analysis

SPSS 26 statistical software has been applied to process data. The specific analyses include: first, using descriptive statistical methods to examine the characteristics of learners' perception of learning environment and learning engagement in blended English learning; second, analyzing the differences among learners with different backgrounds through ANOVA test; finally, using correlation analysis and regression analysis to explore the relationship between learning environment perception and learning engagement.

5. Research Results

5.1 Questionnaire Reliability and Validity Test

1. Blended Learning Environment Support Perception Scale

The reliability test results of the "Blended Learning Environment Affordance Perception Scale" and its various elements are as follows: the standardized Cronbach's α coefficients of physical affordances, functional affordances, resource affordances, and interpersonal affordances are 0.93, 0.909, 0.932, and 0.908 respectively, indicating that each element of this scale has good internal consistency.

This study tested the feasibility of factor analysis for this scale through KMO and Bartlett's sphericity test. The analysis results showed that KMO = 0.949 > 0.7, approximate chi-square value = 2628.423, degrees of freedom = 190, $P < 0.001$, indicating high validity.

2. English Learning Engagement Scale

The reliability test results of the English Learning Engagement Scale and its various elements are as follows: the standardized Cronbach's α coefficients of behavioral engagement, cognitive engagement, and emotional engagement are 0.949, 0.96, and 0.957 respectively, indicating that each element of the learning engagement scale in this study has good internal consistency.

The results of the exploratory factor analysis of the scale showed that KMO = 0.953> 0.7, approximate chi-square value = 4595.565, degrees of freedom = 435, $P < 0.001$, indicating high validity.

5.2 Descriptive Statistical Analysis

Table 2. Descriptive Statistics of Learning Environment Support Perception

	N	*Minimum*	*Maximum*	*Mean*	*SD*
Major	126	1	5	1.67	1.094
Gender	126	1	2	1.72	0.45
Grade	126	1	4	2.72	0.96
Study Time	126	1	4	1.95	1.011
Phyiscal Affordances	126	1	5	3.937	0.9165
Functional Affordances	126	1	5	3.984	0.9032
Resource Affordances	126	1	5	3.98	0.9474
Interpersoal Affordances	126	1	5	4.044	0.8626

Table 2 shows the overall situation of learning environment support perception, including the mean and standard deviation of four dimensions: physical affordances, resource affordances, functional affordances, and interpersonal affordances, which indicate that learners' overall perception of environmental support is relatively high. In terms of each dimension, learners have the highest perception of interpersonal affordances, with a mean of 4.044; while the perception of physical affordances is lowest, with a mean of 3.937. Table 3 presents the mean and standard deviation of

three dimensions: behavioral engagement, emotional engagement, and cognitive engagement. The data analysis results show that the distribution of the sample data conforms to the normal distribution characteristics, indicating that the selection of the research sample is scientific and representative. It is clear that the mean of English learning engagement is slightly higher than that of learning environment perception. Learners' perception of behavioral engagement is highest, with a mean of 4.099; cognitive engagement and emotional engagement have the same mean of 3.98. In terms of standard deviation, the most obvious internal difference lies in the behavioral engagement.

Table 3. Descriptive Statistics of English Learning Investment

	N	*Minimum*	*Maximum*	Mean	*SD*
Behavioral Engagement	126	1	5	4.099	0.8626
Cognitive Engagement	126	1	5	3.98	0.9042
Emotional Engagement	126	1	5	3.98	0.9683

5.3 Difference Analysis

This study used one-way analysis of variance (ANOVA) to compare the means of physical affordances, functional affordances, resource affordances, interpersonal affordances, behavioral engagement, cognitive engagement, and emotional engagement in terms of different major, grade, and learning time; if there is any significant difference between groups, the LSD method would be used for post-hoc testing.

5.3.1 Difference Analysis among Majors

After using one-way (ANOVA) variance analysis to test the differences of each variable among majors, the analysis results showed that there is no significant differences among majors in terms of the behavioral engagement ($F=0.767$, $P=0.549$), emotional engagement ($F=0.362$ $P=0.835$), cognitive engagement ($F=0.64$,$p=0.635$), physical affordances ($F=0.776$,$P=0.543$), functional affordances ($F=0.572$,$P=0.683$), resource affordances ($F=0.56$,$P=0.692$)and interpersonal affordances($F=1.853$, $P=0.123$) ($P>0.05$).

5.3.2 Difference Analysis among Grades

After using one-way (ANOVA) variance analysis to test the differences of each variable among grades, the analysis results showed that there is no significant differences among grades in terms of the behavioral engagement ($F=0.317$, $P=0.813$), emotional engagement ($F=0.253$, $P=0.859$), cognitive engagement ($F=0.395$,$p=0.757$), physical affordances ($F=0.288$,$P=0.834$), functional affordances ($F=0.51$,$P=0.676$), resource affordances ($F=0.119$,$P=0.949$) and interpersonal affordances ($F=0.369$, $P=0.776$) ($P>0.05$).

5.3.3 Difference Analysis among Learning Times on the Platform

After using one-way (ANOVA) variance analysis to test the differences of each variable in terms of learning time, the analysis results showed that there is some significant differences among students who spent different learning times on the "welearn" platform in terms of behavioral engagement ($F=4.117$, $P=0.008$), emotional engagement ($F=6.032$, $P=0.001$), cognitive engagement ($F=7.999$, $p=0.000$), physical affordances ($F=3.522$, $P=0.017$), functional affordances ($F=3.42$, $P=0.02$), resource affordances ($F=4.551$, $P=0.005$)and interpersonal affordances ($F=4.004$, $P=0.009$) ($P<0.05$). Based on the LSD post hoc test (Table 4), the group studying over 10 hours online showed significantly higher level of learning affordances and learning engagement scores compared to the groups studying 1-2 hours online and the groups studying 3-5 hours online.

5.3.4 Correlation Analysis

The Pearson correlation was used to measure the correlations between variables in this study. It indicated that there are significant positive correlations between learning environment affordances and learning engagement ($P<0.01$), with high Pearson correlation coefficients (>0.7); the results of correlation analysis between other variables are shown in Table 5 below.

Table 4. LSD post hoc test

Dependent Variable	*(I) StudyTime*	*(J) Study Time*	*MD(I-J)*	*SE*	*Sig*
physical affordances	*1-2hours*	*3-5hours*	-0.0195	0.1899	0.918
		6-10hours	-0.4268	0.2251	0.06
		10hours and more	-.7607*	0.2749	0.007
	3-5hours	*1-2hours*	0.0195	0.1899	0.918
		6-10hours	-0.4072	0.2396	0.092
		10hours and more	-.7412*	0.2869	0.011
	6-10hours	*1-2hours*	0.4268	0.2251	0.06
		3-5hours	0.4072	0.2396	0.092
		10hours and more	-0.3339	0.3113	0.286
	10hours and more	*1-2hours*	.7607*	0.2749	0.007
		3-5hours	.7412*	0.2869	0.011
		6-10hours	0.3339	0.3113	0.286
functional affordances	*1-2hours*	*3-5hours*	0.0546	0.1874	0.771
		6-10hours	-.5118*	0.2221	0.023
		10hours and more	-.5712*	0.2713	0.037
	3-5hours	*1-2hours*	-0.0546	0.1874	0.771
		6-10hours	-.5663*	0.2364	0.018
		10hours and more	-.6258*	0.2831	0.029
	6-10hours	*1-2hours*	.5118*	0.2221	0.023
		3-5hours	.5663*	0.2364	0.018
		10hours and more	-0.0594	0.3072	0.847
	10hours and more	*1-2hours*	.5712*	0.2713	0.037
		3-5hours	.6258*	0.2831	0.029
		6-10hours	0.0594	0.3072	0.847
resource affordances	*1-2hours*	*3-5hours*	-0.1967	0.1941	0.313
		6-10hours	-.6869*	0.23	0.003
		10hours and more	-.7778*	0.281	0.007
	3-5hours	*1-2hours*	0.1967	0.1941	0.313
		6-10hours	-.4902*	0.2448	0.048
		10hours and more	-.5811*	0.2932	0.05
	6-10hours	*1-2hours*	.6869*	0.23	0.003
		3-5hours	.4902*	0.2448	0.048
		10hours and more	-0.0909	0.3182	0.776
	10hours and more	*1-2hours*	.7778*	0.281	0.007
		3-5hours	.5811*	0.2932	0.05
		6-10hours	0.0909	0.3182	0.776
interpersoal affordances	*1-2hours*	*3-5hours*	-0.035	0.1778	0.844
		6-10hours	-.6069*	0.2107	0.005
		10hours and more	-.5527*	0.2574	0.034
	3-5hours	*1-2hours*	0.035	0.1778	0.844
		6-10hours	-.5719*	0.2243	0.012
		10hours and more	-0.5177	0.2686	0.056
	6-10hours	*1-2hours*	.6069*	0.2107	0.005
		3-5hours	.5719*	0.2243	0.012
		10hours and more	0.0542	0.2914	0.853
	10hours and more	*1-2hours*	.5527*	0.2574	0.034
		3-5hours	0.5177	0.2686	0.056
		6-10hours	-0.0542	0.2914	0.853

behavioral engagement	*1-2hours*	*3-5hours*	0.1124	0.1776	0.528
		6-10hours	-.4184*	0.2104	0.049
		10hours and more	-.6631*	0.257	0.011
	3-5hours	*1-2hours*	-0.1124	0.1776	0.528
		6-10hours	-.5307*	0.224	0.019
		10hours and more	-.7755*	0.2683	0.005
	6-10hours	*1-2hours*	.4184*	0.2104	0.049
		3-5hours	.5307*	0.224	0.019
		10hours and more	-0.2448	0.2911	0.402
	10hours and more	*1-2hours*	.6631*	0.257	0.011
		3-5hours	.7755*	0.2683	0.005
		6-10hours	0.2448	0.2911	0.402
cognitive engagement	*1-2hours*	*3-5hours*	-0.011	0.1786	0.951
		6-10hours	-.6271*	0.2116	0.004
		10hours and more	-1.0484*	0.2585	0
	3-5hours	*1-2hours*	0.011	0.1786	0.951
		6-10hours	-.6161*	0.2253	0.007
		10hours and more	-1.0374*	0.2698	0
	6-10hours	*1-2hours*	.6271*	0.2116	0.004
		3-5hours	.6161*	0.2253	0.007
		10hours and more	-0.4213	0.2927	0.153
	10hours and more	*1-2hours*	1.0484*	0.2585	0
		3-5hours	1.0374*	0.2698	0
		6-10hours	0.4213	0.2927	0.153
emotional engagement	*1-2hours*	*3-5hours*	0.021	0.1952	0.914
		6-10hours	-.6540*	0.2313	0.005
		10hours and more	-.9145*	0.2826	0.002
	3-5hours	*1-2hours*	-0.021	0.1952	0.914
		6-10hours	-.6751*	0.2462	0.007
		10hours and more	-.9356*	0.2949	0.002
	6-10hours	*1-2hours*	.6540*	0.2313	0.005
		3-5hours	.6751*	0.2462	0.007
		10hours and more	-0.2605	0.32	0.417
	10hours and more	*1-2hours*	.9145*	0.2826	0.002
		3-5hours	.9356*	0.2949	0.002
		6-10hours	0.2605	0.32	0.417
	1-2hours	*3-5hours*	-0.1099	0.1973	0.579
		6-10hours	-.7315*	0.2339	0.002
		10hours and more	-.7699*	0.2856	0.008
	3-5hours	*1-2hours*	0.1099	0.1973	0.579
		6-10hours	-.6216*	0.2489	0.014
		10hours and more	-.6601*	0.2981	0.029
	6-10hours	*1-2hours*	.7315*	0.2339	0.002
		3-5hours	.6216*	0.2489	0.014
		10hours and more	-0.0385	0.3234	0.906
	10hours and more	*1-2hours*	.7699*	0.2856	0.008
		3-5hours	.6601*	0.2981	0.029
		6-10hours	0.0385	0.3234	0.906

* The significance level for the mean difference is 0.05.

Table 5. Correlation Analysis

		BI	*CI*	*EI*
S	*Person Correlation*	.756**	.778**	.835**
PS		.787**	.742**	.790**
FS		.757**	.707**	.773**
RS		.744**	.786**	.835**
IS		.803**	.765**	.774**
	Sig.(2-tailed)	0	0	0
	N	173	173	173

Note:
S: learners' satisfaction
PS: physical affordances
FS: functional affordances
RS: resource affordances
IS: interpersonal affordances

5.3.5 Regression Analysis

In this section, the linear regression analysis will be conducted to figure out what factors of students' perception of learning affordances could have an effect on their learning engagement. The sub-dimensions of learning affordances are considered as the independent variables while learning engagement is taken as dependent variable.

Table 6. the linear regression of learners' satisfaction

Model		Standardized Coefficients Beta	t	Sig.	R^2	Adj R^2
	(Constant)		-.277	.782	0.796	0.789
	PS	.262	3.540	.001		
	FS	.091	1.058	.292		
	RS	.426	4.913	.000		
	IS	.188	2.652	.009		
a. Dependent Variable: S						

Note:
S: learners' satisfaction
PS: physical affordances
FS: functional affordances
RS: resource affordances
IS: interpersonal affordances

According to the table 6 the specific analysis will be demonstrated as follows. From the above statistics, the model equation is that: "learning satisfaction =-0.055 + 0.277*physical affordances + 0.097*functional affordances + 0.435*resource affordances+0.211*interpersonal affordances.

The value of sig ($P<0.01$) indicated that physical affordances, resource affordances and interpersonal affordances all have a positive and significant effect on students' learning satisfaction except for the functional affordances. What's more, the perception of resource affordances has the greatest impact on the students' learning satisfaction.

The adjusted R^2 value (0.789) showed that sub-dimensions of learning affordances can explain 78.9% of the variation in students' learning engagement.

According to Table 7, the specific analysis will be demonstrated as follows. From the above statistics, the model equation is that: Emotional Investment = 0.091 + 0.250*physical affordances + 0.047*functional affordances + 0.438*resource affordances + 0.206*interpersonal affordances.

Table 7. the linear regression of Emotional Investment

Standardized Coefficients					
Model	*Beta*	*t*	*Sig.*	R^2	*Adj* R^2
1 (*Constant*)		0.091	0.928	0.756	0.748
PS	0.25	3.082	0.003		
FS	0.047	0.504	0.615		
RS	0.438	4.618	0		
IS	0.206	2.657	0.009		

Dependent Variable:EI
Note:
S: learners' satisfaction
PS: physical affordances
FS: functional affordances
RS: resource affordances
IS: interpersonal affordances

The value of sig (P<0.01) indicated that physical affordances, resource affordances and interpersonal affordances all have a positive and significant effect on students' emotional investment except for the functional affordances. What's more, the perception of resource affordances has the greatest impact on the students' emotional investment.

The adjusted R^2value (0.748) showed that sub-dimensions of learning affordances can explain 74.8% of the variation in students' emotional investment.

Table 8. The linear regression of Cognitive Investment

Standardized Coefficients					
Model	*Beta*	*t*	*Sig.*	R^2	*Adj* R^2
1 (*Constant*)		1.749	.083	.701	.691
PS	.204	2.275	.025		
FS	-.110	-1.053	.294		
RS	.432	4.111	0		
IS	.375	4.368	0		

Dependent Variable: CI
Note:
S: learners' satisfaction
PS: physical affordances
FS: functional affordances
RS: resource affordances
IS: interpersonal affordances

According to Table 8, the specific analysis will be demonstrated as follows. From the above statistics, the model equation is that: Cognitive Investment = 1.749 + 0.204*physical affordances - 0.110*functional affordances + 0.432*resource affordances + 0.375*interpersonal affordances.

The value of sig (P<0.05) indicated that physical affordances, resource affordances and interpersonal affordances all have a positive and significant effect on students' cognitive investment,

while functional affordances shows no significant effect. What's more, the perception of resource affordances has the greatest impact on the students' cognitive investment.

The adjusted R^2 value (0.691) showed that sub-dimensions of learning affordances can explain 69.1% of the variation in students' cognitive investment.

Table 9. The linear regression of Behavioral Investment

Standardized Coefficients					
Model	*Beta*	*t*	*Sig.*	R^2	*Adj* R^2
1 (*Constant*)		2.432	.016	.736	.727
PS	.352	4.181	0		
FS	.120	1.231	.221		
RS	.046	.465	.643		
IS	.415	5.153	0		

Dependent Variable:BI

Note:

S: learners' satisfaction

PS: physical affordances

FS: functional affordances

RS: resource affordances

IS: interpersonal affordances

According to Table 9, the specific analysis will be demonstrated as follows. From the above statistics, the model equation is that: Behavioral Investment = 2.432 + 0.352*physical affordances + 0.120*functional affordances + 0.046*resource affordances + 0.415*interpersonal affordances.

The value of sig ($P<0.01$) indicated that physical affordances and interpersonal affordances have a positive and significant effect on students' behavioral investment, while functional affordances and resource affordances show no significant effect. What's more, the perception of interpersonal affordances has the greatest impact on the students' behavioral investment.

The adjusted R^2 value (0.727) showed that sub-dimensions of learning affordances can explain 72.7% of the variation in students' behavioral investment.

According to the regression analysis, the hypotheses have been verified. Then H1c, H2b and H3b were rejected while other hypotheses had been proved to be true.

6. Research Conclusion

Based on the aforementioned research findings and discussions, this section will summarize the main conclusions of the current study, then explore its implications for teachers and students, point out the limitations of the study, and propose further research plans.

This study took non-English major college students as the research object and explored the impact of learning affordance perception on English learning engagement and its internal mechanism through structural equation models. The research results showed that in the process of English learning, functional affordance, resource affordance, and interpersonal affordance can all significantly promote learners' cognitive engagement, behavioral engagement and emotional engagement. In contrast, physical affordances only had a significant promoting effect on emotional engagement, while their impact on cognitive and behavioral engagement was not significant. This conclusion further expanded the understanding of the impact of learning affordance perception on learning engagement from the perspective of non-English major college students, revealing the differential mechanisms of different types of affordance perception on learning engagement. In particular, the significant impact of physical affordance perception on emotional engagement suggests that we should pay more attention

to the potential impact of the physical environment in the learning environment on emotional experience.

Here are the practical teaching suggestions based on the research findings about the supportive role of the learning environment in promoting engagement.

As for the learning environment affordances, the physical environment should be optimized by implementing flexible seating arrangements and designated quiet zones to facilitate focus and collaboration. Natural lighting and carefully selected color schemes can be used to create a calming atmosphere. Additionally, interpersonal interactions can be strengthened by organizing regular peer discussions and feedback sessions, thereby fostering trust and social connections that significantly improve emotional engagement.

As for the learning engagement, diverse learning materials, such as multimedia resources and research databases, should be provided to support cognitive engagement, and students should be guided in effectively utilizing these resources. Personalized learning pathways, including student-selected projects, can be designed to align resources with individual interests, thereby enhancing emotional engagement. It is important to note that an excessive number of resources should be avoided to prevent cognitive overload.

Given the current evidence indicating that functional affordances, such as specific software tools, have no direct impact on engagement, these tools should be prioritized only when they are closely aligned with learning objectives. The adoption of trendy technologies without clear pedagogical benefits should be reconsidered.

This study only verified the one-way impact of "environmental affordances → learning engagement" and has not yet explored the two-way effect between them, such as high-engagement learners may actively transform the learning environment, which will be further explored in subsequent studies.

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