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# Exploring the Integration of English Language Education Spaces in Smart Housing Design to Enhance Language Learning

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**Abstract** The current language learning environment is facing an important opportunity of digital transformation, and the traditional English education space has been difficult to meet the demand for personalized and intelligent learning. Intelligent housing, as an emerging form of residence, provides a new space carrier and technical support for English education. By deeply integrating advanced intelligent technology with English education and constructing immersive and interactive learning environments, it can effectively break through the limitations of traditional educational spaces and enhance learners' language acquisition efficiency and the quality of learning experience. This study adopts the questionnaire survey method and comparative experimental method to construct a research model containing five dimensions: intelligent environment design, technology integration, psychological and behavioral influence, social interaction support, and sustainability, and to explore the mechanism of the influence of the integration of English education space into the design of intelligent housing on the efficiency of language learning. By pre-testing 100 students and using SPSS software for exploratory factor analysis, 22 valid question items were identified. The questionnaire reliability test showed a Cronbach's alpha coefficient of 0.966 and a KMO value of 0.952, indicating that the scale has good reliability and validity. The results of multiple linear regression analysis showed  $R^2=0.998$ , adjusted  $R^2=0.996$ ,  $F=7632.432$ , and excellent model fit. The results of the control experiment showed that the average theoretical score of the experimental group was 81.65, which was 7 points higher than that of the control group, and the average practical training score was 87.95, which was 5.33 points higher than that of the control group, and the differences were all statistically significant ( $p<0.05$ ). The study confirms that smart housing English education space can significantly improve learning efficiency, in which the acoustic optimization design has the most significant impact (correlation coefficient 0.881), which provides an important reference basis for the future design of smart education space.

**Index Terms** smart housing design, English education space, language learning efficiency, technology integration, social interaction support, sustainability

## 1. Introduction

With the rapid development of the information age, intelligent buildings have emerged in large numbers, intelligent housing has become the inevitable development direction of modern residential construction. Intelligent housing in the residential platform based on the use of modern building technology, computer network communication technology and integrated wiring technology and other technologies and related building equipment and network communications, information appliances and other equipment installation, but for residential users to provide a set of services and management functions as one of the efficient, comfortable and environmentally friendly living environment [1]-[3]. The basic standard is to provide a comfortable, safe, high-grade and pleasant family living space. It has the function of entering the family as an information highway and exchanging information in all aspects. Provide colorful and high-grade amateur cultural life. Provide multi-level family services including children's education and adult education, and provide family health care and remote care services [4]-[6].

Intelligent housing in the intelligent home, intelligent wall, intelligent regulation, intelligent access control and other designs for English education provides a new space, such as home family voice interaction, English display learning wall, realistic scenarios to build, the design of educational environments, to improve students' interest in learning, and then promote student learning [7]-[9]. In the current English education, students' learning efficiency is generally low. And in addition to their own reasons, students' family environment, teaching environment, and language environment are all factors that affect students' English learning efficiency [10], [11]. In this case, combining

intelligent technology and with the creation of English teaching context and the construction of educational space, students can actively devote themselves to learning in a relaxed state and perceive the fun of English learning, so as to improve the efficiency of English learning in an open, free, playful and life-like learning scene [12]-[14]. And by adding English education space in the design of intelligent housing is not a solution.

The acceleration of the globalization process has made the status of English as an international common language more and more prominent, and the improvement of the quality of English education has become a key area of concern in the education reform of various countries. Modern English education is faced with challenges such as single learning environment, limited interaction and insufficient personalization, and the traditional classroom teaching mode can no longer fully meet the diverse needs of learners. At the same time, the rapid development of artificial intelligence, Internet of Things, big data and other emerging technologies has brought revolutionary opportunities for change in the field of education, and the construction of intelligent education environment has become an important direction of education modernization. Intelligent housing, as an important development trend of the future housing pattern, has a highly integrated intelligent system and flexible spatial configuration capabilities, providing a new implementation vehicle for English education. In the smart housing environment, learners can enjoy personalized learning services, immersive language environment, real-time learning feedback and rich interactive experience, which are expected to significantly improve the effect and quality of English learning. Currently, related research mainly focuses on the single application of intelligent education technology or the optimization and transformation of traditional education space, and lacks systematic research on the overall design of English education space in intelligent housing environment, especially in the configuration of space elements, technology system integration, and the assessment of learning effect, etc. There are still theoretical gaps and practical deficiencies.

Based on the above background, this study adopts a quantitative research method to construct a model of the influencing factors of English education space in smart housing, collects data through a questionnaire survey, and applies statistical analysis methods to verify the relationship between each influencing factor and language learning efficiency. The study firstly designed a questionnaire containing five dimensions: smart environment design, technology integration, psychological and behavioral influence, social interaction support, and sustainability, then determined the valid measurement items through exploratory factor analysis, then conducted reliability and validity tests to ensure the quality of the scale, and finally used multiple linear regression analysis to reveal the degree of influence of each factor on learning efficiency. At the same time, controlled experiments were conducted to verify the practical application effect of the English education space in intelligent housing, providing scientific basis for relevant theoretical research and practical application.

## II. Design of research tools

In this study, with reference to the education industry standards issued by the Ministry of Education and related studies, we designed the Questionnaire on the Impact of Incorporating English Educational Spaces in Intelligent Housing Design on Language Learning Efficiency consisting of sample characteristic items and Likert Scale items, selected a school to open two teaching classes for pre-testing (100 students), and invited experts to correct the content of the scale.

Firstly, SPSS software was used to perform exploratory factor analysis on the questionnaire data recovered from the pre-test. After the initial analysis, six factors were explored according to the criterion that the initial eigenroot value was greater than 1, and one of the factors was regarded as the dependent variable according to the purpose of the study, and named "language learning efficiency". Then, the remaining five factors were used as independent variables for the second exploratory factor analysis, and the results showed that the KMO value was 0.975, which was greater than 0.6, and the corresponding P value of Bartlett spherical test was less than 0.001, both of which met the criteria, and the cumulative variance of the post-rotation factor was 77.065%, indicating that the overall result of the exploratory factor analysis was good. According to the research objectives, the five independent variables were named as "intelligent environmental design", "technology integration", "psychological and behavioral influence", "social interaction support" and "sustainability". Finally, based on the correspondence between the factor load coefficient and the factor of each item in the "rotation component matrix" and the expert opinions, the scale items were checked and deleted one by one, and finally 22 items (corresponding to 5 independent variables and 1 dependent variable, respectively) were determined, which were used as the scale tools in this study, and the research model of integrating English education space into the design of smart housing to improve the efficiency of language learning is shown in Table 1.

Table 1: Research model

Factor		Topic
Independent variable	Intelligent environment design	Whether the intelligent lighting system in space significantly improves your learning concentration? (1)
		What is the effect of acoustic optimization on reducing learning? (2)
		Whether the wet temperature automatic adjustment system improves your learning comfort? (3)
		The degree of influence of spatial layout flexibility on learning efficiency? (4)
	Technical integration	Use frequency and effect evaluation of embedded voice interaction equipment? (5)
		How does the virtual situation teaching tool help the word transfer memory? (6)
		Does the interaction of smart screens promote interest in learning? (7)
		Learning how data tracking systems help self-improvement? (8)
	Psychological behavior	Whether space design reduces learning anxiety? (9)
		Whether environmental immersion motivates learning motivation? (10)
		Whether the personalized learning recommendation system enhances the autonomy of learning? (11)
		Spatial aesthetic design has a regulating effect on learning emotion? (12)
	Social interaction support	The use of remote collaboration learning functions? (13)
		Whether the participation of family members promotes learning? (14)
		What is the effect of mutual assistance on the social and regional learning network? (15)
	Sustainability	Multi-functional reuse of space? (16)
What is the balance of energy consumption and learning income? (17)		
Recommendations for durable demand? (18)		
Dependent variable	Linguistic efficiency	Change of the rate of vocabulary memory? (19)
		Whether the fluency of spoken expression is improved? (20)
		Effective learning duration is increased? (21)
		The progress of the achievement is significant? (22)

### III. Data presentation and modeling

On the basis of testing the reliability and validity of the questionnaire, descriptive statistics and single sample t-tests were first performed to obtain the mean and degree of dispersion of the scores of the respective variables. Then Pearson correlation analysis was done to obtain the degree of correlation between the respective variables and the dependent variable [15]. Finally, multiple linear regression analysis was done to further explore the degree of influence of the respective variables on the dependent variable.

#### III. A. Reliability and validity tests of the questionnaire

The valid data of the questionnaire were imported into SPSS, and the reliability test of the questionnaire was conducted, and the Cronbach's  $\alpha$  coefficient was obtained to be 0.966 (>0.9), which indicated that the questionnaire had a high degree of reliability. The structural validity test of the scale data yielded a KMO value of 0.952 (>0.9), and the significance of the Bartlett's spherical test of  $p < 0.001$ , indicating that the correlation between the topics was strong and the questionnaire had good construct validity.

#### III. B. Applying descriptive statistics of effects and single sample t-tests

When descriptive statistics and one-sample t-tests were conducted, the one-sample t-tests were conducted with a score of 3 as the test value, sig indicates significance, and  $sig < 0.05$  indicates that the mean of each variable is significantly greater than 3, which means that the subjects' attitudes are clear. The descriptive statistics of the variables and the one-sample t-test are shown in Table 2 (\*\* indicates  $0.001 < sig \leq 0.01$ . \* indicates  $0.01 < sig \leq 0.05$ ). As shown in the table, the mean value of the scores for each topic was significantly greater than 3, indicating that the subjects as a whole had a clear attitude towards the incorporation of the variables of the English educational space in the design of smart housing. In particular, the maximum standard deviation of 1.158 for topic (16) indicated that the subjects had different views on the multifunctional reuse of space.

Table 2: The variable description statistics and the single sample T test(N=100)

Topic	Mean	Standard deviation	T value
(1)	3.72	1.097	7.749***
(2)	3.61	1.018	7.777***
(3)	3.59	1.031	7.912***

(4)	3.88	1.013	9.177***
(5)	3.78	1.015	8.507***
(6)	3.49	1.093	5.283***
(7)	3.71	1.085	7.338***
(8)	3.81	1.038	8.669***
(9)	3.8	1.085	4.901***
(10)	3.74	1.05	8.381***
(11)	3.51	1.101	7.709***
(12)	3.66	1.109	8.326***
(13)	3.92	1.075	8.421***
(14)	3.63	1.108	6.993***
(15)	3.67	1.051	7.644***
(16)	3.43	1.158	3.11***
(17)	3.78	1.152	6.452***
(18)	3.72	1.044	7.33***

### III. C. Application effect correlation analysis

Simplifying the questions, naming the respective variables, and then summing the scores of the respective variables to obtain the dependent variable “total score”, Pearson correlation analysis was conducted between the respective variables and the dependent variable, and the correlation between the variables and the total score is shown in Table 3 (\*\* indicates a significant correlation at the 0.01 level (two-tailed)). It is generally accepted that when  $|R|$  is between 0.5 and 0.8, the variables are moderately correlated. When  $|R|$  is between 0.8 and 1, the variables are highly correlated with each other. As shown in the table, the respective variables are significantly and moderately highly correlated with the dependent variable at the 0.01 level of significance. The correlation coefficient for question 2 is 0.881, indicating that acoustic optimization in smart housing has a significant impact on the “total score”.

Table 3: The variables are related to the total score

Independent variable	R
(1)	0.714**
(2)	0.881**
(3)	0.816**
(4)	0.839**
(5)	0.785**
(6)	0.775**
(7)	0.862**
(8)	0.782**
(9)	0.579**
(10)	0.842**
(11)	0.826**
(12)	0.86**
(13)	0.822**
(14)	0.789**
(15)	0.833**
(16)	0.615**
(17)	0.875**
(18)	0.877**

### III. D. Regression analysis of application effects

To further explore the degree of influence of the respective variables on the dependent variable, multiple linear regression analysis was done to obtain  $R^2 = 0.998$ , and the adjusted  $R^2 = 0.996$ , which is very close to 1, indicating that the goodness of fit of the multiple linear regression model is very good. At the same time,  $F = 7632.432$  ( $\text{sig} < 0.01$ ), indicating that the model as a whole is significant, indicating that the model construction is reasonable. The results of the multiple linear regression analysis are shown in Table 4. As shown in the table, column B shows the unstandardized regression coefficients of the respective variables, and the significance of all of them is less than 0.001, which indicates that the respective variables have a very significant contribution to the dependent variable.

Table 4: Multivariate linear regression analysis results

	Unnormalized coefficient		Significance
	B	Standard error	
Constants	2.038	0.197	0.000
(1)	1.068	0.062	0.000
(2)	0.967	0.08	0.000
(3)	0.888	0.077	0.000
(4)	1.059	0.076	0.000
(5)	1.06	0.075	0.000
(6)	0.896	0.066	0.000
(7)	1.035	0.077	0.000
(8)	0.929	0.078	0.000
(9)	0.979	0.048	0.000
(10)	1.041	0.079	0.000
(11)	0.938	0.072	0.000
(12)	1.036	0.077	0.000
(13)	0.974	0.075	0.000
(14)	1.028	0.07	0.000
(15)	0.917	0.071	0.000
(16)	1.027	0.05	0.000
(17)	1.025	0.076	0.000
(18)	0.986	0.08	0.000
R <sup>2</sup>	0.998		
Adjusted R <sup>2</sup>	0.996		
F	7632.432(sig<0.01)		

#### IV. Strategies for optimizing space for English language education

(1) Deepen teachers' knowledge of educational space and explore the resources of English educational space in an all-round way

To optimize the English education space in intelligent housing design, it is first necessary to deepen teachers' knowledge of education space and explore the resources of English education space in an all-round way. In fact, educational space is not only a physical space, but also contains multiple dimensions such as social, cultural and emotional, which provide rich resources for English education. English teachers should pay attention to contextual teaching, use educational space to create a rich language environment and stimulate students' awareness of language practice [16]. For example, by simulating actual contexts such as business meetings, tourist guides, restaurant meals, etc., students can learn and use English in simulated practice to enhance their interest and motivation in language learning. Students can be encouraged to participate in community life and communicate with others by setting up language corners and foreign language clubs to improve their speaking ability and communication skills. At the same time, the community can provide a platform for students to share resources and learn from each other, which helps to improve their independent learning ability. Teachers should also draw on the concept of multicultural education and integrate multicultural elements into the educational space. For example, international exchange activities can be carried out to let students come into contact with and understand different cultures and enhance their cross-cultural communication skills.

(2) Strengthen the interactive function of English network education space

The optimization of the interactive function of the English network education space is particularly important in the design of intelligent housing. The interactive function can not only enhance students' learning experience and improve their learning efficiency, but also help to cultivate students' independent learning ability and cooperative spirit.

a) English teachers should strengthen the user interaction design of the network education platform. The operation of the platform should be simple and easy to understand, the interface should be clear, and the feedback should be rapid, so as to ensure that students use the platform smoothly for learning. In addition, the platform provides assistance for students' personalized learning, such as customized learning paths and visualization of learning progress, in order to improve students' motivation and satisfaction.

b) English teachers should focus on the social interaction function of the online education space. Online discussion forums can be set up to encourage students to communicate and discuss about the course content to

enhance their depth and breadth of thinking. At the same time, cooperative learning modules can be set up to encourage students to work in groups and improve their teamwork and problem-solving abilities.

c) English teachers should emphasize teacher-student interaction in online education space. Teachers can guide and support students' learning through online Q&A and real-time feedback to enhance their learning effect. At the same time, teachers can obtain students' learning data through online education space to make real-time adjustment and optimization of teaching.

d) English teachers should also pay attention to the media interaction function of network education space. Multimedia, virtual reality and other technologies can be utilized to enrich the presentation of teaching content and increase students' interest in learning. For example, virtual reality technology can be used to immerse students in a simulated English environment and enhance their language practice ability.

### (3) Updating English teachers' concept of educational space

Educational space is not only a place for students to learn, but also a platform for teachers to teach. Therefore, updating teachers' concept of educational space is an important step in optimizing English educational space in smart housing design. First, teachers should recognize the multidimensionality and complexity of educational space. Educational space includes not only physical space, but also social space and psychological space. Teachers should regard the educational space as an organic whole and organically combine various forms of teaching, such as classroom teaching, network teaching and practical activities, so as to realize the diversification and personalization of teaching. Secondly, teachers should recognize the openness and flexibility of educational space. In the context of new liberal arts, the educational space should be open and changing rather than fixed and closed. Teachers should be adept at utilizing and changing the educational space to accommodate students' learning needs and changes in instruction. Again, teachers should recognize the subjective and social nature of educational space. Educational space is co-created by teachers and students and is a place for them to interact, communicate and cooperate. Teachers should encourage students to participate in the design and use of educational spaces so that they can learn and grow through interaction and practice.

## V. Analysis of the effectiveness of the application of optimization strategies in English language education

### V. A. Data sources

The final paper was mainly based on examining the students' language learning efficiency. The final examination is conducted at the end of the semester, and the results of the theoretical examination of the control group and the experimental group are collected and analyzed comparatively. The practical training examination is mainly to test the students' ability to apply what they have learned in practice by means of "practical training tasks". The practical training assessment adopts the form of practical exercises. Finally, the results of the control group and the experimental group are collected.

### V. B. Statistical analysis steps

#### V. B. 1) Pre-test analysis of control and experimental groups

In order to ensure the rigor and standardization of the research process, a simple test of the knowledge of the course was conducted on the control and experimental groups before the course was offered, and the results of the test showed that the students in the control and experimental groups had zero level of knowledge about the course.

#### V. B. 2) Basic descriptive statistical analysis of pre-tests and post-tests

Through the basic descriptive statistical analysis of the control group and the experimental group, it is possible to clearly and intuitively see the distribution of the grades of the two classes, which is conducive to the analysis of the overall characteristics of the class grades.

##### (1) Basic descriptive analysis of theoretical grades

SPSS software was used to analyze the basic descriptive statistics of the theoretical scores of the control group and the experimental group. The theoretical grades of the control group and the experimental group are shown in Table 5. The statistical results show that the average theory score of the experimental group is 7 points higher than the average theory score of the control group. From the standard deviation of the control and experimental groups, it can be shown that there is a difference between the performance of the students in the groups of the control and experimental groups, and the majority of the students' performance in the control group is distributed between  $(74.65 \pm 5.402)$  points, and the majority of the students' performance in the experimental group is distributed between  $(81.65 \pm 5.113)$  points.

Table 5: The theoretical results of the control group and the experimental group

Group	N	Minimum	Maximum	Mean	Std.Deviation	Variance
Control group	50	61	88	74.65	5.402	31.654
Experimental group	50	72	93	81.65	5.113	25.115

(2) Basic descriptive analysis of practical training achievements

SPSS software was used to analyze the basic descriptive statistics of the control group's practical training achievements and the experimental group's practical training achievements. The practical training achievements of the control group and the experimental group are shown in Table 6. As can be seen from the table, the mean score of practical training achievement of students (N=50) in the control group is 82.62 with a standard deviation of 5.226. The mean score of practical training achievement of students (N=50) in the experimental group is 87.95 with a standard deviation of 5.982. The statistical results show that the average practical training achievement of the experimental group is higher than the average theoretical achievement of the control group by 5.33 points.

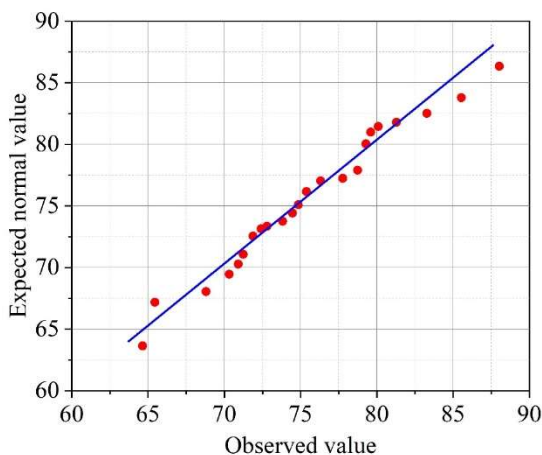
Table 6: The performance of the control group and the experimental group

Group	N	Minimum	Maximum	Mean	Std.Deviation	variance
Control group	50	70	91	82.62	5.226	29.653
Experimental group	50	76	96	87.95	5.982	36.143

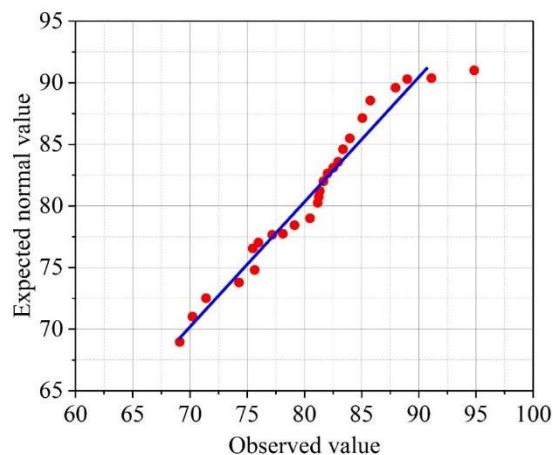
**V. B. 3) Test for normal distribution of posttest scores in control and experimental groups**

(1) Normal distribution test of theoretical scores

The Q-Q probability plot analysis of the theoretical scores of the control group and the theoretical scores of the experimental group was carried out by using SPSS software to test whether the data distribution of the control group and the experimental group conformed to the normal distribution, and the Q-Q plots of the theoretical scores of the control group and the experimental group are shown in Fig. 1 (Figs. a and b denote the theoretical scores of the control and the experimental groups, respectively). From the "control group theoretical performance Q-Q chart" and "experimental group theoretical performance Q-Q chart", it can be seen that almost all the sample data points in the chart are surrounded by a straight line, and it can be considered that the distribution of theoretical performance of the control group and the experimental group conforms to the normal distribution.



(a) The theoretical results of the control group



(b) The theoretical results of the experimental group

Figure 1: The theoretical results of the control group and the experimental group are shown in Q-Q

(2) Normal distribution test of practical training achievements

Using SPSS software to analyze the Q-Q probability plot of the control group's practical training achievement and the experimental group's practical training achievement, in order to test whether the data distribution of the control group and the experimental group conforms to the normal distribution, and the Q-Q plots of the control group's and the experimental group's practical training achievement are shown in Fig. 2 (Figs. a and b represent the control group's and the experimental group's practical training achievement, respectively). As can be seen from the "control group training achievement Q-Q graph" and "experimental group training achievement Q-Q graph", almost all the

sample data points in the graph are close to the straight line distribution, which can be assumed that the distribution of the control group and the experimental group's training achievement basically conforms to the normal distribution. It can be concluded that the distribution of practical training achievements of the control group and the experimental group basically conforms to normal distribution.

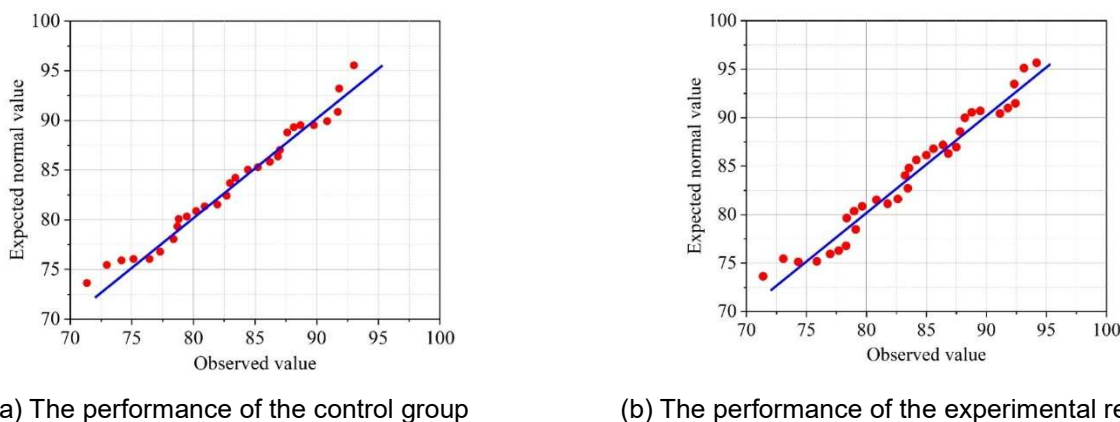


Figure 2: The experimental results are shown in Q-Q

**V. B. 4) Paired-sample t-test for control and experimental groups**

(1) Significant difference analysis of the theoretical grades of the control group and the experimental group

First, the original hypothesis  $H_0$  is proposed. it is assumed that there is no significant difference between the theoretical grades of the experimental group that receives distance learning support services and the control group that does not, i.e.,  $H_0: \mu_1 - \mu_2 = 0$ . Where  $\mu_1$  and  $\mu_2$  are the mean values of the theoretical grades of the control group and the experimental group, respectively.

Next, a significant difference analysis was conducted. The study significance level  $\alpha = 0.05$  was made to make a decision. SPSS software was used to conduct a pairs of samples t-test on the theoretical scores of the control group and the experimental group, and the independent samples test of the theoretical scores of the control group and the experimental group is shown in Table 7. As can be seen from the table, the observed value of the F statistic of the variance chi-square test in the independent samples t-test for the control group and the experimental group is 0.936, and its corresponding probability P-value (Sig. = 0.331) is greater than the significance level of 0.05, so there is no significant difference between the variance of the control group and the experimental group, and the results of the t-test should be looked at in the first row at this point. Under the assumption of equal variance Sig. (2-tailed)=0.000 is less than the level of significance 0.05, i.e.  $P = \text{Sig. (2-tailed)} = 0.000 < 0.05$ , so the original hypothesis  $H_0$  is not valid, i.e., the statistical results show that there is a significant difference between the theoretical scores of the experimental group and the theoretical scores of the control group. It can be shown that the method of this paper significantly promotes the improvement of students' theory scores.

Table 7: Independent sample test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Theoretical achievement t	Equal variances assumed	0.936	0.331	-3.691	83	0.000	-4.3162	1.1569	-6.59632	-1.95662
	Equal variances not assumed			-3.691	82.612	0.000	-4.3162	1.1569	-6.59677	-1.95421

(2) Significant difference analysis of the practical training scores of the control group and the experimental group

The same as the above steps of "analysis of significant differences between the theoretical scores of the control group and the experimental group", the use of SPSS software on the theoretical scores of the control group and the

experimental group's practical training scores for independent samples T-tests, independent samples of the control group and the experimental group's training scores are shown in Table 8. The same as the above analysis of theoretical performance, under the assumption of equal variance Sig.(2-tailed)=0.022 is less than the significance level of 0.05, i.e.,  $P = \text{Sig.}(2\text{-tailed}) = 0.022 < 0.05$ , so the statistical results show that there is a significant difference between the experimental group's practical training performance and the control group's practical training performance. It can be shown that the method of this paper more obviously promotes the improvement of students' practical training performance.

Table 8: Independent sample test of the experimental results

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Physical achievement	Equal variances assumed	0.475	0.493	-2.369	83	0.022	-2.9362	1.25362	-5.5261	-0.46392
	Equal variances not assumed			-2.369	82.06	0.022	-2.9362	1.25362	-5.5026	-0.46021

## VI. Conclusion

The integration of English education space in smart housing design can effectively enhance language learning efficiency, and all research indicators show a significant positive impact. The scale reliability validity test showed that the Cronbach's alpha coefficient reached 0.966 and the KMO value was 0.952, indicating that the research instrument has good reliability and validity. The results of the multiple linear regression analysis show that the five influencing factors explain language learning efficiency to an extremely high degree, and the  $R^2$  value reaches 0.998, indicating that the model fit is excellent and can accurately reflect the intrinsic relationship between the variables. The control experiment further verified the correctness of the theoretical analysis, and the experimental group was significantly better than the control group in both theory scores and practical training scores, with an average improvement of 7 points in theory scores and 5.33 points in practical training scores, and the results of the statistical tests all reached the significant level.

It was found that the five dimensions of intelligent environment design, technology integration, psychological and behavioral impact, social interaction support, and sustainability all had a positive effect on language learning efficiency, with the acoustically optimized design having the most prominent effect. This finding provides important guidance for the design and application of English education spaces in smart housing, suggesting that attention should be focused on the optimal configuration of the acoustic environment while taking into account the coordinated development of other technological elements. In the future, the standardized design scheme of English education space in smart housing should be further improved, and the industrialization and application of related technologies should be promoted, so as to contribute to the overall improvement of the quality of English education.

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