International Journal of Computational and Experimental Science and ENgineering (IJCESEN)

Vol. 11-No.3 (2025) pp. 3808-3820
http://www.ijcesen.com

ISSN: 2149-9144

Research Article

Construction And Initial Validation Of The Home Learning Environment Scale: An Exploratory Study

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Article Info:

DOI: 10.22399/ijcesen.2117
Received : 05 March 2025
Accepted : 01 May 2025

Keywords

Home Learning Environment Scale
Exploratory Factor Analysis
Social Learning Theory

Abstract:

The purpose of this study is to develop a set of scientific and valid home learning environment scales to provide a quantitative tool for related research and practice. Based on social learning theory, this study modified the design of the questionnaire from previous studies and invited experts to review and evaluate the content of the items to ensure content validity. Through two pretests, the first with a sample size of 54 for initial exploration and the second with a sample size of 494 for in-depth validation, the performance of the scale was assessed using exploratory factor analysis, reliability analysis, descriptive analysis, discriminant analysis, and structural equation modeling. The results showed that the scale reliability and validity of the final five retained items were good and could measure the home learning environment more accurately. However, the study has problems such as incomplete dimension coverage, sample limitation and single method. Future research could expand the dimensions of the scale, enlarge the sample range, and combine multiple research methods. The scale developed in this study makes up for the shortcomings of the existing scales and is of great significance in promoting the research and optimization of the home learning environment.

1. Introduction

As the primary place where children grow up, the learning environment of the family plays a crucial role in shaping children's academic achievement, cognitive development, and attitudes toward learning [40]. From the time a child learns to speak, the learning resources provided by the family, the learning atmosphere, and the degree of parental involvement in learning activities implicitly influence the child's learning trajectory [35]. A home learning environment that is rich in children's books, has dedicated study time and separate study areas, and in which parents are active in tutoring reading, writing, and supervising homework can greatly stimulate children's interest in learning, develop good study habits, and enhance their learning abilities [17].

The home learning environment consists of several elements, including the physical, psychological, and social environments [23]. The physical environment mainly refers to the study space and study facilities in the home, such as study rooms, desks, and bookshelves [38]. A comfortable and quiet study space can provide children with good study conditions, reduce distractions, and improve study efficiency [4]. The psychological environment, on the other hand, includes the family's learning atmosphere, parents' educational concepts and expectations [26]. A positive learning atmosphere, such as family members' love of learning and encouraging children to pursue knowledge, can stimulate children's enthusiasm for learning [25]. Social environment mainly refers to interpersonal relationships in the family, such as parent-child relationships and sibling relationships [29]. Good interpersonal relationships can provide children with emotional support and opportunities to learn and cooperate, which promotes children's learning and growth [8].

The layout and amenities of the physical environment can affect a child's learning experience [12]. Proper spatial planning, such as separating learning areas from recreational areas to

avoid interfering with each other, allows children to stay focused while learning [7]. The quality and suitability of learning facilities are also critical. Comfortable seating, adequate lighting, and desk heights that are appropriate for the child's age will help the child stay in good physical condition and reduce fatigue during the learning process [39]. As for the psychological environment, parents' own attitudes and behaviors toward learning are key to creating a positive learning atmosphere [27]. If parents love to read and keep learning new things, children will be influenced by the subtle influence of learning as a fun and valuable activity [21]. At the same time, parents' expectations of their children should be reasonable and constructive; too high or too low expectations may have a negative impact on children's motivation to learn [21]. Reasonable expectations can stimulate children's learning potential and give them a sense of accomplishment as they strive to achieve their goals [37]. Harmonious parent-child relationship in the social environment can make children more willing to communicate with their parents and share their joys and confusions in learning [32]. Parents' patience in listening to their children's ideas and giving positive feedback and suggestions can help enhance children's confidence in learning [6]. And positive learning interactions between siblings, discussing problems together and sharing learning methods with each other can create a learning atmosphere of healthy competition and motivate children's learning [24].

Home learning environment is one of the most important factors affecting children's cognitive and behavioral development [22]. A good home learning environment, including a quiet learning space, abundant learning resources, and parental attention and support to learning, can stimulate children's interest in learning, improve learning efficiency, and develop independent learning ability [13]. Sonali et al.'s (2024) study found that learning resources in the home learning environment, such as books , stationery, computers, etc., were positively associated with children's development [3]. Li et al.'s (2023) study found that having an abundance of books and learning materials in the home was positively associated with children's reading ability and academic achievement[18]. In addition, the positive learning atmosphere that parents create for their children, encouraging them to explore knowledge and participate in learning activities, etc., also helps to promote children's learning and development [15].

In terms of study space, a quiet, clean area dedicated to study can reduce external interference and make it easier for children to concentrate and enter the study state [20]. The study by Venera et al. (2023) points out that children who have a separate study room or a fixed study corner have a higher degree of concentration when studying and complete their homework with better quality [34]. The richness of learning resources is also a key element of the family learning environment. In addition to traditional books and magazines, modern families can also make use of online resources, such as online learning platforms and educational APPs, to provide children with diversified learning channels. In addition, the cultural atmosphere in the family, such as the participation of family members in cultural and artistic activities, and the attitude of respect and pursuit of knowledge, will also have a subtle impact on children's learning [11]. Emer & Ivan's (2023) study concluded that families that frequently organize family book sharing sessions and visit art exhibitions are more likely to have children who have an interest in culture and art and develop good learning habits [9]. The manner and extent of parental involvement in children's learning should not be overlooked as well, including parental supervision, guidance, encouragement, and interaction with children's learning, all of which play an important role in the family learning environment [1]. Parents who are actively involved in their children's learning are able to keep abreast of their children's learning status, give targeted help and support, enhance parent-child relationships, and provide strong emotional motivation for their children's learning [28].

The Home Environment Observation Scale (HOME) was developed in 1984 by American psychologists B.M. Caldwell and R.H. Bradley [2]. The original version, used for children aged 0-3 years, had 45 entries and consisted of 6 subscales: parental reactions, acceptance of the child, organization of the environment, learning materials, parental involvement, and various experiences. Later versions were developed for ages 3-6, 6-10, and 10-15 [2]. The scale is assessed partly by observing children's interactions with their mothers or caregivers, and partly by asking parents about the situation [2]. Although the scale is able to assess the stimulation and support of children in the home environment in a more comprehensive and multidimensional way, especially in the early stages of child development, it provides a more detailed assessment of parent-child interactions and the provision of learning resources in the home environment. However, there are still some limitations when applied to the specialized assessment of home learning environments. There is insufficient depth in the assessment of autonomous learning spaces and the utilization of online learning resources in home learning

environments for slightly older children, such as those in secondary school.

The Family Child Care Environment Rating Scale Revised (FCCERS - R) was authored by Thelma Harms, Debby Cryer, and Richard M. Clifford [30].The FCCERS - R consists of 38 items divided into 7 subscales including Space and Facilities, Personal Care Routines, Listening and Talking, Activities, Interactions, Program Structure, and Parents and Caregivers [30]. The scale covers many aspects of the family child care environment, from the physical environment to interpersonal interactions to educational activities and program structure, and can comprehensively assess the quality of the care environment. It is also highly targeted and designed specifically for family child care programs for children from infancy to school age, taking into full consideration the characteristics and needs of child care in the family environment. However, although a certain amount of cultural and socio-economic diversity has been taken into account, it may still not be able to fully adapt to all types of family environments, and further adjustments and additions may be needed for some special family situations or cultural backgrounds.

The Chinese version of the Family Environment Scale (FES - CV) was revised and rewritten by Fei Lipeng et al. in 1991 on the basis of the Family Environment Scale (FES) compiled by American psychologist Moss R. H. [2]. The scale contains 10 subscales evaluating 10 different family social and environmental characteristics: closeness, emotional expression, ambivalence, independence, success, knowledge, recreation, moral-religious views, organization, and control [33]. Although the scale is not specifically designed for home learning environments, the dimensions of Intellectualism and Organizationality have some relevance to home learning environments. However, the scale is not detailed enough to measure specifically the home learning environment, and lacks in-depth measurement of key elements such as learning resources, learning space, and specific ways of parental involvement in learning activities, making it difficult to accurately assess the core characteristics of the home learning environment.

To summarize, the existing scales for assessing the home learning environment are incomplete in terms of dimension setting. These scales only focus on one aspect of the home learning environment, focusing only on the assessment of learning resources, the number of books and school supplies in the home, but neglecting important factors such as the rationality of the learning space, the planning of the learning time, and the quality of parental participation in learning activities. It also did not address whether the family provided a dedicated and quiet study area for the child and whether the child had a regular study schedule. In addition, the existing scales lack in-depth and comprehensive measurements of the abstract but crucial dimension of family learning climate, making it difficult to accurately reflect the existence of a positive and encouraging learning climate in the family.

Therefore, this study focuses on developing a set of scientific and valid home learning environment scales, including parent-child interactions, home learning atmosphere, and characteristics of learning materials, and validating them through rigorous pilot studies (reliability and validity), aiming to provide a powerful quantitative tool for home learning environment research and practice, and to help optimize the home learning environment to promote children's learning and development.

2. Theory

Social learning theory was developed by Albert Bandura [19]. The theory advocates that individuals learn by observing the behaviors exhibited by others, i.e., role models, and their consequences [14]. The learning process includes attentional processes (the individual notices the role model behavior), retention processes (storing information about the observed behavior in memory), reproduction processes (being able to reproduce the observed behavior at the right time), and motivational processes (the drive to perform the behavior due to reinforcement and other factors) [22]. In addition, self-efficacy is also an important concept in the theory and refers to an individual's subjective judgment of his or her ability to successfully complete a behavior, which influences the individual's behavioral choices and level of effort [5].

The theory supports the generation of each topic for this study. In the home learning environment, parents are the most direct role models for their children. This study set up questions where parents personally taught literacy and supervised homework, and by observing these behaviors of their parents, children learned the attitudes and approaches that should be taken towards learning. This is in line with the social learning theory that individuals learn by observing role model behaviors. Parents' behaviors become the object of imitation for children, which helps them to develop good learning habits and acquire learning skills.

This study also sets up questions on the aspect of rich learning materials and educational toys that provide children with fodder for observation and learning. When children are exposed to these resources, they observe the knowledge and

playfulness embedded in them and learn by imitation.

The proper setup of the learning space and the accessibility of the items create a favorable learning environment for the child. This study also set up questions related to this aspect. Parents' planning of the learning space and the way the objects are placed become an environmental model for the child's learning. In such an environment, the child observes the parents' emphasis on learning and then imitates the learning behaviors that should be expected in that environment, such as focusing on learning in a separate learning area and having easy access to learning resources for independent learning, reflecting the role of the environment in shaping learning behaviors in the social learning theory.

The setting of questions in terms of parents' arrangement of their children's study time also implies modeling time management for children. By observing the study time set by parents, children gradually form the awareness of studying on time and allocating time reasonably, imitate the time management mode of parents, and cultivate self-disciplined study habits, which is also a reflection of the role modeling behavior influencing individual study behavior in social learning theory.

3. Research Design

Quantitative methods focus on measuring variables and using numerical data to test hypotheses or theoretical models () Since this pilot study aimed to develop a reliable and valid Home Learning Environment Scale (HLE), a quantitative method research design was utilized for this pilot study. The process of the pilot study included item generation, pretesting, instrument validation, and ethical considerations. In the process of pretesting, two pretests were used in this study. The first pretest with a smaller valid sample size (54 items) served as an initial exploration, allowing the study to quickly identify obvious problems that may exist with the Home Learning Environment Scale, including the ease of instrument operation and the accuracy of the data readings, and providing direction for subsequent improvement. The second pre-test with a larger valid sample size (494) serves as a more in-depth validation based on the improvements made. Since the sample size is closer to that required for the formal study, it can more accurately assess the performance of the Home Learning Environment Scale when applied on a large scale, such as the stability of the testing instrument and the consistency of the measurement results. Both samples were drawn from parents of 5-6 year old children who volunteered to participate in the home learning environment of this study in five kindergartens in Petaling Perdana, Selangor, Malaysia. Data collection for both the first and second pretests of this study was conducted through a professional online questionnaire collection tool called "Questionnaire Star", and each item was designed as a mandatory option so that there were no missing values. The Home Learning Environment Scale developed in this pilot study consisted of 11 items on a five-point Likert scale before the first pretest. Therefore, in order to validate the Home Learning Environment Scale and to ensure that it is accurate and reliable, this study first tested content validity before pretesting the scale.

3.1 Items Generation

The Home Learning Environment Scale for this study was designed with modifications based on questionnaires from previous studies. In order to validate the content validity of the Home Learning Environment Scale, an expert in the field of educational psychology was invited to develop and validate the Home Learning Environment, as well as an expert in the field of children to review and assess the content of the items. The reviewing expert reviewed each item from the perspective of whether it effectively reflected the home learning environment and whether the wording of each item was within the understanding of the home learning environment. Based on the feedback and suggestions from the reviewing experts, the wording of the 11 items was modified for this study. Each item was measured on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

3.2 First pre-testing

Pre-testing is a procedure conducted prior to formal data collection to assess the effectiveness of a survey instrument in collecting data. This procedure is usually a part of a pilot study that identifies weaknesses or errors in the survey instrument. The purpose of a pilot test is usually to assess 25-100 subjects, generally depending on the total number of subjects [3]. At this stage, it is not necessary to test subjects statistically [10]. Yunus & Khan(2011) argue that a minimum of 30 subjects should be tested during pre-testing to ensure that the subjects are representative [43]. If the questionnaire fails to meet the challenges of pilot testing, the goal is to redesign the questionnaire to obtain better results [16]. The pilot test questionnaire was evaluated by implementing a reliability test and Cronbach's alpha with a minimum standard of 0.5 [10].

Table 1. *Content Audit Before and After Comparison Scale*

No.	Pre-audit items	Modified items
1	My child has toys or games that require fine motor skills.	I have a lot of educational toys at home that my child can play with.
2	My child has a number of toys to teach him/her the names of animals, vehicles, fruits, etc.	I teach my child to read and write at home to help him/her improve their literacy skills.
3	We have alphabet books/blocks/magnetic letters/drawing recognition cards/exercise books at home.	I have alphabet books/blocks/magnetic letters/picture recognition cards/practice books at home.
4	There is a special place in the house for books and toys.	I have a special place in my house for books and toys.
5	These toys and books are easy for child to reach.	My child has easy access to toys and books around the house.
6	I give my child pencils/markers/crayons to play with.	I supervise the children's homework every day.
7	We have a lot of child's books at home.	I have a lot of children's books at home.
8	I give my child the books and stories they need.	My child has a separate study area.
9	The child has space to do sports activities (e.g. swimming lessons).	My child has dedicated study time at home.
10	I take my child to art activities (e.g. dance, painting classes).	My child has the opportunity to do art activities at home.
11	I take my child to cultural events (e.g. cinema, theatre, museums).	I accompany my child to watch educational videos at home.

In this study, exploratory factor analysis and reliability analysis of the Home Learning Environment Scale for 5-6 year olds were collected and discussed in the first pretest.

3.2.1 EFA analysis

The first pretest of this study analyzed the pretest results through multiple EFAs, and finally, based on multiple analyses and adjustments of KMO values, cumulative variance kinks, and rotated component matrices, five items were retained for the final Home Learning Environment Scale. The rotated component matrices for the five retained items did not have any dimensions, so there is no rotated component matrix table. Table 2 shows the KMO values for the five retained topics, with KMO=.791>0.7, which means that the correlations between the variables are fair and can generally be analyzed for factor analysis, but further screening or manipulation of the variables may be needed to improve the analysis.

Table 2. *First pre-test KMO values*

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.791
Bartlett's Test of Sphericity	Approx. Chi-Square	128.109
	df	15
	Sig.	.000

Table 3 shows the values of the total variance explained by the Home Learning Environment Scale.The cumulative variance contribution rate of the EFA is 60.243%, which indicates that the common factors have a certain ability to summarize the information of the original data, and that it is feasible to carry out the subsequent analyses and interpretations based on these common factors. It also shows that the extracted common factors can explain 60.243% of the total variance of the original variables. That is to say, about 60.243% of the variance of the original variables can be explained by the extracted metrics, and the remaining 39.757% of the variance cannot be explained by these metrics, which may be due to other unconsidered factors, measurement errors or random factors.

3.2.2 Reliability Analysis

Table 4 shows the content of the five items that were ultimately retained for the first pretest and the results of the reliability analysis. The answer options continue to use a 5-point Likert scale with 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly Agree. The Cronbach's alpha coefficient for this study = 0.827 , Cronbach's alpha coefficient between 0.8 - 0.9 indicates that the scale has high reliability. It indicates that the items of the Family Learning Environment Scale have strong correlations with

Table 3. *Total variance explained for the first time*

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.012	60.243	60.243	3.012	60.243	60.243
2	.728	14.564	74.807			
3	.605	12.094	86.900			
4	.371	7.417	94.317			
5	.284	5.683	100.000			
Extraction Method: Principal Component Analysis.						

Table 4. *Items retained under EFA analysis and reliability analysis*

No.	Reserved items	Answer					Reliability
1	I teach my child to read and write at home to help him/her improve their literacy skills.	1	2	3	4	5	.827
2	I supervise my children's homework every day.	1	2	3	4	5	
3	I have a lot of children's books at home.	1	2	3	4	5	
4	My children have dedicated study time at home.	1	2	3	4	5	
5	My child has a separate study area.	1	2	3	4	5	

each other and are able to measure the same trait or concept more consistently. It also means that this value indicates a high degree of consistency in what is measured by the items that make up the Home Learning Environment Scale.

3.3 Second Pre-Testing

3.3.1 Descriptive Analysis

Table 5 shows the descriptive analysis of the second pre-test, with no missing data in a valid sample size of 494, the data is intact.The mean values of HLE1 - HLE5 range from 3.47 - 3.51, indicating that the overall scores are in the upper middle of the range, with little difference in the mean levels of the different items. The medians were all 4.00, meaning that at least half of the sample scored greater than or equal to 4 on each item, and the data were concentrated in the higher score bands. All of the variables in this study have an absolute value of kurtosis less than 10 and an absolute value of skewness less than 3, indicating that the values of the five items of the Home Learning Environment Scale are distributed in a basic normal distribution.The Minimum is 1, and the Maximum is 5, which means that scores on the items fall within the set range of 1-5. 25% is 3.00, which means that 25% of the sample scored on the items. 25% of the sample scored close to the mean on each item. 50% and 75% were both 4.00, indicating that the majority of the sample was concentrated at the median of the five items, further reflecting the concentration of data in the higher score bands.

3.3.2 Differentiation Analysis

Table 6 shows the differentiation analysis of the second pretest, F-values are used in ANOVA to test whether there is a significant difference in the means between the different groups.The F-values of HLE1-HLE5 are all larger and the corresponding Sig. values are less than 0.05, which indicates that there is a significant difference in the means between the high ability group and the low ability group, i.e., the family The five items of the Home Learning Environment Scale have the ability to differentiate between respondents with different levels of proficiency. t-values of HLE1-HLE5 measure the degree of difference between the means of the high ability group and the low ability group, and the absolute value of the t-values are large, which implies that the more significant the difference between the means of the two groups. t-values of HLE1-HLE5 are all large. -HLE5 df are large, implying high reliability of the statistical test. sig. (2-tailed) of HLE1-HLE5 are .000 (<0.05), indicating that the difference in means between the high ability group and the low ability group on the items is of extremely significant statistical significance, i.e., these items are effective in differentiating between different groups of respondents.

Table 5. *Second Pretest Descriptive Analysis*

		HLE1	HLE2	HLE3	HLE4	HLE5
N	Valid	494				
	Missing	0				
Mean		3.49	3.49	3.47	3.51	3.49
Median		4.00				
Skewness		-.420	-.326	-.410	-.390	-.305
Kurtosis		-.523	-.684	-.679	-.672	-.716
Minimum		1				
Maximum		5				
Percentiles	25	3.00				
	50	4.00				
	75	4.00				

Table 6. *Distinction analysis of the second pretest*

Items	F	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
HLE1	36.053	-24.180	382.014	.000	-1.783	.074	-1.928	-1.638
HLE2	26.636	-25.151	389.685	.000	-1.868	.074	-2.014	-1.722
HLE3	46.066	-22.351	380.635	.000	-1.783	.080	-1.940	-1.626
HLE4	27.478	-24.962	386.923	.000	-1.859	.074	-2.006	-1.713
HLE5	14.778	-22.807	393.973	.000	-1.788	.078	-1.942	-1.634

Table 7. *Second pretest KMO analysis*

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.876
Bartlett's Test of Sphericity	Approx. Chi-Square	1151.541
	df	10
	Sig.	.000

Table 8. *Second pretest total explained variance*

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.343	66.866	66.866	3.343	66.866	66.866
2	.489	9.784	76.650			
3	.414	8.285	84.935			
4	.404	8.081	93.017			
5	.349	6.983	100.000			
Extraction Method: Principal Component Analysis.						

The difference in Mean Difference for HLE1-HLE5 is in the range of -1.783 - 1.868, reflecting the extent to which these five items are effective in differentiating between different levels of respondents. The difference of Mean Difference of HLE1-HLE5 is in the range of -1.783 - -1.868, reflecting the degree of differentiation of these five items for different levels of respondents, the larger the difference, the more obvious the effect of differentiation. 95% Confidence Interval of the Difference lower and upper intervals do not contain 0 , further indicating that there is a significant difference between the means of the two groups at the 95% confidence level, supporting the conclusion that the five question items of the Home Learning Environment have a good discriminatory effect.

3.3.3 EFA analysis

The results of the EFA analysis for the second pretest of this study further support the results of the first pretest, for the five items retained from the first pretest, the rotated component matrix for the second pretest still does not have any dimensions, therefore there is no rotated component matrix table. Table 7 shows the KMO values for the five retained items, KMO = 0.876 , with a KMO between 0.8 - 0.9, implying that the data performs well in terms of sampling adequacy, and that there are strong common factors between the items of the Home Learning Environment Scale, which makes it suitable for conducting factor analysis.

Table 8 shows the total explained variance for the second pretest. One component out of five observations was found, Component 1 with an eigenvalue of 3.343 (>1), implying that the principal component was retained and that this principal component contained more information about the original variables. The variance contribution of Component 1 was 66.866%, which means that it explained 66.866% of the total variance of the original variables. The cumulative variance contribution of Component 1 of 66.866% is greater than 60%, which means that the extraction is well explained and the factor effect is good.

The values in Table 9 are the component loadings of the second pre-test, representing the correlation coefficients between the original variables (HLE1-HLE5 in the Items column) and the extracted principal component (Component 1).The loadings of HLE1-HLE5 on Component 1 are all greater than 0.8, which indicates that they are all better explained by this principal component, and implies that there is a strong positive correlation between HLE1-HLE5 has a strong positive correlation with Component 1.

3.3.4 Reliability Analysis

Table 10 shows the reliability analysis of the second pretest, the Cronbach's alpha coefficient of the five items = 0.876 , the same as the Cronbach's alpha coefficient of the first pretest, which is between 0.8-0.9 indicating that the scale has a high reliability. It means that the items of the Family Learning Environment Scale have a strong correlation with each other and are able to measure the family learning environment in a more stable way. It also means that this value indicates a high degree of consistency in what is measured by the items that make up the Home Learning Environment Scale.

Table 9. *Matrix of components for the second projection test*

Component Matrix[a]	
Items	Component
	1
HLE1	.832
HLE2	.822
HLE4	.820
HLE5	.814
HLE3	.801
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

Table 10. *Reliability analysis of the second pre-test*

Reliability Statistics	
Cronbach's Alpha	N of Items
.876	5

3.3.5 Structural Equation Modelling (SEM)

3.3.5.1 Confirmatory Factor Analysis

Figure 1 shows the latent variable, Home Learning Environment, measured by five observed variables, HLE1-HLE5. There are unidirectional arrows between the observed variables and the latent variables, indicating the relationship of the latent variables to the observed variables. Each observed variable corresponds to an error term e1 - e5 , with the arrows weighted at 1, indicating that these relationships are standardized settings in the model setup to measure the error that exists in the measurement of the latent variable by the observed variables. As a whole, the structural equation model fits well.

Table 11 shows the values of the fit indicators for the home learning environment, CMIN/DF=2.301 (CMIN/DF<5), which indicates that the model fits the data well and this model is within the acceptable range. rMR=0.021,Usually the smaller the value of RMR, the better the model fit, the value of RMR in this study is smaller, which indicates that the model fit is good. gFI=0.990. AGFI=0.971, the range of values is between 0 - 1, the closer to 1 the better the fit, therefore, the model fit for the five items of the home learning environment is good.RMSEA=0.051 (RMSEA<0.08), which indicates that the fit is better and the model is in the better interval.PGFI=0.330, the larger the value of the measure of model parsimony indicates that the model is more parsimonious and valid.NFI = 0.990, RFI = 0.980, IFI = 0.994, TLI = 0.989, which is close to 1, indicating that the model improves a lot relative to the independent model, and CFI = 0.994 (CFI>0.9), implying that this model fits very well.

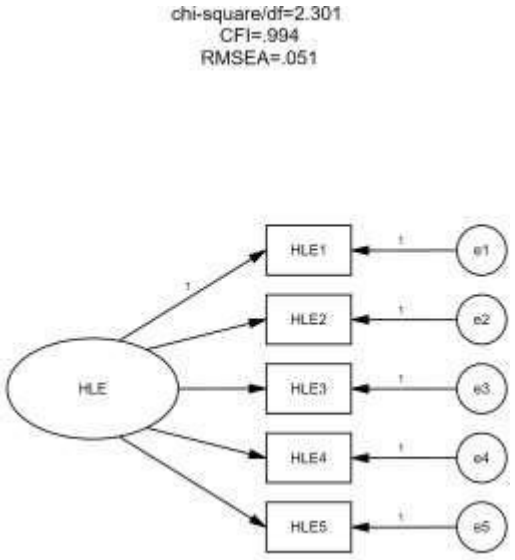

Figure 1. *CFA analysis of home learning environment*

3.3.5.2 Aggregation Validity

Table 12 shows the convergent validity and factor loadings for the home learning environment. Factor loadings reflect the degree of contribution or strength of association of the observed variable to the latent variable, and in general, the greater the absolute value of the factor loadings, the greater the measurement validity of the observed variable to the latent variable. The standardized factor loadings between the observed variables (HLE1 - HLE5) and the latent variable (HLE) are all greater than 0.7, indicating that they are more strongly associated with the latent variable Home Learning Environment and have better measurement validity for the latent variable.

Table 11. *Values for CFA analysis of home learning environments*

Model	CMIN/DF	RMR	GFI	AGFI	PGFI	NFI	RFI	IFI	TLI	CFI	RMSEA
Default model	2.301	.021	.990	.971	.330	.990	.980	.994	.989	.994	.051

Table 12. *Convergent validity of the home learning environment*

Items			Estimate	CR	AVE
HLE1	<---	HLE	.789	0.876	0.586
HLE2	<---	HLE	.771		
HLE3	<---	HLE	.739		
HLE4	<---	HLE	.772		
HLE5	<---	HLE	.757		

4. Discussion

This study focuses on the development of a set of scientific and valid home learning environment scales, aiming to provide a powerful quantitative tool for home learning environment research and practice. Through the detailed elaboration of the scale development process and the analysis of various data, this study obtained a series of valuable findings, which are of great significance to the understanding of the measurement of the home learning environment and its impact on children's learning and development.

From the item generation stage of the scale development, the design was modified based on the questionnaires of previous studies and experts were invited to review and evaluate the content of the items to ensure that the scale had a certain degree of content validity. The experts reviewed the items from the perspectives of whether they could effectively reflect the family learning environment and whether they were appropriately worded, and revised the wording of the 11 items to make the scale more accurate in measuring the target concepts. This process reflects a multidimensional consideration of the home learning environment, covering learning resources, learning space, parental involvement, etc., which is in line with the complex and multifaceted nature of the home learning environment.During the pretesting phase, two pretests were conducted with different sample sizes to provide comprehensive data support for scale optimization. The first pretest identified the five topics retained for the scale through exploratory factor analysis (EFA) and reliability analysis. The values provided initial evidence of the feasibility and stability of the scale in measuring the home learning environment.The second pretest was analyzed in more depth with a larger sample size. Descriptive analyses showed that the sample data were complete, the data were concentrated in the higher score bands, and the absolute values of kurtosis and skewness of all variables met the requirements of normal distribution, indicating that the scale scores were reasonably distributed and had good measurement properties. In the differentiation analysis, the F-value, t-value, df, and Sig. value of HLE1 - HLE5 indicate that the five items of the scale have good differentiation ability for respondents at different levels, and are able to effectively differentiate between individuals at different levels of home learning environments.

The EFA analysis, which was conducted again, indicated that the data performed well in terms of sampling adequacy, and there were strong common factors among the items, which made them suitable for factor analysis. Meanwhile, the loadings of each item on the principal components were all greater than 0.8, indicating that there was a strong positive correlation between the items and the principal components, which further validated the structural validity of the scale. The high reliability of the scale was reconfirmed in the reliability analysis.

The results of the validated factor analysis (CFA) in structural equation modeling (SEM) showed a good model fit between the latent variables of home learning environment and the five observed variables. In the convergent validity analysis, the standardized factor loadings between the observed variables and the latent variables were all greater than 0.7, indicating that the measurement validity of the observed variables on the latent variables was good and could effectively reflect the concept of home learning environment. Taken together, the Home Learning Environment Scale developed in this study shows better properties in terms of reliability and validity, and is able to measure the home learning environment more accurately. This not only provides a reliable measurement tool for subsequent studies related to the home learning environment, but also helps to explore in depth the relationship between the home learning environment and children's learning, cognitive, and emotional development. Meanwhile, the results of the study also provide valuable reference for parents, educators and policy makers to better understand the importance of the home learning environment and take targeted measures to optimize the home learning environment for children's holistic development.

5. Limitation and Suggestions

5.1 Limitation

Dimension coverage is not comprehensive. Although the Family Learning Environment Scale

developed in this study covers important aspects such as learning resources, learning space, and parental involvement, the family learning environment is a complex ecosystem, and there are many key dimensions that are not adequately included. For example, cultural heritage activities in the family, such as telling family stories and passing on traditional skills, have a profound impact on children's values and attitudes toward learning, but are not addressed in the scale. In addition, the dimension of time management in the family learning environment was not considered in terms of how parents arrange the family's overall learning and leisure time and the impact of this time arrangement on the children's learning rhythm, in addition to whether the children have dedicated time for learning.

Sample Limitations. The sample of the study was selected from parents of 5-6 year old children from five kindergartens in Petaling Perdana, Selangor, Malaysia only. This resulted in a geographically diverse sample with differences in culture, educational resources, and family attitudes in different regions, which may affect the applicability of the scale in other regions.

The research methodology was homogenous. This study relied primarily on quantitative research methods, collecting data through questionnaires and analyzing them statistically. Although quantitative methods have the advantages of objectivity and reproducibility, they have some limitations in studying the home learning environment. Some key factors in the home learning environment, such as the emotional quality of parent-child interactions and the subjective perception of the home learning atmosphere, are difficult to be accurately captured by quantitative data.

5.2 Suggestions

Expanding the scale dimensions. The dimensions of the Home Learning Environment Scale should be further expanded in subsequent studies. Through extensive literature review, expert consultation, and field research on different families, more key factors affecting the family learning environment should be identified and included. For the dimension of family cultural heritage activities, relevant questions can be set to ask parents whether they often tell family stories to their children and whether they allow their children to participate in learning traditional skills, etc. For the dimension of family learning time management, questions can be designed to understand how parents plan the family's weekly learning and leisure time, and whether children have the right to arrange their own learning time, etc.

Expanding the scope of the sample. In order to improve the generalizability of the scale, the scope of the sample should be expanded. Geographically, families from different countries and regions can be selected for the study to compare the differences in family learning environments under different conditions of cultural background and educational resources and to test the validity of the scale. For families with children of different ages, separate sampling studies should be conducted to develop versions of the Home Learning Environment Scale applicable to different age groups, or age-stratified measurement dimensions should be added to the existing scale to ensure that the scale can accurately assess the home learning environments of children of different ages.

Combining multiple research methods. In future research, quantitative research methods should be combined with qualitative research methods. While using questionnaires to collect data for quantitative analysis, in-depth interviews and participatory observation are conducted. Interview parents and children to understand their subjective feelings, expectations, and problems they face in the home learning environment; observe the home learning scene to record the real situation of parent-child interactions, the way learning resources are used, and so on. The qualitative findings and quantitative data are complemented with each other to provide a more comprehensive understanding of the family learning environment and a richer basis for the optimization of the scale.

6. Conclusions

This study focuses on the development of a set of scientific and valid home learning environment scales to provide quantitative tools for home learning environment research and practice through a rigorous quantitative research design.

In the course of the study, based on previous research questionnaires, experts in the fields of educational psychology and children were invited to jointly develop and modify the scale items to ensure content validity. After two pre-tests, the sample size of the first pre-test was 54 to initially explore the problems of the scale, and the sample size of the second pre-test was 494 for in-depth validation on the basis of improvement. The performance of the scale was comprehensively assessed through various methods, including exploratory factor analysis (EFA), reliability analysis, descriptive analysis, discriminant analysis, and structural equation modeling (SEM). The results of the study showed that the final retained five-item Home Learning Environment Scale had good performance.

This study is of great value. In terms of research, the developed Family Learning Environment Scale makes up for the shortcomings of the existing scale in terms of dimensional settings, and is able to measure the family learning environment in a more comprehensive and in-depth way, providing a reliable quantitative tool for the subsequent family learning environment-related research, and helping to push forward the development of research in this field. In practice, the scale can help parents and educators understand the current situation of the family learning environment more accurately and identify problems, so as to optimize the family learning environment in a targeted manner, create better conditions for children's learning and development, and promote children's cognitive and behavioral development.

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
- **Acknowledgement:** The authors declare that they have nobody or no-company to acknowledge.
- **Author contributions:** The authors declare that they have equal right on this paper.
- **Funding information:** The authors declare that there is no funding to be acknowledged.
- **Data availability statement:** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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