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Introducing the Home Learning Environment Questionnaire and examining the profiles of home learning environments in Greece

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The Home Learning Environment (HLE) plays a prominent role in children's development. Several measures have been developed to assess its quality; however, most of them seem to mainly focus on specific aspects of the HLE construct. The aim of this study was to develop and validate the Home Learning Environment Questionnaire (HLEQ); and to examine the characteristics of the HLE and the HLE profiles using the new instrument in the Greek educational context. The HLEQ is a parent-reported measure addressing both activities and interactions, comprising of six factors that are considered key elements of the HLE: indoor, outdoor, and digital learning activities, warmth/support, conflict, and inconsistent discipline. The development of HLEQ followed a robust methodological approach, including the collection of an initial pool of items, expert review to examine its content validity, and piloting. The HLEQ was administered to 814 parents ($M_{age} = 37.86$ years, $SD = 4.84$) of children ($M_{age} = 64.12$ months, $SD = 7.19$) attending 84 state funded kindergartens in Greece. A cross-validation approach was used to examine the factor structure of the HLEQ. Exploratory and confirmatory factor analysis and exploratory structural equation modeling procedures were implemented. Latent profile analysis was employed to identify the HLE profiles. Results provided initial support for the factor structure, reliability, and validity of the HLEQ. The HLEQ displayed good psychometric properties for measuring the quality of home learning activities

and home learning interactions in the contemporary early HLE. Four HLE profiles were revealed, representing different parent-child interaction patterns during the learning activities. Limitations and implications for policy and practice are discussed.

KEYWORDS

home learning environment, digital learning activities, home learning interactions, early childhood education, scale development, questionnaire psychometrics, latent profile analysis, home learning activities

Introduction

A large volume of recent empirical evidence has shown the beneficial effects of a high-quality Home Learning Environment (HLE) on children's cognitive development (Tamis-LeMonda et al., 2019; Bonifacci et al., 2022), social development (Rose et al., 2018) and their overall well-being (Dearing and Tang, 2010). Researchers acknowledge that while factors like family's socioeconomic status (SES) or educational background influence children's educational attainment (Melhuish et al., 2008; Kluczniok and Mudiappa, 2019), the quality of HLE seems to be equally important. As Sylva and her colleagues stated, "what parents do is more important than who parents are" (2004, p. 164).

The quality of the early HLE is also associated with long-term effects on children's literacy and numeracy competencies and their academic achievement (Niklas and Schneider, 2017). Several studies using different measures for assessing the HLE (e.g., Foster et al., 2005; Melhuish et al., 2008; Bonifacci et al., 2021) have shown the impact of the HLE on children's outcomes. Rodriguez and Tamis-LeMonda (2011) used a measure for all aspects of the HLE, and found strong associations between the HLE and children's skills in receptive vocabulary and emergent literacy. Melhuish et al. (2008) used another measure and reported that the early HLE predicted numeracy achievement at the age of five. Manolitsis et al. (2013) examined the effects of home literacy and numeracy activities on emergent reading and math acquisition by using more content-specific measures for the aspects of HLE. Due to the influence of HLE on children's outcomes, researchers have reported the need for reliable early assessments of the quality of children's home environments as a first step to identify children at risk of not achieving their full potential and to design effective and targeted interventions (Niklas et al., 2016; Aminipour et al., 2018).

Given the importance of HLE on children's development is well-documented, researchers (Lehr et al., 2020) suggested a more in-depth examination of the role of HLE by following person-centered approaches. Person-centered approaches can capture the profiles of parental involvement in the HLE and evaluate the importance of environmental stimulations

across the preschool years in detail. In addition, researchers acknowledge that the characteristics of the HLE may be influenced by cultural factors (Aminipour et al., 2018). The aim of this study is to introduce a newly developed measure for the assessment of the quality of the HLE in families with preschool children and examine its psychometric properties. An additional purpose is to investigate the quality and the profiles of the HLE in Greece using a person-centered approach.

Defining the home learning environment

A review of the existing literature revealed two major approaches to the way the HLE is operationalized. In the first approach, researchers perceive the HLE as a broad construct suggesting that the overall quality and quantity of stimulation offered to a child within the family's microsystem constitutes a learning environment that significantly influences the child's development (Dearing and Tang, 2010). The HLE is viewed as a wide context with multiple dimensions that facilitates different processes through which children learn (Kluczniok et al., 2013). In the second approach, researchers perceive the HLE as more content-specific and focused on elements that promote literacy and numeracy. The content-specific approach includes various dimensions of the HLE for example the home literacy environment (Rose et al., 2018), the home numeracy environment (Manolitsis et al., 2013; Bonifacci et al., 2021), and the home digital environment (Sonnenschein et al., 2021).

Researchers from both approaches acknowledge two central dimensions of the HLE. The first dimension refers to the participation of parents and children together in stimulating activities. The Home Learning Activities (HLA) constitutes "the range of formal and informal activities in which parents and children engage. These activities provide opportunities for communicative exchanges and interpersonal interactions that facilitate learning" (Hayes et al., 2018, p. 1405). The literature describes several categories when classifying the types of HLA. A broad approach of HLAs divides them into *indoor* or home-based and *outdoor* or enrichment activities. Indoor HLA include

the learning stimulation that the child receives within the home (e.g., learning letters or numbers, doing crafts), whereas outdoor HLA refer to the various learning experiences provided to the child outside of the home (e.g., visiting a library, doing sports) (Foster et al., 2005). Cultural activities (e.g., going to the museum, cinema) constitute another individual type of outdoor learning activities (Kluczniok and Mudiappa, 2019). A more content-specific approach of HLAs classifies them as formal and informal (Sénéchal and LeFevre, 2002) or direct and indirect activities (Manolitsis et al., 2013), which refer to the degree a parent either directly teaches the child or incidentally provides learning stimulation during their everyday activities. Another important type of activities that hold a center place in the HLE nowadays is *digital* activities. The “intrusion” of smart devices in family’ lives introduced new types of learning and entertainment activities and transformed the concept and the content of HLE (Griffith and Arnold, 2019; Sonnenschein et al., 2021). Some studies for example categorize HLA in digital and non-digital activities (e.g., Neumann, 2018).

The second dimension refers to the quality of parent-child interactions during HLA as a core component of the HLE (Rodriguez and Tamis-LeMonda, 2011; Griffith and Arnold, 2019). A positive parent-child relationship is associated with beneficial developmental outcomes (Bradley and Corwyn, 2005). *Warm* and *supportive* interactions allow the child to feel secure to explore the environment and learn (Ainsworth et al., 2015). In contrast, harsh parenting, such as negative control, results in more *conflicted* parent-child interactions and problematic outcomes in children (Baumrind et al., 2010). Moreover, *inconsistent discipline*, permissive and chaotic parental practices are associated with increased child behavior difficulties (Arnold et al., 1993). In the present study the term “Home Learning Interactions” (HLI) is used to refer to various parent-child interactions during HLA.

Based on the above, the HLE constitutes a multifaceted construct that includes both “what” and “how” HLAs are implemented (Dearing and Tang, 2010). To this point, a recent study that introduced a new model, the Home Learning Ecosystem (Gregoriadis and Evangelou, 2022), describes a high-quality home learning environment as “a safe and developmentally conducive environment that offers consistent opportunities for formal and informal teaching and playing activities, indoors and outdoors. It provides space, stimuli and time for autonomy and individual play and also for ample caregiver-child learning activities of various types, executed in a positive and supporting climate. The warmth, support and responsiveness of the caregiver-child interactions (e.g., parents, siblings, grandparents) during these activities defines to a great extent the quality of this home learning ecosystem” (p. 4).

Similarly, the current study conceptualizes the term “Home Learning Environment” during the early childhood period, as a broad construct that represents the quality of indoor, outdoor, and digital learning activities and interactions among parents and children.

Measuring the quality of the home learning environment

There are various instruments available to assess the quality of the HLE. Some of the most widely used are the Home Observation for the Measurement of the Environment Inventory (HOME; Bradley and Corwyn, 2005), the early years HLE Index (Melhuish et al., 2008), the Questionnaire on the HLE (Niklas and Schneider, 2017) and the HLE subscale of Parenting Questionnaire (Morrison and Cooney, 2002). Most of the existing instruments measuring the HLE have some applicability limitations. For example, some instruments capture effectively the multidimensional nature of the HLE but are not very easy to apply when collecting data from a large sample as it exceptionally time consuming (e.g., HOME observation scale). Other instruments with strong psychometric properties (e.g., HLE Index) focus on a relatively narrow selection of learning activities and therefore do not collect information about all the dimensions of the HLE (e.g., parent-child interactions). Some instruments measure domain-specific activities (e.g., for numeracy or literacy) (e.g., the Questionnaire on the HLE or the HLE subscale of Parenting Questionnaire), and therefore do not capture the full range of the HLE dimensions (e.g., home digital practices).

To avoid focusing mainly on the HLA, some studies attempted to assess the nature of parent-child interactions during the learning activities by using small sets of items, for instance by asking the parent “How often do you express affection by hugging, kissing?” “Overall, how close would you say you are to child?” (e.g., Hartas, 2012, p. 864). However, these individual items did not represent the various dimensions of parenting practices and do not seem to fully capture the nature of the parent-child relationship (Niklas et al., 2016). In addition, while studies on general parenting measure the parent-child relationship through exploring either parenting styles (Baumrind et al., 2010) or the dimensions of parenting practices (Skinner et al., 2005), research on HLE is still unclear on how to measure the quality of interactions during learning activities. For instance, the HOME includes items representing the parenting dimensions of warmth/responsiveness and harshness/discipline, whereas other studies (e.g., Rose et al., 2018; Tamis-LeMonda et al., 2019) use qualitative methods to observe the interactions and measure their quality by using rating scales of mother’s sensitivity and cognitive stimulation. Furthermore, most of the existing measures seem to be relatively outdated regarding the important role of digital HLA in daily family practices.

The review of the existing instruments revealed a number of limitations regarding their length, focus and methodology used. These limitations highlight the need for the development of a new and updated HLE measure. The current study suggests that a measure that assesses the parent-child learning interactions in a variety of indoor and outdoor activities—including the family’s digital practices—may be particularly useful in bringing a broader

insight into the quality of the contemporary HLE. Based on the above, the new instrument addresses both activities and interactions, but not the physical environment of a child's home.

Home learning environment profiles

Previous longitudinal studies demonstrated patterns of changes and improvements in the HLE over time (Son and Morrison, 2010), that predicted children's literacy and academic skills. For instance, Rodriguez and Tamis-LeMonda (2011) identified a variation in early HLE trajectories. Specifically, six different HLE profiles were identified, namely environments that were characterized as consistently low or high, and environments displayed varying patterns of change. Hayes et al. (2018) identified three longitudinal profiles of parental involvement in shared reading (high-stable involvement, medium-stable involvement, and low-increasing involvement). Based on the evidence for the changes of the HLE over time and the existence of sub-profiles within the broad context of the HLE, a question arises of whether distinct HLE types do exist that reflect particular patterns of variations in parent-child interaction during learning activities. A more in depth understanding of the characteristics and patterns of early HLEs can assist to determine the profiles of families who provide lower quality learning environments and whose children are at risk of school failure (Lehrl et al., 2020).

Only a few studies have employed person-centered approaches to identify profiles of family involvement in home and center-based programs in Early Head Start. The aim was to recognize the role of the different dimensions and patterns of family engagement in these programs in order to further support them (Bulotsky-Shearer et al., 2012; Jeon et al., 2020). To the best of our knowledge, existing research has not examined the multifaceted construct of the HLE by identifying typologies that share particular patterns of parent-child interactions during the learning activities. The present study addresses the aforementioned gap in the literature by following a person-centered approach and employing a classic latent profile analysis (LPA) to identify distinct HLE profiles. Such an understanding can contribute to further address the needs of each of these profiles and intervene to support them.

The home learning environment of Greek families

Many studies from several countries and cultural contexts from North America (Rodriguez and Tamis-LeMonda, 2011) and South America (Foster et al., 2005), to Europe (Melhuish et al., 2008; Kluczniok et al., 2013), Asia (Aminipour et al., 2018; Zhang et al., 2020), and Australia (Niklas et al., 2016; Hayes et al., 2018) enhance our understanding of the characteristics of the HLE. As far as Greece is concerned, there is limited

evidence about the quality and the profile of HLE with the few available studies mainly focusing on Greek parents supporting their children's literacy and numeracy practices. For instance, in their cross-cultural study, LeFevre et al. (2010) found that Greek parents indicated less frequent engagement with their children in literacy and numeracy activities than parents in Canada. A higher frequency of formal home numeracy practices were related to children's numeracy outcomes and home literacy practices also predicted children's numeracy skills. In another study, Manolitsis et al. (2013) found that Greek parents reported more frequent engagement in formal home numeracy than in formal home literacy activities, while the frequency of both formal home literacy and numeracy activities predicted children's early reading and math outcomes. Furthermore, recent findings indicated that Greek parents support children's access and interactions with smart mobile devices as they consider them as a means to develop a stimulated HLE (Papadakis et al., 2019). However, the above studies did not examine how parents were involved with children in the activities and what kind of interactions they used to enhance children's learning. The present research adds to the sparse literature and provides an insight into the characteristics of the HLE in Greece assessed by a new broad measure.

The present study

The purpose of the present study was to introduce a new measure, the Home Learning Environment Questionnaire (HLEQ), to assess the quality and the profile of the HLE of families with preschool children. The specific research aims were: (a) to explore the psychometric properties of HLEQ, namely internal consistency, construct validity, and the pattern of associations among the HLEQ dimensions; (b) to provide an initial assessment of the characteristics of the HLE in Greece and (c) to identify typologies of the HLE which reflect patterns of parent-child interactions during the learning activities. Based on the reported purpose, the research questions of this study are as follows:

RQ1: Is the HLEQ a suitable measure to evaluate the quality of a contemporary early HLE?

RQ2: What are the characteristics of the Greek HLE?

RQ3: Which profiles of the HLE are identified in the Greek cultural context?

Materials and methods

Participants

A total of 814 parents participated in the study and filled out the new instrument. Using a multi-stage sampling technique, participants were recruited from 84 state funded kindergarten classes from urban and suburban areas of Western and Central

Macedonia in Greece. 84.2 percent of the participating parents were mothers ($n = 685$), and 15.8 percent were fathers ($n = 129$). The mean age of the parents was 37.86 years ($SD = 4.84$, range = 38) and the majority of them were Greek (94.2% of mothers, 95.9% of fathers). Mother's educational level was as follows: 1.8% of them attended only elementary school, 3.4% graduated from low secondary school, 17.4% obtained a high school degree, 19.5% obtained a college/vocational training institute degree, 39.3% obtained a university degree, and 18.1% had completed post-graduate studies. Father's educational level was as follows: 2.1% of them attended only elementary school, 5.8% attended only junior high school, 33.7% obtained a high school degree, 14.5% obtained a college/vocational training institute degree, 31% obtained a university degree, and 12.5% had completed post-graduate studies. Based on the National Statistics of Greece (Hellenic Statistical Authority, 2022), parent's educational level in this study was representative of the selected region. Regarding the mother's occupation, 65.1% were employed, 17.4% were unemployed, and 17.5% had selected household as their occupation. 97.4% of fathers were employed and only 2.4% were unemployed. Their children's age ranged between three to 6^o years ($M_{age} = 64.12$ months, $SD = 7.19$, range = 45) at the time of parental consent.

For this analysis, the sample was randomly divided into two groups, group A ($N = 405$) and group B ($N = 409$). Group A was used to investigate the factorial validity of the HLEQ, and Group B served to cross-validate findings. Preliminary examination revealed that there were no differences between the two groups with respect to age ($p > 0.05$) and gender ($p > 0.05$). The total sample was used to examine the profile and the characteristics of the Greek HLE.

Measures

Home learning environment questionnaire

The Home Learning Environment Questionnaire (HLEQ) was developed to assess the characteristics of the early years HLE. HLEQ is a self-reported instrument comprised of 32 items that measure activities and interactions with six dimensions of HLE, namely Indoor learning activities (six items), Outdoor learning activities (five items), Digital learning activities (five items), Warmth/Support (six items), Conflict (five items), and Inconsistent discipline (five items). Responses are rated on a six-point Likert-type scale ranging from 1 (never) to 6 (always). Parents indicate the frequency with which they implement a specific practice.

Indoor learning activities were conceptualized as the activities that parents do with children at home to promote child's learning (e.g., "The parent helps the child "write" letters and words," Hayes et al., 2018). Outdoor learning activities refer to the range of out-of-home activities parents offer to their children (e.g., "The parent takes the child to a sport activity, e.g., swimming lessons," Foster et al., 2005). Digital

learning activities assess the digital practices of families for learning purposes (e.g., "The parent plays with the child with numeracy applications, e.g., tablet, smartphone," Neumann, 2018). Warmth/Support reflects the degree to which a parent responds to the child's learning needs in a supportive way (e.g., "The parent encourages the child to keep up with an activity, when the child finds it challenging," Bradley and Corwyn, 2005). Conflict captures the degree to which parents disagree with children when they engage in a learning activity (e.g., "The parent gets upset and raises his/her voice, when the child does not meet his/her expectations in any activity," Baumrind et al., 2010). Inconsistent discipline refers to parenting behaviors that are lax, chaotic, and weak to set limits and control (e.g., "The parent is inconsistent between warning and applying negative consequences," Skinner et al., 2005).

Home learning environment questionnaire: Scale development

A robust methodological approach was used for the development of the HLEQ comprising of the following stages. Based on a thorough examination of the relevant literature and the available instruments for the HLE an initial bank of 136 items was developed, containing items that already existed in published measures, adapting existing items, and new items created by the authors. The item bank contained the following information: item description, item dimension, and the source of the item. From the initial 136 items, the most representative ones were selected for the two main HLE dimensions (HLA and HLI) and they were adapted to the Greek context and language. The reduced item bank contained 83 items and it was sent to seven scholars with relevant expertise for review. The academic experts evaluated and provided feedback regarding the clarity and improving the content validity of each item in two areas: (a) the dimension to which they consider the item belongs to, and (b) how well each item addresses the dimension it is destined to cover. Based on the experts' feedback, the final version of the Home Learning Environment Questionnaire (HLEQ) consisted of 60 items.

Subsequently, two pilot studies were conducted. In the first pilot study 20 parents of preschool children assessed the wording and the clarity of the HLEQ items. Parents did not report any issues during the completion of the instrument. Afterward, a second pilot study was run on 175 parents for assessing the construct validity and reliability of the instrument. Results of exploratory factor analysis and reliability analysis showed that 28 of the 60 initial items should be dropped because of low loading, cross-loading, and low item to total correlation. After discarding these items, a new analysis showed six factors with eigenvalues above unity (indoor, outdoor, and digital learning activities, warmth/support, conflict, inconsistent discipline) with satisfactory α values (ranging from 0.885 to 0.658). The version including 32 items was used in the main study on a sample of 814 parents.

Procedure

The Greek Institute of Educational Policy (official institute of the Ministry of Education) approved the ethics of the study and issued permission to access kindergartens (License number: 46/4-10-2018). Parents were contacted through schools. The authors informed the teachers, parents, and children about the study's purpose and procedures. They assured participants that their responses would be held in strict confidence and that they would be solely used for academic purposes. After consent forms were collected from each school, ten children were randomly selected from each classroom, and they gave the HLEQ to their parents to complete it at home at their convenience. Parents' participation in the study was voluntary. A total of 89% (814 out of 917) of the children returned the questionnaires to their kindergarten teachers.

Statistical analysis

A cross-validation approach was used to examine the factor structure of the HLEQ. Initially, exploratory factor analysis (EFA) was employed on parents' responses of group A ($N = 405$) to understand the underlying structure of HLEQ. Principal axis factoring as the extraction method and direct oblimin rotation as the oblique rotation method were used because factors were expected to be intercorrelated. For determining the number of factors that should be retained parallel analysis was performed. Rotated factor matrices were examined to evaluate the factor loadings. Items with factor loadings above 0.30 were considered statistically significant and were used to interpret the emerged factors.

Based on the EFA results, confirmatory factor analysis (CFA) and exploratory structural equation modeling (ESEM) were conducted on parents' responses of group B ($N = 409$) to further examine the underlying structure of the HLEQ. Marsh et al. (2014) urged researchers to routinely examine the fit of CFA and ESEM when testing the dimensionality of an instrument. In case of a similar fit, the more parsimonious model (CFA) should be retained. Apart from the chi-square values along with its degrees of freedom, three supplementary goodness of fit indices were used to examine the fit of the postulated models, namely comparative fit index (CFI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA). According to Hu and Bentler (1999) values close to 0.95 for CFI, 0.08 for SRMR, and 0.06 for the RMSEA suggest a good fit of the examined model to the data. Modification indices and standardized residuals were used to locate the model ill fit. Factors' score reliability was calculated using the omega coefficient (McDonald, 1999).

A latent profile analysis (LPA) was employed to identify the underlying latent HLE profiles. A range of different goodness-of-fit indexes and tests of statistical significance were used to determine the optimal model with k profiles for the patterns

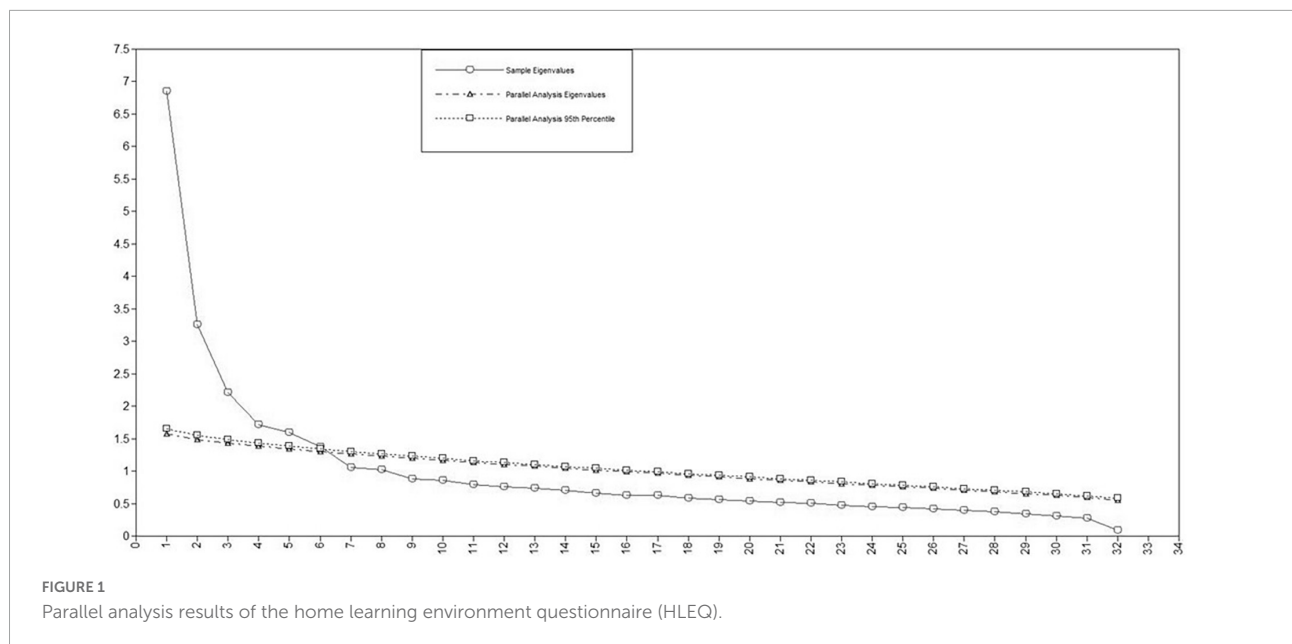
of HLA and HLI. Smaller values of the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) indicate a better fit, while higher values up to 1 for entropy indicate a better fit (Nylund et al., 2007). The Vuong-Lo-Mendell-Rubin Statistic Likelihood Ratio Test (VLMR LRT; Lo et al., 2001) was examined to test whether a model with k profiles fits the data better than a model with $k-1$ profiles. A statistical significant p -value (e.g., $p < 0.05$) for the sample size adjusted VLMR LRT (Adj. VLMR LRT) and the Bootstrap Likelihood Ratio Test (BLRT) indicates that a model of k profiles provides significantly better fit when contrasted with a solution including one fewer profile ($k-1$) (Voulgaridou et al., 2022). When the profiles obtained in each sub-sample were finalized the proportion of the class was considered (Marsh et al., 2009). All analyses were conducted using Mplus ver. 7.3 (Muthén and Muthén, 2015).

Results

Factor structure of home learning environment questionnaire

Parents' responses to the 32 items of the HLEQ from group A were submitted to EFA. Parallel analysis procedures suggested that six factors should be retained (Figure 1). All items were associated with their respective factors and yielded statistically significant loadings ranging from 0.345 to 0.886. The factor correlation matrix revealed significant associations ranging from -0.438 to 0.537 . Factors' internal consistency using the omega coefficient showed satisfactory values. Specifically, the omega coefficient was 0.855 for Digital learning activities, 0.811 for Warmth/support, 0.801 for Indoor learning activities, 0.782 for Conflict, 0.668 for Outdoor learning activities and 0.710 for Inconsistent discipline.

Based on the EFA findings a six-factor correlated model submitted to CFA and ESEM using responses of group B. Goodness-of-fit indices showed that ESEM solution ($\chi^2 = 581.42$, $df = 319$, CFI = 0.928, RMSEA = 0.045, SRMR = 0.032) provided a better fit to the data in relation to the CFA solution ($\chi^2 = 869.86$, $df = 449$, CFI = 0.882, RMSEA = 0.048, SRMR = 0.060). The chi-square difference showed that the ESEM model provided a significantly better fit to the data in relation to the CFA ($\Delta\chi^2 = 278.96$, $df = 130$, $p < 0.001$). Further examination of the ESEM model modification index suggested that a correlation between the residuals of items "The parent plays with the child with literacy applications (e.g., tablet, smartphone)" and "The parent plays with the child with numeracy applications (e.g., tablet, smartphone)" should be introduced. With this slight model modification, the model fit was substantially improved: $\chi^2 = 493.77$, $df = 318$, CFI = 0.951, RMSEA = 0.037, SRMR = 0.028. Moreover, the magnitude of the correlated



residuals was statistically significant and meaningful (0.793), providing additional support to our decision.

All items were associated with the latent factor designed to assess and with the exception of one item [The parent plays sports with the child (e.g., riding bicycles, playing football) they all yielded moderate to high loadings (range 0.300–0.851) (Table 1)]. Despite the fact that the pattern of significant positive and negative associations among HLEQ factors was similar from ESEM and CFA solution, associations from ESEM solution were more pronounced (Table 2). Based on the above findings, the ESEM model was selected as the more tenable for parents' responses to HLEQ. Omega values for HLEQ factors from group B were all satisfactory (Table 2). The internal consistency reliability of the HLEQ was 0.754.

Characteristics of the Greek home learning environment

Means and standard deviations of the several learning activities that parents do with children and the types of learning interactions during the activities are provided in Table 1. The Warmth/Support factor showed the highest mean ($M = 5.40$, $SD = 0.58$) and the Conflict the lowest ($M = 2.13$, $SD = 0.75$). The item of the HLAs with the highest scores reported by parents was the share-reading and discussing a book with the child ($M = 4.72$, $SD = 1.11$). Concerning the interactions in the HLE parents, reported that they very frequently show their pride about their child's effort, even when it is incomplete ($M = 5.64$, $SD = 0.69$), while they almost never belittle the child when the child does not complete an activity or follows instructions ($M = 1.24$, $SD = 0.73$).

Identifying home learning environment profiles

In response to the third research question, LPA was conducted to unveil the number of HLE profiles in the dataset. Table 3 presents the fit indices (i.e., AIC, BIC, Adjusted BIC, entropy value, VLMR LRT, Adjusted LMR LRT, and its p value) for the various LPA models with one through six profiles for HLE. AIC, BIC, and adjusted BIC values were decreasing as the number of classes were increasing. The same tendency was also noticed for the Bootstrap LRT. However, the VLMR LRT and adjusted LMR LRT clearly showed that a four-profile model should be retained. Moreover, a solution of six or more classes would result in extremely small sizes for some groups and it would make the interpretation difficult. Wang and Wang (2020) maintain that each of the derived latent classes should not be too small and that the number of classes should also be theoretically defensible and conceptually meaningful. Based on above findings and considerations we considered that the best-fitting model (bolded in Table 3) is composed of four classes for the profiles of HLE. Such an approach was followed in prior studies when facing a similar situation (Voulgaridou et al., 2022). The entropy of the selected model was 0.75, suggesting a good level of classification (Asparouhov and Muthén, 2014). Thus, the four-classes model was selected as the one that best describes the typology of Greek HLE. In the analysis, average posterior probabilities for the four-classes profile solutions were acceptable ($p < 0.05$), indicating a high degree of probability that families were correctly classified into the best HLE profiles.

Once the number of classes was identified, HLE profiles were classified based on their most likely latent class pattern in regard to HLEQ factors. The final latent class solution

TABLE 1 Home learning environment questionnaire (HLEQ) items loadings for the exploratory structural equation modeling (ESEM) solution and descriptive statistics.

	ESEM						M	SD
	F1	F2	F3	F4	F5	F6		
F1–indoor learning activities							4.31	0.84
The parent. . .								
Shares reading and discusses a book with the child	0.436	0.008	0.185	0.155	−0.017	−0.109	4.72	1.11
Helps the child “write” letters and words	0.413	0.104	0.207	0.046	−0.035	0.036	4.68	1.10
Plays shape recognition games with the child	0.419	0.143	0.147	−0.093	−0.003	−0.017	3.82	1.36
Does art and craft activities with the child	0.851	0.009	−0.041	0.008	−0.046	0.029	4.42	1.12
Plays construction games with the child (e.g., building blocks)	0.724	−0.040	0.010	−0.092	0.090	−0.164	4.48	1.07
Plays role-play games with the child (e.g., the baker and the customer)	0.466	−0.041	0.141	0.118	0.005	0.062	3.72	1.35
F2–digital learning activities							2.39	1.10
The parent. . .								
Shares reading an e-book with the child on smart devices (e.g., tablet, e-reader, and smartphone)	−0.009	0.788	−0.060	0.057	−0.038	−0.006	2.29	1.35
Plays with the child literacy applications (e.g., tablet, smartphone)	0.020	0.682	0.047	0.020	−0.020	0.021	2.43	1.42
Plays with the child numeracy applications (e.g., tablet, smartphone)	0.007	0.724	0.077	−0.037	−0.020	0.037	2.42	1.40
Surfs the web with the child (e.g., to find a story or a song)	0.063	0.672	0.022	0.009	0.094	0.017	2.90	1.45
Plays video games with the child	−0.079	0.636	−0.034	−0.037	0.043	−0.052	1.92	1.19
F3–warmth/support							5.40	0.58
The parent. . .								
Listens and respects the child’s opinion during a learning activity	0.183	0.057	0.496	−0.002	−0.166	0.059	5.22	0.90
Enjoys “teaching” the child (e.g., how to fold clothes)	0.062	0.072	0.493	−0.076	−0.111	−0.094	5.41	0.76
Encourages the child to explore and ask questions	0.042	0.022	0.658	0.058	0.026	−0.050	5.52	0.78
Encourages the child to keep up with an activity, when the child finds it challenging	−0.009	−0.014	0.673	0.134	0.154	0.008	5.50	0.83
Corrects the child’s efforts without telling him/her off	−0.004	−0.018	0.649	−0.072	−0.021	−0.036	5.07	0.88
Shows his/her pride about the child’s effort, even when it is incomplete	0.002	−0.018	0.564	0.029	−0.095	−0.040	5.64	0.69
F4–outdoor learning activities							3.59	1.12
The parent. . .								
Visits a library with the child	0.259	0.069	−0.074	0.300	−0.060	−0.101	2.30	1.45
Plays sports with the child (e.g., riding bicycles, playing football)	0.151	0.159	0.056	0.162	−0.081	−0.079	4.15	1.43
Takes the child to a sport activity (e.g., swimming lessons)	−0.064	−0.023	0.033	0.628	0.057	−0.105	4.0	2.00
Takes the child to an art activity (e.g., dance, painting lessons)	0.004	−0.026	−0.025	0.739	−0.015	0.050	3.47	2.18
Takes the child to cultural events (e.g., cinema, theater, museums)	0.096	0.051	0.078	0.581	−0.003	−0.002	4.0	1.45
F5–conflict							2.13	0.75
The parent. . .								
Gets frustrated, when she/he spends a whole day sharing a number of activities with the child	−0.068	−0.020	0.026	0.084	0.647	0.082	2.50	1.22

(Continued)

TABLE 1 (Continued)

	ESEM						<i>M</i>	<i>SD</i>
Does not pay enough attention during activities to what the child says to him/her, when the parent feels tired	−0.081	0.071	−0.052	0.017	0.588	0.034	2.64	1.18
Gets upset and raises his/her voice, when the child does not meet his/her expectations in any activity	0.033	0.025	−0.122	−0.056	0.717	−0.001	2.14	1.09
Belittles the child, when the child does not complete an activity or follows instructions	0.007	0.097	−0.204	0.026	0.347	−0.096	1.24	0.73
Gets easily upset with the child during learning activities	0.014	−0.064	0.009	−0.012	0.711	0.016	2.13	0.90
F6–inconsistent discipline							2.50	0.85
The parent . . .								
Let's the child get away with things, that she/he really should not be doing (e.g., spending more time than allowed watching TV)	−0.232	0.173	0.006	−0.057	0.112	0.386	2.80	1.14
Reprimands the child in an inconsistent way	0.072	0.000	−0.134	−0.041	0.199	0.458	2.44	1.15
Is inconsistent between warning and applying negative consequences	−0.039	−0.032	0.136	−0.027	0.261	0.474	2.62	1.32
Is less strict with the child's discipline, when they are outdoors	0.045	−0.046	−0.057	0.130	0.018	0.581	2.58	1.33
Gives in to the child's demands, when the child throws a tantrum (e.g., screams for sweets in a supermarket)	−0.106	0.082	−0.021	0.000	−0.054	0.626	2.11	1.16

TABLE 2 Associations among home learning environment questionnaire (HLEQ) factors and internal consistency.

	1	2	3	4	5	6
1. Indoor learning activities	(0.817)					
2. Digital learning activities	0.178*	(0.882)				
3. Warmth/support	0.450**	0.218**	(0.808)			
4. Outdoor learning activities	0.196**	0.019	0.240**	(0.663)		
5. Conflict	−0.370**	−0.103	−0.365**	−0.076	(0.748)	
6. Inconsistent discipline	−0.286**	0.038	−0.270**	−0.166*	0.390**	(0.760)

Below diagonal ESEM solution * $p < 0.05$, ** $p < 0.001$, values in parenthesis are the omega coefficients.

TABLE 3 Comparison of fit indices for latent class analysis models with 2–6 classes for home learning environment (HLE) profiles.

No. of profiles	AIC	BIC	Adj. BIC	Entropy	VLMR LRT	Adj. VLMR LRT	BLRT
2	11749.9	11839.3	11778.9	0.748	576.3 (7)*	564.3*	576.3 (7)*
3	11619.4	11741.6	11659.1	0.740	144.6 (7)*	141.5*	144.6 (7)*
4	11460.6	11615.7	11511.0	0.749	126.5 (7)*	123.9*	126.5 (7)*
5	11393.2	11581.3	11454.3	0.777	81.4 (7) ns	79.7 ns	81.4 (7)*
6	11340.5	11561.4	11412.2	0.767	66.7 (7) ns	65.4 ns	66.7 (7)*

AIC, Akaike information criteria; BIC, Bayesian information criteria; Adj. BIC, sample size adjusted BIC; VLMR LRT, Vuong-Lo-Mendell-Rubin Statistic Likelihood Ratio Test; Adj. VLMR LRT, sample size adjusted VLMR LRT; BLRT, Bootstrap Likelihood Ratio Test. Bold indicates the best-fitting model. * $p < 0.05$.

is shown in [Table 4](#) and the corresponding profiles are visualized in [Figure 2](#). Profile 1, representing 4.8% of the participants, presented high levels of Warmth/Support, moderate levels of Indoor and Outdoor learning activities, Conflict and Inconsistent discipline, and low levels of Digital learning activities. Profile 2, which represented the majority of the participants (45.45%), was characterized by high

levels of Warmth/Support and involvement in Indoor and Outdoor learning activities, and low levels of Digital learning activities, Conflict, and Inconsistent discipline. Profile 3, representing 33.17% of the participants, presented high levels of Warmth/Support and involvement in Indoor learning activities, moderate levels of Outdoor learning activities and Inconsistent discipline, and low levels of Digital learning activities and

TABLE 4 Classification of home learning environment (HLE) profiles based on their most likely latent class pattern in regard to home learning environment questionnaire (HLEQ) factors.

HLEQ factors	Latent profile			
	Profile 1 (4.8%)	Profile 2 (45.5%)	Profile 3 (33.2%)	Profile 4 (16.6%)
Indoor learning activities	2.869	4.617	3.804	4.887
Outdoor learning activities	2.846	3.847	3.141	3.992
Digital learning activities	2.043	2.037	2.036	4.104
Warmth/support	3.872	5.684	5.072	5.669
Conflict	3.205	1.813	2.481	1.985
Inconsistent discipline	3.455	2.111	2.892	2.521

N = 814.

Conflict. Profile 4, representing 16.6% of the participants, presented high levels of Warmth/Support and all three types of learning activities and low levels of Conflict and Inconsistent discipline.

Discussion

The aim of this study was to develop and validate an instrument that measures the quality of various dimensions of the early HLE. Despite the well-established importance of the HLE for children's development, several studies have used different measures to assess its quality that mainly focus on specific aspects of the HLE (Aminipour et al., 2018; Kluczniok and Mudiappa, 2019). An instrument for assessing the broad construct of the contemporary early HLE was recently reported as still missing (Niklas et al., 2016; Gregoriadis and Evangelou, 2022). Findings suggested that HLEQ is a promising self-report measure developed for assessing the HLE across families with preschool children.

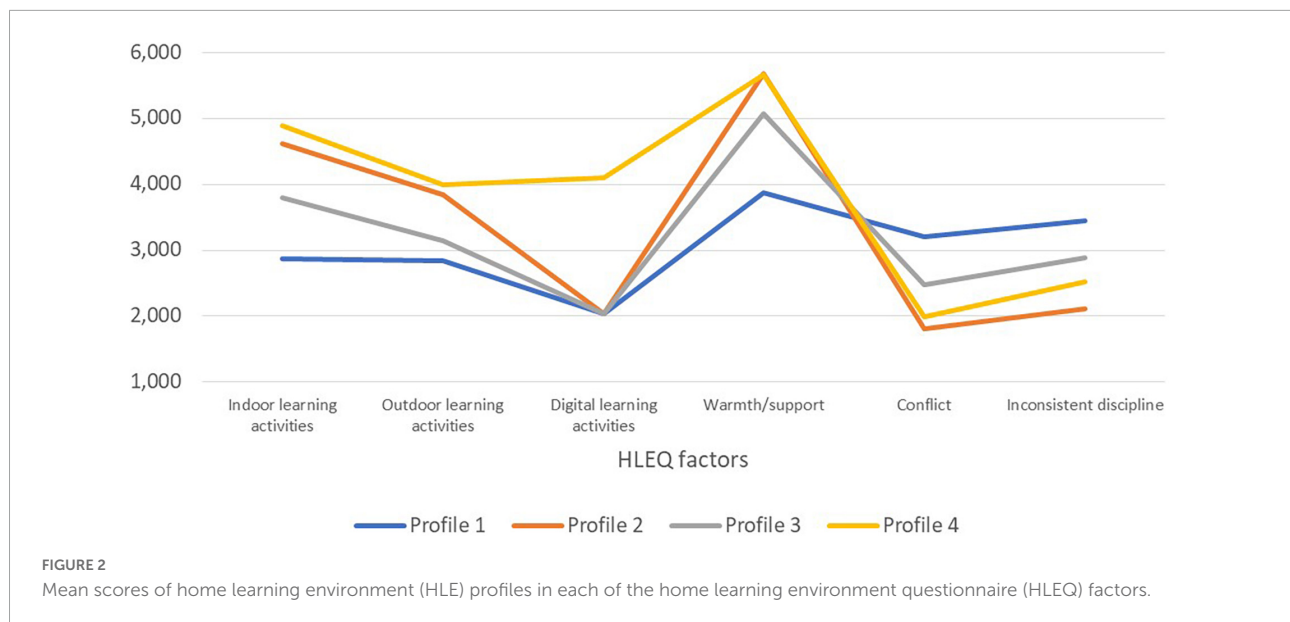
Specifically, HLEQ's psychometric properties showed that the multidimensional construct of HLE can be measured with high levels of precision and accuracy. The validity of the HLEQ was obtained using a robust methodological approach, including extensive literature review, content analysis by experts, pilot study, and three statistical techniques for understanding its factorial structure. Results showed that a six-factor model was the most tenable among other examined models. Reliabilities of the HLEQ's factors were acceptable and relatively high for a self-reported parenting questionnaire. The six-factor solution of HLEQ consisted of factors that they were separately included in existing HLE measures (e.g., Indoor learning activities, Outdoor learning activities, Warmth), while new factors were incorporated (e.g., Digital learning activities, Support, Conflict, Inconsistent discipline). The six-factor structure of the HLEQ agreed with findings from previous studies (Kluczniok et al., 2013; Tamis-LeMonda et al., 2019) regarding the multidimensional nature of HLE.

An advantage of the present study was the employment of a sophisticated statistical technique, namely the ESEM. According to Asparouhov and Muthén (2009), ESEM combines

the advantages of both EFA and CFA into a single framework. Previous studies showed that the application of ESEM resulted in a superior model fit compared to CFA in various instruments in the field of social sciences (e.g., Tsigilis et al., 2018; Tsigilis and Koustelios, 2019). The usefulness of ESEM in describing the empirical data was also evident in the current study. Analysis using ESEM showed that HLEQ's fit was superior compared to CFA, as all goodness-of-fit indices yielded satisfactory values in contrast to the CFA analysis, which was unsatisfactory. Forcing HLEQ items to load only on their respective latent factors seems to be a restrictive assumption. Furthermore, because ESEM allows items to have multiple cross-loadings, the correlations among the latent factors are not inflated (Marsh et al., 2014), resulting in a more accurate estimation of the associations. Thus, researchers and practitioners can have increased confidence in the derived associations of HLEQ within the Greek educational context. Future studies examining the quality of HLE could benefit from the usage of ESEM as an alternative approach to CFA.

The present study extended the field knowledge on HLE by studying the core characteristics of a contemporary HLE. The six-factor solution of HLEQ indicated that within the HLE parents engage with their children in digital and several learning activities inside and outside of the home. Their interactions during these activities were characterized as warm and supportive, with low levels of conflict and inconsistent discipline. Overall, the findings of this study confirmed that the families' engagement in HLEs and the quality of HLEs are fundamental elements of a modern HLE (Gregoriadis and Evangelou, 2022).

Specifically, results indicated that parents participated in various indoor, outdoor, and digital learning activities. A high level of engagement in stimulating activities within HLE has been reported in the majority of existing studies, confirming that the dimensions of indoor, outdoor, and digital learning activities are well-settled in the core of the HLE construct (e.g., Foster et al., 2005; Melhuish et al., 2008; Niklas and Schneider, 2017). Shared book reading was the most frequent learning activity reported by parents confirming that it is the most common home learning activity that parents engage with their preschool children (Morrison and Cooney, 2002;



Sénéchal and LeFevre, 2002; Hayes et al., 2018). In addition, the content of the items retained in the Outdoor learning activities confirmed its cultural value (Kluczniok and Mudiappa, 2019). Outdoor learning activities included activities like visiting the library, museums, theaters, or participation in extracurricular activities like dance, music, or sports; such activities require by nature specific financial resources; thus, they reflect a lifestyle that may differentiate family opportunities. Additional research is needed to further explore the relationship between the family's SES and the quality of the HLE in the Greek context.

As far as digital learning activities are concerned, results were aligned with previous evidence showing that children are exposed daily to a variety of digital media within the home digital environment (Sonnenschein et al., 2021), and they are fluent in using portable digital devices and software from the earliest years of their lives (Neumann, 2018; Papadakis et al., 2019). The non-significant associations between the Digital learning activities with Conflict and Inconsistent discipline suggest that future studies should further examine the patterns of parent-child interactions in both digital and non-digital activities.

Besides the well-established effects of the quantity and the quality of the various types of shared stimulating activities on a child's development, the quality of parent-child interactions during learning activities also matters (Bradley and Corwyn, 2005; Rodriguez and Tamis-LeMonda, 2011). A strength of the present study is that it attempted to assess three distinct types of parent-child interactions during their shared HLAs. Therefore, this study suggests that an essential feature of the HLE is not only what parents do with children (Sylva et al., 2004) but also how they do it (Dearing and Tang, 2010; Gregoriadis and Evangelou, 2022); thus, emphasis in intervention programs can be placed in supporting the quality of interactions during learning activities.

The patterns of associations revealed that Warmth/Support was positively correlated with the Indoor, Outdoor, and Digital learning activities, whereas Conflict showed negative correlations with Indoor and Outdoor learning activities. Thus, results indicated that Greek parents exert more positive and supportive behaviors and less negativity and disapproval during the learning process. The high levels of frequency in Warmth/Support in contrast to the average and lower levels of frequency in the HLA was in agreement with previous studies showing that Greek parents engage less frequently in learning activities at home compared to parents from other cultures (LeFevre et al., 2010). A warm and responsive home environment across the globe empowers children's learning and improves learning outcomes (Bradley and Corwyn, 2005). However, one possible interpretation of the very positive parent-child HLIs in Greece could be that it has been described as a more collectivist society, in which the family system is considered a crucial source of emotional support for its members (Georgas et al., 1997). Similar patterns of adult-child relationships have been reported in Greek educational settings too. A series of Greek studies (Gregoriadis and Tsigilis, 2008; Gregoriadis et al., 2020, 2021) found that kindergarten teachers characterized their relationships with their children as warm, supportive, and close with low levels of conflict and dependency.

The negative correlation of Inconsistent discipline with Indoor learning activities and its positive correlation with Outdoor learning activities indicated that Greek parents set more limits and rules inside their homes, and they are more relaxer with children's discipline outside of their homes. This might reflect parents' beliefs that by giving in to their children's challenging behaviors, they can temporarily prevent children's antisocial behavior (Arnold et al., 1993). To the best of our knowledge, this is the first study that attempted to measure

the quality of parent-child interactions in the HLE through the parenting dimension of Inconsistent discipline. Future studies should explore in more depth the quality of learning interactions within the HLE.

An additional purpose of this study was to examine the number and the nature of the existing latent profiles of the HLE in the Greek cultural context by following a person-centered approach. The advantage of a person-centered approach is that it has the potential to identify the typologies of the HLE that share particular patterns of variations in parent-child interactions and activities (Jeon et al., 2020). Based on the conceptual framework of the Home Learning Ecosystem, higher levels of involvement in HLAs (indoor, outdoor, and digital) and Warmth/support practices reflect a more positive aspect of the HLE, where participants receive positive learning experiences (Gregoriadis and Evangelou, 2022); in contrast higher levels of conflicts and inconsistent discipline practices indicate poor or negative parent-child interactions in the HLE. In the present study four underlying latent subgroups were identified indicating different patterns of parent-child interactions during the learning activities at home. These profiles are presented and discussed in a decreasing order in relation to the percentage covered in the sample.

Profile 2, *the Supportive HLE*, was characterized by high levels of Warmth/Support and involvement in Indoor and Outdoor learning activities, and low levels of Digital learning activities, Conflict, and Inconsistent discipline. Profile 2 implies a good quality HLE, but the low levels of Digital learning activities may represent parents who perceive children's engagement with digital technology, even for learning purposes, as a negative aspect of the HLE similar to Conflict and Inconsistent discipline.

Profile 3, *the Average HLE*, was characterized by high levels of Warmth/Support and involvement in Indoor learning activities, moderate levels of Outdoor learning activities and Inconsistent discipline and low levels of Digital learning activities and Conflict. The average levels of Outdoor learning activities and Inconsistent discipline practices of families in this profile may represent parents with some minor permissive and chaotic characteristics compared to more strict parents of Profiles 2 and 4. In addition, although Profile 3 and Profile 2 have a similar trajectory, families of Profile 3 showed lower levels of involvement in Indoor and Outdoor learning activities and higher levels of Conflict and Inconsistent discipline in contrast to families of Profile 2. These results may represent parents who may need support to become aware and understand how to be supportive to their children's learning compared to parents of Profiles 2 and Profile 4.

Profile 4, *the Positive HLE*, showed high levels of Warmth/Support and involvement in HLAs (indoor, outdoor, and digital) and low levels of Conflict and Inconsistent discipline. Parents in this profile provide more often a variety of stimulation to children within the home affective environment

in order to support children's learning, while negative parent-child interactions are rare. So, this profile reflects a positive HLE.

Profile 1, *the Accompanying HLE* was characterized by high levels of Warmth/Support, average levels of Indoor and Outdoor learning activities, Conflict and Inconsistent discipline, and low levels of Digital learning activities. Despite the average levels of Indoor learning activities, Outdoor learning activities, Conflict, and Inconsistent discipline, a detailed examination of the results indicated that families in Profile 1 show a slight tendency for more frequent conflicts and chaotic practices during the engagement in indoor and outdoor learning activities. This slight tendency, alongside the low levels of engagement in digital learning activities, may represent higher risks or needs, which may require more support for these families on how to provide a positive HLE. Overall, higher levels of learning interactions and lower levels of engagement in learning activities were observed in Profile 1, which could reflect parents who do not actively provide learning stimulation but accompany the child in the learning process in a more passive way.

Previous studies showed distinctive and varying patterns of family engagement in children's learning at home (Bulotsky-Shearer et al., 2012; Jeon et al., 2020) and demonstrated several trajectories of HLE during the early years (Son and Morrison, 2010; Rodriguez and Tamis-LeMonda, 2011; Hayes et al., 2018). To the best of our knowledge this is the first attempt to identify typologies of HLEs with specific characteristics concerning the type of parent-child interactions during HLAs by using the LPA. Thus, it is hard to compare our findings with previous ones. This study extends the current knowledge base by identifying four distinct types of profiles comprised of varying levels of HLIs during the HLAs. A deeper knowledge of the early HLEs and its patterns can function as a guide to identify families who may need further support. In addition, it can help practitioners to design and implement interventions that support a positive HLE.

Limitations and future research

The present study is not free of limitations. First, acknowledging the relationship between the HLE and children's outcomes, additional research is needed to examine the concurrent validity of the HLEQ by exploring its association with several child competencies, like literacy, numeracy, or socioemotional skills. Second, future studies, apart from replicating the present findings, could examine other types of the measure's quality characteristics such as the temporal stability of the HLEQ and investigate the concurrent validity of the HLEQ with other existing HLE measures. Third, the current report provides initial validation of the HLEQ in a sample from northern Greece, limiting the generalizability of the results. Therefore, supplementary research is needed to validate the HLEQ in different cultural settings.

Fourth, HLEQ is an instrument that measures the frequency of various parent-child learning activities in and out of home as well as the frequency of parenting practices (e.g., warm, supportive, conflict, and chaotic practices) during the parent-child learning interactions. These parenting practices reflect warmth, support, and responsiveness of the caregiver-child interactions during the home learning activities, thus providing information to a certain degree about the quality of the home learning ecosystem (Gregoriadis and Evangelou, 2022). Therefore, despite the quantitative indicators for the frequency of activities and parenting practices, the HLEQ offers the opportunity for measuring what parents do with their children and how they do it in the HLE; thus offering information for the quality of parent-child relationship in the HLE. However, it is suggested the needs for future mixed method studies that will also obtain qualitative information for various aspects of the early HLE (e.g., how stimulating is the reading to the child or how effective are the supportive practices for children's learning). Finally, as the physical environment of the home constitutes another core aspect of the HLE (Tamis-LeMonda et al., 2019; Gregoriadis and Evangelou, 2022), an additional shorter scale than the HOME, with descriptive items about the home's physical environment and the availability of learning materials in combination with the psychometric scale of HLEQ could provide a holistic assessment of the quality of HLE.

Conclusion and implications

The HLE has important effects on children's development. Several measures have been developed for assessing its quality. However, they mainly focus on specific aspects of its construct. There is little work on the quality properties of HLEs. The self-reported HLEQ is a reliable instrument for measuring the quality of parent-child interactions during several learning activities within a HLE. A robust methodological approach was followed for the development of the HLEQ, whereas its psychometric properties were analyzed using ESEM, a promising, recently developed statistical methodology. Findings provided initial support for its factor structure, reliability, and validity.

Overall, the HLEQ confirmed the multidimensional construct of the HLE by indicating six dimensions. A strength of the HLEQ is that it constitutes a measurement that has a bifold function. On the one hand, it can be used to measure the broad construct of the HLE. On the other hand, its multidimensional content allows for more targeted measures of specific domains of the HLE. For instance, a researcher interested in focusing on the impact of HLAs on particular outcomes could utilize the relevant factors of the instrument. Furthermore, the identification of the four profiles of HLE that show different patterns of parent-child interactions during the HLAs could help researchers and practitioners focus on developing interventions designed to support families and

offer their children high-quality experiences at home. Ongoing research on early assessments of children's HLE can provide evidence about their stability over time, their impact across children's developmental domains, and their relationship to other learning environments as is the school.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Greek Institute of Educational Policy (Ministry of Education, Research and Religious Affairs) (License number: 46/4-10-2018). The patients/participants provided their written informed consent to participate in this study.

Author contributions

KK was responsible for the data collection procedure. KK and NT worked on the statistical analysis of the datasets. KK, AG, NT, VG, and ME worked together for the writing and completion of the manuscript. All authors contributed to the study's research design.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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