Sakarya University Journal of Education

e-ISSN : 2146-7455
Publisher : Sakarya University

Vol. 16, No. 1, 68-88, 2026
DOI: https://doi.org/10.19126/suje.1825424

Research Article

Parental Involvement in Home-Based Mathematics Learning: Scale Development and Validation in Türkiye

Ahmet İnci[1*]
M. Furkan Tunç[1]
Şeyma Barbaros[1]
Ahmet Şükrü Özdemir[1]

[1] Istanbul Sabahattin Zaim University, İstanbul, Türkiye,
ahmet.inci@izu.edu.tr,
frkntnc2527@gmail.com,
seymaa.b.09@gmail.com,
ahmet.ozdemir@izu.edu.tr,
ror.org/00xvwpq40

*Corresponding author

Received: 17.11.2025
Accepted: 11.03.2026
Published Online: 19.03.2026

Abstract: Acknowledging a lack of precise instruments that specifically measure the nature and quality of parental engagement within the home environment, particularly in mathematics, this study aimed to develop and validate the Parental Involvement in Mathematics Scale (PIMS). PIMS is a multidimensional instrument designed to assess the academic support parents provide exclusively in the home setting, deliberately excluding school-based involvement. The methodology involved rigorous psychometric procedures, including content validation and subsequent factor analyses across two independent parent samples residing in the Marmara Region of Türkiye. Exploratory Factor Analysis (EFA) was performed on a sample of 171 parents, and Confirmatory Factor Analysis (CFA) on an independent sample of 241 parents. The final 16-item scale confirmed a reliable three-factor structure: Directive Involvement, Interactive Involvement, and Situational Involvement. Psychometric analyses confirmed acceptable internal consistency ($\alpha=.70$) and strong criterion validity, demonstrating a significant positive correlation with the criterion measure ($r=.61$, $p<.01$). Despite its robust psychometric foundation, the scale's measurement power is limited by the Situational Involvement factor's low internal consistency and restricted item count. Overall, PIMS provides researchers and practitioners with a reliable and valid tool for precisely assessing home-based parental involvement in mathematics, facilitating the design of effective, targeted interventions.

Keywords: Parental Involvement, Mathematics Education, Home-Based Learning, Scale Development, Elementary School Student

1. Introduction

Education is a dynamic process that shapes individuals' cognitive, affective, and social development (Lyons & Higgins, 2014). This process interacts directly not only with the individual's inherent characteristics but also with external environmental factors (Auerbach, 2016). For instance, Vygotsky's sociocultural theory posits that learning is profoundly shaped by social interaction, emphasizing that knowledge is constructed at the social level and subsequently internalized by the individual (Vygotsky, 1978). This approach highlights that learning is fundamentally a social, rather than purely individual, process. Similarly, Bronfenbrenner's ecological systems theory views individual development as occurring through continuous interactions with multiple environmental systems. Within the microsystem level, this theory identifies the family, school, and peer groups as the most immediate influences (Bronfenbrenner, 1977). The interactions across these layers shape both the individual's developmental and learning processes. When these theories are considered together, it is evident that an individual's learning and developmental trajectories are shaped by social relations and environmental contexts. In this context, continuous interactions between the individual and their environment can lead to relatively permanent changes in their cognitive, affective, and behavioral development (Arı, 2014).

Among these environmental factors, the family system specifically influences students' academic achievement and attitudes toward the educational process. As a key component of this system, parental involvement can shape the quality of a student's educational experience. Specifically, since mathematics requires abstract reasoning, interactive parental involvement—such as discussing problem-solving strategies or verbalizing mathematical concepts—serves as a crucial scaffolding mechanism. This interaction not only clarifies abstract concepts but also models mathematical thinking, thereby directly influencing the child's cognitive processing and reducing math anxiety (Liu et al., 2026; Yuan et al.,

Cite as(APA 7): İnci, A., Tunç, M. F., Barbaros, Ş., & Özdemir, A. Ş. (2026). Parental involvement in home-based mathematics learning: Scale development and validation in Türkiye. *Sakarya University Journal of Education, 16*(1), 68-88. https://doi.org/10.19126/suje.1825424

2026). Research consistently demonstrates that active parental involvement in the educational process improves students' focusing skills and increases their motivation to learn (Mardianti, 2025), supports their psychological resilience (Tianyu & Masnan, 2023), and positively affects their attitudes toward the course (Oluwatelure & Oloruntegbe, 2010). These effects have significant consequences for academic performance and mental health, extending across the primary, secondary, and high school levels (Wang & Sheikh-Khalil, 2014). Indeed, parental involvement can significantly indirectly contribute to academic success by influencing students' motivational, cognitive, and behavioral attributes related to learning (Hoover-Dempsey & Sandler, 2005).

Particularly in disciplines involving abstract concepts, such as mathematics, parental support is critical for enhancing not only students' attitudes but also their academic achievement (Becker & Epstein, 1981; Epstein, 2018; Grolnick et al., 1997; Özdemir & İnci, 2024). Given that mathematics courses are often perceived as challenging by students, parental support can increase students' interest in learning mathematics (Mohd Hanafiah et al., 2024) and potentially reduce their math anxiety (Tang & Tran, 2023). However, the effect of parental support is not uniformly positive. The effectiveness of parental involvement is highly contingent upon its specific form and relevant contextual factors. As suggested in the literature, some types of involvement correlate positively with academic success, while others may be ineffective or even counterproductive (Boonk et al., 2018). This observed diversity underscores the need for categorizing parental involvement to achieve a more systematic understanding of the construct.

Parental involvement has been modeled using various theoretical approaches in the literature and conceptualized within multidimensional frameworks. While Grolnick and Slowiaczek (1994) classified parental involvement into three dimensions—behavior, intellectual/cognitive, and personal—Epstein et al. (2018) presented a more comprehensive model by dividing this involvement into six categories: parenting, communicating, volunteering, learning at home, decision-making, and collaborating with the community. Focusing specifically on early adolescence, Hill and Tyson (2009) conceptualized parental involvement in three categories: home-based, school-based, and academic socialization. Subsequently, Boonk et al. (2018) simplified this existing diversity and conceptualized parental involvement in two basic forms: home-based and school-based. Collectively, these models demonstrate that parental involvement is not merely a form of behavior; rather, it is a multi-layered process that affects multiple dimensions, ranging from students’ academic achievement and cognitive development to their attitudes toward the educational process and motivation, thereby enabling the systematic evaluation of this complex process.

1.1. Studies to measure parental involvement

Research on parental involvement aims to systematically evaluate parental roles in educational processes by considering the behavioral, cognitive, and emotional dimensions of the concept. Consequently, the literature contains numerous scales, both originally developed and adapted across different cultures. For example, multidimensional scales focusing on parental involvement have been developed by Gürbüztürk and Şad (2010) for the primary school level, Santillan et al. (2023) for the high school level, and Gugiu et al. (2019) and Yampolskaya and Payne (2025) for the preschool level. While Gugiu et al. (2019) generated original items based on the Hoover-Dempsey and Sandler model, Yampolskaya and Payne (2025) achieved a valid and reliable measurement tool by restructuring existing items within a national dataset. Similarly, Ahmetoğlu et al. (2018) and Xia et al. (2021) conducted adaptation studies focused on cultural validity, adapting the Family Involvement Questionnaire (Fantuzzo et al., 2000) into Turkish and Chinese, respectively. Among the scale adaptations based on Epstein's six types of parental involvement, Ahioğlu Lindberg and Demircan (2013) evaluated multidimensional perceptions using tools administered to secondary school students, and Erdener (2016) used tools administered to school principals and teachers. Furthermore, Goulet et al. (2023) adopted a measurement approach to parental involvement based on student perceptions using the Student-Rated Parental School Involvement Questionnaire (SR-PSIQ) scale, developed at the primary school level.

Studies that address parental involvement are significant in the literature, particularly those that focus on the psychological and motivational processes that shape involvement beyond mere behavioral aspects. To this end, Walker et al. (2005) revised the first two levels of Hoover-Dempsey and Sandler's theoretical framework and developed a corresponding scale to measure the psychological constructs underlying involvement. Their work linked the theoretical rationale (why and how parents are involved) to forms of home- and school-based involvement. The scale developed from this model was later adapted to Turkish culture by Işık and Şahin (2021) to assess the involvement level of primary school parents. Similarly, Yosef et al. (2021), building on Epstein's typology, created a multidimensional parental competence scale to evaluate parental involvement skills in primary education. More recently, Ebeoğlu Duman and Akgöz Aktaş (2024) integrated a psychological dimension by developing a scale that jointly evaluates the behavioral and emotional aspects of parenting.

Parental involvement scales have diversified beyond assessing general levels to capture the relationships parents establish with the educational process under specific contextual conditions. Reflecting this perspective, Yurtbakan and Akyıldız (2020) developed a measurement tool that simultaneously captures parents' perceptions of the school and their engagement forms. Furthermore, to address structural differences in the learning environment, Liu et al. (2010) developed a scale for K-12 parents to assess involvement in online learning environments, while Çetinkaya (2024) introduced a unique scale to measure family involvement in home literacy activities.

Alongside instruments developed for general parental involvement, several original and adapted scales are structured specifically within the context of mathematics education. For instance, Özcan (2016) developed a questionnaire to assess elementary school parents' beliefs and awareness of the mathematics course and their child's school process; however, this study was limited to descriptive statistics and lacked reported validity or reliability analyses. In another study, Özcan et al. (2018) developed the 16-item "Family Support in Mathematics Homework Process Scale" (FSMS) for students, focusing on the mathematics homework process across three dimensions: "guidance," "support," and "facilitation". Johnson (2014), as part of the MINDSET STEM program supported by the US National Science Foundation, applied the short form of the parental involvement scale developed by Epstein et al. (2018) at the high school level. This study collected multidimensional data from parents, teachers, and students. The scale consists of five components: parental involvement, math attitude, parent-teacher relationship, parent-student relationship, and parent partnership. Subsequently, Masal et al. (2019) adapted the short form of the scale to the middle school level, translated it into Turkish, and provided validity and reliability analyses across student, teacher, and parent samples.

While these contributions highlight the need for measurement tools that assess parental involvement in mathematics, evaluating the unique academic interactions that occur exclusively at home remains challenging because most existing scales conflate home-based involvement with school-based components. By centering exclusively on home-based academic interactions, deliberately excluding school-based aspects, and assessing involvement through the child-parent relationship, the current study makes a distinct and valuable contribution to the literature.

1.2. The current study

According to Boonk et al. (2018), parental involvement comprises two primary dimensions: home-based involvement, involving parental support for learning at home, and school-based involvement, encompassing active participation in school-related events and decision-making processes.

They emphasize that home-based involvement demonstrates a stronger correlation with academic achievement. Consequently, our scale was developed to focus on four main categories derived from the framework of home-based involvement.

The four categories defining the scope of home-based involvement are as follows: Academic Pressure and Control, which encompasses behaviors such as directing, rule-setting, and exerting pressure aligned with achievement expectations to enhance academic performance; Home-based Engagement in Learning Activities, which refers to parents' involvement in educational tasks with their children, including providing learning materials and fostering a supportive environment; Assistance with Homework, which details the ways parents engage in their children's homework process, including the guidance provided and the extent to which independent work is promoted; and finally, Parental Support/Encouragement in Learning, which includes elements such as how parents motivate and reassure their children as part of the academic process, thereby supporting their positive attitude toward learning.

In the scale design, we intentionally excluded elements such as parental expectations and parent-teacher communication because these bear the imprint of school-based involvement and could consequently obscure the measurement of the child-parent academic relationship at home. In the literature, these elements are often intertwined with school interactions, potentially encompassing relationships with school administration and teachers rather than solely the academic process at home. Similarly, other potential categories were excluded if they did not directly address the link between the child, parent, and the academic process exclusively in the home environment.

The core purpose of this study is to measure only academic interactions stemming from direct child-parent relationships within the home setting. Therefore, we strictly delimited the scale's scope by focusing exclusively on indicators isolated from school-based factors, such as homework assistance, involvement in home learning activities, and emotional support. This deliberate, focused approach enhances the measure's validity and yields a clear, unique profile of home-based parental involvement, facilitating the development of targeted parental interventions. Accordingly, the main aim of the current study was to develop a parental involvement scale focused specifically on academic interactions in the home environment.

Although the initial item pool was developed based on these four theoretical categories derived from Boonk et al. (2018), subsequent Exploratory Factor Analysis indicated that some conceptual overlap and structural requirements resulted in a refined three-factor solution: Directive Involvement, Interactive Involvement, and Situational Involvement, which are further detailed in the Results section.

2. Method

2.1. Research design

The current study employed a rigorous Construct Validation research design, focusing on the systematic development and psychometric validation of a new measurement tool specifically targeting parental involvement in mathematics. This approach inherently involved multiple, sequential methodological phases typical of scale development studies:

Item generation and refinement, expert content validity review (Lawshe method), Exploratory Factor Analysis (EFA), and Confirmatory Factor Analysis (CFA). This design ensures that the developed instrument is theoretically sound and empirically validated.

The theoretical framework underpinning this design is rooted in the aim to measure home-based involvement, which, according to Boonk et al. (2018), exhibits a stronger relationship with academic achievement than school-based involvement.

The design was intentionally focused on indicators isolated from school-based factors, such as parent-teacher communication or participation in school events. This strategic exclusion was necessary to enhance the validity of measuring academic interactions exclusively in the home environment.

The methodological process began with the generation of 49 items across four initial theoretical categories (academic pressure/control, engagement in learning activities at home, assistance/help with homework, and emotional support/encouragement in learning). Following the content validity assessment using the Lawshe method, the item pool was reduced to 30. An Exploratory Factor Analysis (EFA) was subsequently conducted, resulting in the retention of 16 items based on structural integrity and statistical adequacy. This final set of items was categorized under three distinct factors: Directive Involvement, Interactive Involvement, and Situational Involvement. The item reduction process across these stages is summarized in Table 1.

Table 1

Item Reduction Process Based on Content Validity and Exploratory Factor Analysis

Parental involvement dimensions	Starting	After Lawshe	EFA
Academic pressure/control	12	6	3
Engagement in learning activities at home	11	8	5
Assistance/help with homework	14	7	4
Parental support/encouragement in learning	12	9	4
Total	49	30	16

In terms of methodological adequacy and statistical power, scale development literature offers various opinions regarding the number of participants required. Recommended minimums include reaching at least 4 (Nunnally, 1978) or 5 (MacCallum et al., 2001) times the number of scale statements, or up to 10 times the number of scale statements (Bryman & Cramer, 2012; Hair et al., 2014). Furthermore, some views suggest a minimum of 140 people should be included in such studies (Karagöz, 2021). The sample size used in both the EFA (N=171) and the CFA (N=241) stages were considered adequate for the structural equation modeling analyses employed in this validation study.

2.2. Working group

The study employed a convenience sampling method, primarily because of the difficulty in accessing parents willing to complete detailed academic scales and the need to obtain sufficient data points for structural equation modeling (EFA and CFA). The selection focused on parents whose children were attending public schools in the Marmara Region of Türkiye and had at least one child enrolled at the primary or secondary school level. This specific setting was chosen to ensure feasibility and maximize response rate from a population with diverse socio-economic and educational backgrounds, which is essential for generalizability in a scale validation study.

The scale development utilized two independent samples for the successive stages of validation:

Sample 1 (Exploratory Factor Analysis - EFA)

The initial scale validation was conducted with 171 parents. Participants included 80.7% females and 19.3% males. The age distribution showed that 63.2% were between 30 and 41, 26.9% were between 42 and 53, 7% were 29 or younger, and 2.9% were between 54 and 65. Regarding educational background, the sample demonstrated diversity, with the highest proportion being high school graduates (32.2%), followed by bachelor's degree holders (25.7%), associate degree holders (14.6%), primary school graduates (11.1%), middle school graduates (8.8%), and those with postgraduate degrees (6.4%). Additionally, 1.2% reported their education level as "other". Among participants, 54.4% had children attending middle school, while 45.6% had children in primary school.

Sample 2 (Confirmatory Factor Analysis - CFA)

The hypothesized three-factor model was tested using Confirmatory Factor Analysis (CFA) on an independent sample consisting of 241 parents. A total of 85.1% of participants were female, while 14.9% were male respondents.

The age grouping was revised for the CFA stage to achieve a more balanced distribution: 16.2% of participants were aged 34 or below, 60.6% were aged 35-44, and 23.2% were aged 45 or above.

The educational background of the CFA sample remained varied: 29.9% were high school graduates, 27.8% held a bachelor's degree, 11.6% had an associate degree, 11.2% were middle school graduates, 9.1% had completed primary school, 7.5% held a master's degree, and 2.9% had a doctorate. Regarding their children's education level, 68% had children in middle school, while 32% had children in primary school.

2.3. Data collection tools

The study employed two instruments: a Demographic Information Form and an established Family Involvement Scale, which were used to assess criterion-related validity.

2.3.1. Demographic information form

This form was used to systematically collect essential demographic data from participants. It included specific questions regarding the parents' age, gender, educational attainment, and their child's grade level.

2.3.2. Parental involvement in Mathematics Scale (PIMS) Response format

The newly developed scale uses a 5-point Likert scale to capture the continuum of parental involvement: 1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, and 5 = Strongly agree. High PIMS scores consistently indicate a high level of parental involvement in their child's mathematics learning. The principles emphasized in the literature for item writing—such as ensuring statements are simple, precise, and clear, and that each item contains a single idea—were strictly followed during item generation.

2.3.3. Family Involvement Scale (FIS)

To examine criterion-related validity, the Family Involvement Scale (FIS), developed by Walker et al. (2005) and adapted into Turkish by Işık and Şahin (2021), was employed. This scale also uses a five-point Likert-type response format (1 = Strongly disagree to 5 = Strongly agree).

The original FIS consisted of eight dimensions and 60 items. However, due to expert opinions and the need for cultural adaptation to the Turkish context, it was reduced to five dimensions and 25 items. In the Turkish adaptation used for the criterion validity analysis, a factor loading of at least .40 was required for an item to be retained in a factor, with a minimum difference of .10 between an item's loading in its factor and its loading in other factors. The cumulative variance explained by the adapted scale was 60.7%.

2.4. Data analysis

The data analysis process adhered to the established sequential steps for construct validation and scale development. Data were collected via convenience sampling, with both online and in-person administration.

2.4.1. Analytical procedure

The initial phase focused on item refinement and content validity. Following the generation of 49 items, the principles of clear, precise, and simple statement writing (DeVellis & Thorpe, 2021) were considered. Seven experts (six in mathematics education) reviewed the items using the Lawshe method, resulting in an initial reduction of the item pool to 30. Three specific items (Items 2, 9, and 13) were reverse-coded to account for the fact that high scores on these items reflect attitudes inconsistent with the scale's targeted construct of continuous, process-oriented parental involvement (e.g., reactive interest limited to exam periods).

2.4.2. Exploratory and confirmatory factor analysis

As suggested in the literature for multidimensional scales (Şencan, 2005), factor analysis preceded the reliability assessment. Exploratory Factor Analysis (EFA) was performed first to identify the underlying factor structure. Data adequacy was confirmed using Bartlett's Test of Sphericity ($p \leq .05$) and the Kaiser-Meyer-Olkin (KMO) test (values ≥.85 are considered ideal). The factorization technique used was Principal Component Analysis (PCA), chosen for its utility in exploring data structure and for its emphasis on explained variance. Principal Component Analysis (PCA) was used as a reliable initial exploratory approach to identify the scale's basic component structure, even though it is formally classified as a data reduction technique. Hair et al. (2019) and Tabachnick and Fidell (2013), who contend that PCA frequently produces empirically comparable results to popular factor analysis techniques (such PAF or ML) when the number of items is manageable and factor loadings are reasonably high, endorse this choice. Furthermore, the practical distinctions between PCA and EFA are often insignificant in the early stages of scale development, especially when the objective is to identify fundamental dimensions, as noted by Field (2018) and Howard (2016). Confirmatory Factor Analysis (CFA) was conducted on an independent sample to further validate the dimensionality, fully address latent-structure concerns, and provide a more rigorous evaluation of the model. This two-step process guarantees that the structure found is a theoretically sound latent construct rather than just the outcome of data reduction (Kline, 2023). Item retention adhered to strict criteria, including a minimum factor loading value of .32, a theoretical requirement of at least three items per factor (Çokluk et al., 2012), and common variance coefficients of .20 or greater (Şencan, 2005). This EFA yielded a final 16-item scale, grouped into three factors: Directive Involvement, Interactive Involvement, and Situational Involvement.

Subsequently, the hypothesized three-factor structure was tested using Confirmatory Factor Analysis (CFA) on an independent sample. Model fit was evaluated using standard indices: Comparative Fit Index (CFI) (≥.90), Non-Normed Fit Index (NNFI) (≥.90), and Root Means Square Error of Approximation (RMSEA) (≤.08) (Byrne, 2010). Construct validity was further assessed through metrics such as Average Variance Extracted (AVE) and Composite Reliability (CR).

2.4.3. Validity and reliability

Criterion-related validity was established by calculating Pearson correlation coefficients between the newly developed scale scores and an established criterion measurement tool. For the final scale, reliability was assessed through the calculation of Cronbach's alpha coefficient (internal consistency), along with test-retest reliability coefficient and corrected item-total correlation coefficients.

3. Results

In developing a multidimensional scale, factor analysis should be performed before the reliability analysis in light of the information in the literature (Şencan, 2005). Factor analysis has two types: exploratory and confirmatory. It is used to obtain clues about the relationship structure between many variables that are thought to be related (DeVellis, 2016). To determine the sub-dimensions, an exploratory factor analysis was first carried out in this study, employing the Principal Component Analysis technique (Çokluk et al., 2012).

3.1. Exploratory factor analysis

In the study, the results of the Principal Component Analysis (PCA) applied to examine the factor structure of the 16-item scale and the eigenvalues are presented in Table 2.

Table 2

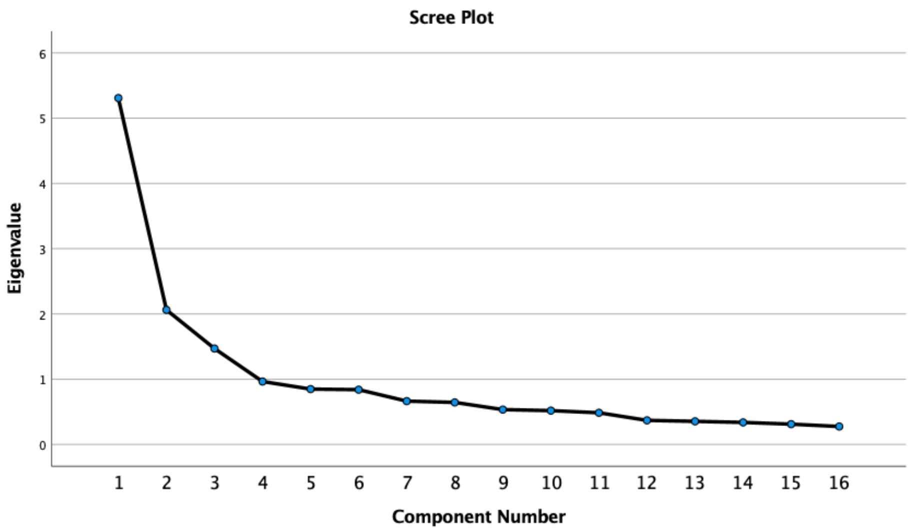
Eigenvalues

Factor	Eigenvalues	Variance %	Total Variance %
1	5.23	32.74	32.74
2	1.96	12.26	45.00
3	1.37	8.58	53.59

As shown in Table 2, the Kaiser-Meyer-Olkin (KMO) Sample Adequacy Test (KMO = .864) indicated that the sample was sufficiently large for factor analysis. The Bartlett's Test of Sphericity result ($\chi^2(120)$ = 984.003, $p < .001$) indicated that item correlations were adequate for PCA. According to Kaiser's (1974) eigenvalue-greater-than-one rule, the 16 items of PIMS loaded onto three factors with eigenvalues above 1 (eigenvalue = 8.56; see Table 2). Examination of the scree plot revealed two marked drops followed by a plateau, suggesting that components beyond the cut-off contributed minimally and uniformly to the explained variance. Accordingly, a three-factor solution was identified as the most theoretically and statistically appropriate structure for the instrument (see Figure 1). In line with internationally accepted definitions, Exploratory Factor Analysis (EFA) was used to identify the latent structure of the scale without imposing a predefined model (Fabrigar & Wegener, 2012; Goretzko et al., 2021), whereas Confirmatory Factor Analysis (CFA) was subsequently employed to test the adequacy of the hypothesized factor structure against the observed data (Besnoy et al., 2016; Brown, 2015). These primary sources guided the interpretation of the factor-analytic procedures and the evaluation of model fit during the validation process.

Figure 1

Scree Plot



The factors obtained as a result of the analysis, item numbers, and factor loadings are presented in Table 3.

As shown in Table 3, the scale items' factor loadings ranged from .52 to .85, and the common variance coefficients ranged from .32 to .80.

Table 3

Scale Factors, Item Numbers, and Factor Loadings

First factor		Second factor		Third factor	
Items	**Factor Loadings**	**Items**	**Factor Loadings**	**Items**	**Factor Loadings**
10	.791	1	.857	9	.669
16	.738	3	.796	2	.633
7	.725	5	.784	13	.525
14	.676	8	.678		
4	.669	15	.645		
11	.627	6	.635		
12	.605				

3.2. Confirmatory factor analysis

The Confirmatory Factor Analysis (CFA) was conducted using an independent sample of 241 parents whose children are enrolled in primary or middle schools located in the Marmara Region of Türkiye. Of this group, 85.1% were female, and 14.9% were male. The age grouping was revised for the CFA stage due to a concentration in a specific age range observed during the Exploratory Factor Analysis (EFA). This adjustment was made to achieve a more balanced distribution across age groups and to enhance the statistical significance of the analyses. Accordingly, 16.2% of the participants were aged 34 or younger, 60.6% were aged 35-44, and 23.2% were aged 45 or older. In terms of educational background, 29.9% of the participants were high school graduates, 27.8% held a bachelor's degree, 11.6% had an associate degree, 11.2% were middle school graduates, 9.1% had completed primary school, 7.5% held a master's degree, and 2.9% had a doctorate. Regarding their children's education level, 68% had children in middle school, while 32% had children in primary school. This demographic distribution indicates that the scale was tested with parents of diverse ages and educational backgrounds, reflecting a broad and varied participant profile.

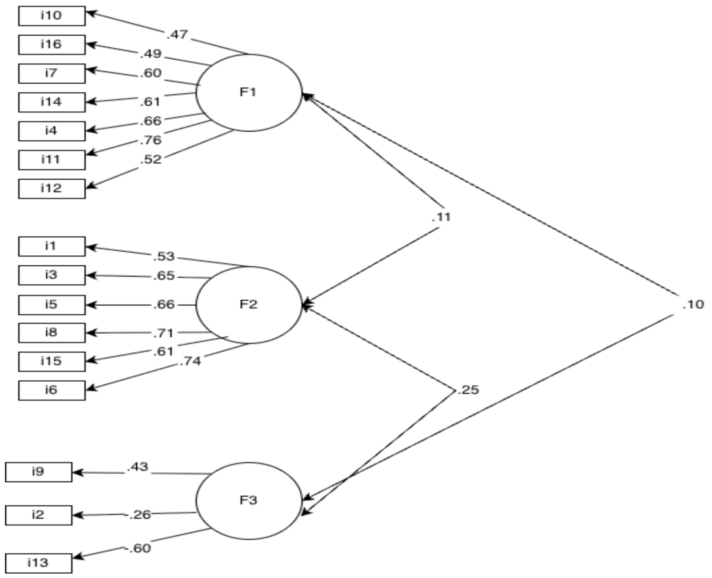
Confirmatory Factor Analysis (CFA) was conducted to evaluate the scale's construct validity. Model fit was assessed using multiple indices recommended in the international literature, including Chi-square, the Comparative Fit Index (CFI), Goodness of Fit Index (GFI), Incremental Fit Index (IFI), the Standardized Root Mean Square Residual (SRMR), and the Root Mean Square Error of Approximation (RMSEA). In accordance with established thresholds (Brown, 2015; Hair et al., 2014; Kline, 2023), values of CFI, GFI, and IFI ≥ .90, SRMR ≤ .08, and RMSEA ≤ .08 were considered indicative of acceptable model fit. CFA was performed using an independent sample of 241 participants. The fit indices obtained from the analysis were χ^2/df (204.694/98) = 2.089, p = .001, IFI = .90, CFI = .90, GFI = .90, SRMR = .063, and RMSEA = .067. These results demonstrate that the three-factor model provided a satisfactory fit to the data, meeting internationally accepted criteria. The final validated CFA model is presented in Figure 2.

As seen in Figure 2, the factor loadings of the items belonging to factor F1 (Directive Involvement) range from .47 to .76. The highest loading was observed in i11 (.76), and the lowest loading was observed in i10 (.47). This indicates that the relevant items adequately predict the factor.

The factor loadings for F2 (Interactive Involvement) range from .53 (i1) to .74 (i6). All items exceed the .50 threshold and demonstrate strong structural validity. In particular, i6 (.74), i8 (.71), and i5 (.66) strongly represent the factor, with high loadings.

Figure 2

Confirmatory Factor Analysis



In the confirmatory factor analysis, the factor loading of i2—part of the F3 (Situational Involvement) factor—was found to be .26. The low factor load of this item is a statistical weakness. Although this value falls below the conventionally accepted threshold for factor retention, the item was preserved in the model due to its conceptual relevance. Specifically, the item captures a parental tendency to seek external social support (e.g., from family members or neighbors) when direct academic assistance cannot be provided. This behavior represents a distinct, context-dependent form of involvement and complements other items within the same factor that reflect situational responses, such as arranging private tutoring for the child or increasing engagement during exam periods. Together, these items form a theoretically coherent construct that reflects reactive and circumstantial support strategies rather than consistent, proactive involvement. The inclusion of item i2 thus enhances the conceptual breadth of the factor, capturing a unique behavioral dimension not addressed by more resource- or time-bound items. Consequently, the decision to retain this item was based not solely on statistical criteria, but on its meaningful contribution to the theoretical integrity and content validity of the factor.

Furthermore, the structural considerations reinforce this decision: since the F3 factor comprises only three items, removing i2 would compromise the factor's stability and lead to its elimination from the model.

Therefore, i2 was maintained not only for its substantive contribution but also for the preservation of the model's structural coherence. Future research may revisit this item using alternative samples to further examine its psychometric adequacy and refine its operationalization if necessary. The Composite Reliability (CR) and Explained Mean Variance (AVE) values calculated within the scope of construct validity are presented in Table 4.

Table 4

Construct Validity

Factors	AVE	CR
Directive Involvement	.35	.79
Interactive Involvement	.43	.82
Situational Involvement	.20	.41

As indicated in Table 4, the Composite Reliability (CR) and Average Variance Extracted (AVE) were calculated for each factor. The findings show that the CR values for the Directive and Interactive factors are .79 and .82, respectively, and exceed the recommended threshold of .70. This indicates that these factors are sufficiently internally consistent (Hair et al., 2019).

However, the AVE values for the same factors (.35 and .43) were below the recommended threshold of .50. Low AVE values indicate that the common variance among the items within the relevant factors is limited and that convergent validity is not fully achieved. However, the literature indicates that when CR values are above .70, AVE values below .50 do not completely invalidate construct validity; this situation can be considered an acceptable limitation, especially in the early stages of scale development (Fornell & Larcker, 1981; Hair et al., 2019). In this context, the Directive and Interactive factors have been retained in the model, despite their limited convergent validity, considering their theoretical foundations and reliability levels.

The findings regarding the Situational Involvement factor point to a more pronounced limitation. The calculated AVE (.20) and CR (.41) values for this factor are well below the recommended thresholds. This indicates that the factor is weak in terms of construct validity and that the items do not adequately reflect it. In particular, the low factor loading of item i2 in this factor is considered one of the main reasons for this weakness. Therefore, the Situational Involvement factor has been treated not as a well-established dimension, but as an emerging, exploratory one that aims to capture the contextual and situational aspects of parental involvement. Future studies are recommended to further examine this factor with new items and to retest it with different samples.

3.3. Discriminant validity

The Fornell-Larcker criterion was used to assess the PIMS's discriminant validity. This criterion states that each construct's square root of the Average Variance Extracted (AVE) should be higher than its correlations with any other construct. The square root of the AVE for each factor (bold on the diagonal) is greater than the inter-construct correlations, as Table 5 illustrates. All these values are greater than the interfactor correlation coefficients (.50, -.36, -.26). This finding demonstrates that the PIMS subdimensions are statistically distinct from each other and that discriminant validity has been established.

Table 5

Discriminant Validity (Fornell-Larcker Criterion)

Factors	1. Directive	2. Interactive	3. Situational
1.Directive Involvement	0.59		
2.Interactive Involvement	0.50	0.65	
3.Situational Involvement	-0.36	-0.26	0.45

Note: Values in bold on the diagonal represent the square root of the Average Variance Extracted (AVE) for each construct. Off-diagonal values represent the correlations between the constructs. Discriminant validity is established when the diagonal values are greater than the off-diagonal correlation coefficients in their respective rows and columns.

As shown in Table 5, all values are greater than the interfactor correlation coefficients (.50, -.36, -.26). This finding demonstrates that the PIMS subdimensions are statistically distinct from each other and that discriminant validity has been established.

3.4. Criterion validity

The results of the Pearson correlation analysis conducted to assess criterion validity are presented in Table 6. The Pearson correlation coefficient (r = .61, p < .01) for the Parental Involvement in Mathematics Scale indicates a moderate to strong positive association with the related construct. A positive and significant correlation was observed.

Table 6

Correlations Between the Target Measurement Tool and the Criterion Measurement Tool (N = 241)

Scale	Number of Statements	Pearson Correlation
Parental Involvement in Mathematics Scale	16	.61**
Family Involvement Scale	25	

As indicated in Table 6, there is a positive and significant correlation between PIMS and the criterion scale.

The results of the correlation analysis are presented in Table 7.

Table 7

Correlation of Scale Sub-Factors with Other Scale

Scale / Sub-Factor	1	2	3	4	5	6	7	8	9	10
Parental involvement in mathematics (1)	1	.70**	.89**	.01	.61**	.30**	.51**	.32**	.43**	.61**
Directive involvement (2)		1	.50**	-.36**	.58**	.41**	.50**	.37**	.41**	.48**
Interactive involvement (3)			1	-.26**	.64**	.22**	.57**	.27**	.51**	.64**
Situational involvement (4)				1	-.38**	-.15**	-.41**	-.17**	-.37**	-.27**
Family involvement (5)					1	.49**	.81**	.60**	.81**	.89**
Beliefs of parents (6)						1	.26**	.31**	.27**	.33**
School-based parenting skills (7)							1	.26**	.57**	.69**
Parents' perception of teacher expectations (8)								1	.40**	.38**
Parent opportunities (9)									1	.65**
Home-based parenting skills (10)										1

As shown in Table 7, the analysis indicated that the sub-dimensions of Parental Involvement in Mathematics showed significant positive relationships with the sub-dimensions of Family Involvement, School-Based Parenting Skills, Parents' Perception of Teacher Expectations, Parent Opportunities, and Home-Based Parenting Skills.

Additionally, it was found that Parental Involvement in Mathematics and Family Involvement were significantly negatively correlated with academic disengagement-related factors, while showing significant positive correlations with supportive parental beliefs and involvement-based parenting skills.

The reliability analysis results are presented in Table 8.

Table 8

Reliability Coefficients

Scale	Number of Statements	Coefficient
Parental Involvement in Mathematics Scale	16	.70
Family Involvement Scale	25	.92

As seen in Table 8 the Family Involvement scale has a high-reliability coefficient (α = .92), indicating strong internal consistency. On the other hand, the Parental Involvement in Mathematics scale has an acceptable reliability coefficient (α = .70).

The results of the item analysis are presented in Table 9.

Table 9

Corrected Item-Total Correlations and Cronbach's Alpha if Item Deleted

Item Code	Corrected Item Total Correlations	Cronbach's Alpha (If item is deleted)
Item 1	.498	.760
Item 2	.131	.799
Item 3	.593	.752
Item 4	.589	.752
Item 5	.571	.753
Item 6	.591	.750
Item 7	.437	.770
Item 8	.481	.762
Item 9	.707	.734
Item 10	.373	.772
Item 11	.496	.760
Item 12	.469	.766
Item 13	.621	.775
Item 14	.624	.773
Item 15	.662	.764
Item 16	.368	.773

As indicated in Table 9, the reliability of each item on the scale was assessed using corrected item-total correlations and Cronbach's alpha values calculated if the item were deleted. The results indicated that the majority of the items demonstrated coefficients above the acceptable threshold of .30, suggesting they align well with the overall construct and contribute meaningfully to the scale's internal consistency. Items 9, 15, and 14 demonstrated the highest item-total correlations (.707, .662, and .624, respectively).

Item 2 presents an exceptional case, exhibiting notable statistical weaknesses. As the reviewer correctly noted, this item yielded a factor loading of .26, which falls below the conventional thresholds for practical significance (e.g., Tabachnick & Fidell, 2013).

This statistical weakness is further confirmed by its notably low corrected item-total correlation (.131) and by the finding that its removal would substantially increase Cronbach's Alpha from .70 to .799. Despite this clear statistical profile, a deliberate decision was made to retain the item based on its critical conceptual contribution.

Item 2 captures a distinct aspect of parental involvement that is theoretically different from direct academic assistance yet holds crucial contextual significance. Specifically, it reflects a parent's mobilization of support networks (family, close contacts) when they are unable to directly support their child's academic efforts.

This conceptual divergence—measuring resource mobilization rather than direct interaction—likely explains its weak statistical association with the other items (both factor loadings and item-total correlations). In conclusion, although Item 2 is statistically marginal, it was retained to prioritize content validity and the broader theoretical integrity of the scale. This decision accepts a statistical trade-off to ensure the instrument fully captures the contextual and situational dimensions of parental engagement, reflecting how parents maintain involvement even when not directly assisting.

4. Discussion and Conclusion

This study introduces the Parental Involvement in Mathematics Scale (PIMS), an instrument developed to fill a critical and persistent gap in the literature: the precise measurement of home-based academic interactions, purposefully decoupled from school-based components. This methodological isolation constitutes PIMS's primary strength and differentiation. The vast majority of existing instruments treat parental involvement holistically or inextricably intertwine home and school dimensions (e.g., Gugiu et al., 2019; Walker et al., 2005; Yosef et al., 2021), including prominent Epstein-based models (Johnson, 2014; Masal et al., 2019). Whereas these scales make it challenging to isolate the independent construct of home support, PIMS is more specific, enabling a focused analysis of this micro-level environment. This critical methodological decision is strongly justified by existing evidence demonstrating that home-based involvement consistently reveals a stronger correlation with academic achievement than school-based involvement (Boonk et al., 2018). This deficiency is mirrored in existing mathematics education tools. PIMS is quantifiably stronger than prior scales in the Turkish context that lacked rigorous validity and reliability analyses (Özcan, 2016). Furthermore, PIMS is qualitatively different from instruments like that of Özcan et al. (2018). In contrast to that scale's limitations—its restriction to the homework context and its reliance on child perceptions—PIMS captures the parent's perspective across a broader, more structured framework of home support.

Therefore, PIMS directly addresses the need for a valid measurement tool structured for parents of elementary and middle school students, focused exclusively on home-based academic interactions. This targeted approach is theoretically crucial, rooting the scale in Vygotsky's Sociocultural Theory (1978) and Bronfenbrenner's Ecological Systems Approach (1977). The developed scale was structured according to Boonk et al.'s (2018) definition of home-based involvement, aiming to provide a multidimensional assessment of parental support within the home learning environment. Items initially generated under four theoretical categories were clustered into three distinct factors following exploratory factor analysis (EFA). Based on their content integrity, these three factors were named "Directive Involvement," "Interactive Involvement," and "Situational Involvement."

The three aspects of parental involvement identified in this study align with different theoretical frameworks that promote learning mathematics. First, Directive Involvement works mainly through theories of self-regulation; parents assist students in internalizing academic goals and controlling their attention during challenging assignments by promoting persistence, setting up learning materials, and highlighting the practical applications of mathematics (Zimmerman, 2002).

Second, Interactive Involvement transcends general "homework help" (Dumont et al., 2014) and aligns with Vygotsky's idea of scaffolding; parents serve as the "more knowledgeable other" by watching videos together and providing direct modeling, thereby lessening the cognitive load required for students to understand abstract mathematical ideas. This dimension creates a 'Zone of Proximal Development' where parents guide children through complex algorithmic steps (Vygotsky, 1978), transforming a solitary struggle into a shared learning experience.

Finally, Situational Involvement functions as a compensatory resource management technique. This dimension emphasizes how parents who lack specific content knowledge indirectly support learning by using outside resources (like private tutoring or family members) to address short-term performance deficiencies like test preparation. Collectively, this multidimensional construct offers a precise assessment of the nuance and consistency of parental engagement beyond mere frequency.

The Exploratory Factor Analysis (EFA) confirmed that a three-factor structure was appropriate, thereby supporting the scale's construct validity. Kaiser-Meyer-Olkin sampling adequacy coefficient (.864) and Bartlett's test of sphericity ($\chi^2(120) = 984.003$, $p < .001$) supported the suitability of the data for factor analysis. Three factors with eigenvalues greater than 1 were retained, explaining 53.59% of the total variance, with factor loadings for the 16 retained items ranging from .52 to .85. Directive Involvement includes behaviors such as guidance, encouragement, and resource support provided without direct involvement with the child. Interactive Involvement groups the parent's active and simultaneous interaction behaviors, such as studying together and providing explanations. The third factor, Situational Involvement, reflects conditional participation behaviors (e.g., increased interest during exam periods, arranging private tutoring, or mobilizing external support). The items belonging to F3 (Items 2, 9, and 13) were reverse-coded because their content, such as Item 13 ("I pay more attention...''), represents a reactionary, exam-focused interest rather than the continuous, process-oriented support targeted by the scale. The fact that this factor comprises only three items is acknowledged as a limiting factor in terms of measurement power. Nevertheless, its strong theoretical justification and contribution to content integrity supported the retention of this factor (Worthington & Whittaker, 2006).

Confirmatory Factor Analysis (CFA) was performed on an independent sample (N=241) to rigorously test the validity of the EFA-derived three-factor structure. The resulting goodness-of-fit indices (χ^2/df = 2.089, CFI = .90, GFI = .90, IFI = .90, SRMR = .063, RMSEA = .067) indicated that the model provided an acceptable fit to the data. The fact that the CFI, GFI, and IFI values met the conventional threshold of≥.90 (Kline, 1998; Lomax, 2004) supports the construct's general validity. Furthermore, the SRMR and RMSEA values falling below recommended limits suggest the model's error terms are restricted. However, these findings also indicate that the model does not achieve perfect fit (Kline, 2023).

As part of the validity and reliability analyses, the internal consistency of the entire scale was assessed using Cronbach's alpha, which yielded an acceptable coefficient of α=.70. This level meets the accepted limit value in social sciences, indicating that the overall structure provides a consistent and reliable measurement (George & Mallery, 2003). Criterion validity was assessed via correlation analysis with the Family Involvement Scale (FIS) adapted by Işık and Şahin (2021). This analysis revealed a significant, moderate-to-strong positive correlation between the PIMS and the FIS (r=.61, p<.01). Furthermore, sub-dimension-level analyses showed that the PIMS has significant relationships in the theoretically expected direction with constructs such as home-based skills, perceptions of teacher expectations, and parent opportunities. Moreover, the scale's negative association with academic apathy, coupled with its positive association with supportive parental beliefs and active engagement behaviors, indicates that it successfully reflects both the extent and the quality of home-based involvement. Collectively, these findings provide robust support for PIMS's criterion-related and construct validity.

The structure of PIMS provides a functional tool for both educational practitioners and researchers by assessing parents' academic interaction styles specifically within the home environment. The items reveal behavioral patterns across distinct forms of parental involvement, such as guidance, collaboration, and the use of external resources, thereby offering a detailed profile of parental support. Consequently, the scale can be used by teachers and school guidance services as a monitoring tool to precisely identify areas where parental support is concentrated or limited.

Furthermore, PIMS is a valid and reliable measurement tool for researchers exploring parental involvement patterns across various sociocultural contexts and identifying specific needs for early intervention.

In conclusion, the Parental Involvement in Mathematics Scale (PIMS) offers a stronger, more differentiated instrument for assessing parental support by addressing two fundamental limitations in the existing literature. First, whereas many established instruments (e.g., Epstein-based models) either treat involvement holistically or inextricably intertwine home and school-based components, PIMS provides a more precise and methodologically "clean" tool by exclusively decoupling academic interactions within the home environment. Second, rather than limiting the construct to singular frequency scores or homework-specific behaviors, PIMS offers a qualitatively stronger framework by differentiating support into directive, interactive, and situational interventions. This resultant three-factor structure is the scale's primary contribution, providing crucial indicators of the continuity, form, and consistency of parental engagement, not just its frequency. Despite the psychometric limitations noted for the situational dimension, this qualitative distinction among support types is particularly valuable for educational policies and early intervention strategies, especially in cognitively demanding subjects such as mathematics, offering a level of nuance that broader scales lack. PIMS demonstrated robust psychometric properties, confirming that this novel, multidimensional structure is both valid and reliable. Its criterion validity further solidified its theoretical grounding by confirming expected relationships with established constructs. Overall, by providing a tool that precisely assesses how (the type) and when (the consistency) parents are involved, not just if, PIMS offers a significant advancement for academic research and the structuring of targeted, evidence-based interventions for educational practitioners. Therefore, further studies utilizing samples from diverse geographical regions and varying socio-demographic characteristics will be an essential step toward comprehensively testing the scale's structural integrity and expanding its utility.

5. Limitations

While the PIMS offers a unique means of assessing parental involvement by focusing exclusively on home-based academic interactions, certain limitations may affect the generalizability of the findings and the scope of application. Firstly, data collection utilized a convenience sampling method, reaching participants both online and in person. Although this process provided representational diversity, the inability to fully control the regional distribution of participants poses a limitation regarding spatial homogeneity. Secondly, the sample group was predominantly female (80.7% in EFA, 85.1% in CFA), which limits the reflection of potential gender-based differences in attitudes toward parental involvement. Thirdly, only home-based academic interactions were included in the scope of the study; indirect influences, such as parent-teacher communication or school practices, were deliberately excluded, thus restricting a holistic view of the parent-school ecosystem.

Fourthly, the construct validity is partially constrained because the Situational Involvement factor (F3) is represented by a restricted number of three items. This measurement limitation is exacerbated by Item 2, which exhibited a relatively low factor loading in the CFA (.26) and a low corrected item-total correlation (.131). Although removing Item 2 would statistically improve the Cronbach's Alpha value substantially (from α=.70 to α=.799), the item was retained.

The retention decision prioritizes the item's conceptual relevance—capturing the unique context-dependent behavior of mobilizing external social support—and its critical role in maintaining the structural coherence of the three-item F3 factor, thereby safeguarding the scale's theoretical integrity. To overcome this limitation in future studies, it is necessary to develop new and additional items (i.e., expanding the item pool) to more robustly and comprehensively measure the theoretical construct encompassed by the third factor.

Fifthly, the criterion-related validity of the PIMS was assessed using a single instrument (Family Involvement Scale). While statistically significant, relying on a single criterion limits the breadth of the validation scope. Future studies should employ multiple criterion measures, including student achievement scores (e.g., GPA or standardized math test results), to provide more comprehensive validity evidence.

Finally, as the data relies entirely on parental self-reports, the findings are subject to perception-based biases (e.g., social desirability bias). Parents may have overestimated their involvement levels. Future research could mitigate this by incorporating multi-source data, such as teacher evaluations or student reports, to cross-validate parental claims (Podsakoff et al., 2003; Saris & Gallhofer, 2014).

Article Information Form

Author Contributions: Conceptualization: AI; Methodology: FT; Validation: AI, FT, SB, ASÖ; Formal analysis: AI, FT, SB, ASÖ; Investigation: AI, FT; Resources: AI, FT; Data curation: AI, FT, SB, ASÖ; Writing – original draft: AI, FT; Writing – review & editing: AI, FT, SB; Visualization: AI, FT.

Ethical Approval: Marmara University Research and Publication Ethics Committee. Decision dated 01.03.2024 and numbered 03-28 (Approval No: 759540, Date: 15 February 2024).

Authors Notes: This study was presented as an abstract paper at the EDUCONGRESS 2025 International Congress on Education (26-29 November 2025, Antalya-Türkiye).

Conflict of Interest Disclosure: No potential conflict of interest was declared by the authors.

Artificial Intelligence Statement: The content of this article was not generated using artificial intelligence tools. However, AI-based language tools were used solely to improve the academic language, check grammar, and enhance the clarity of the English translation.

Plagiarism Statement: This article has been scanned by iThenticate.

References

Ahioğlu Lindberg, E. N., & Demircan, A. N. (2013). Parental involvement in secondary schools based on student opinions: A scale adaptation. *Anadolu Journal of Educational Sciences International, 3*(1), 35–46.

Ahmetoğlu, E., Acar, İ. H., Sezer, T., & Yavuz, E. A. (2018). Aile katılımı ölçeği'nin Türk kültürüne uyarlanması [Adaptation of the Parental Involvement Scale to Turkish culture]. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi, 18*(1), 21–40. https://doi.org/10.17240/aibuefd.2018..-368784

Arı, E. (2014). Basic concepts [Temel kavramlar]. In S. Büyükalan Filiz (Ed.), *Theories and approaches to learning teaching* [*Öğrenme öğretme kuram ve yaklaşımları*] (3rd ed., pp. 2–26). Pegem Akademi.

Auerbach, P. (2016). Education in a free society. In *Socialist optimism: An alternative political economy for the twenty-first century* (pp. 319–344). Palgrave Macmillan. https://doi.org/10.1007/978-1-137-56396-5_12

Becker, H. J., & Epstein, J. L. (1981). *Parent involvement: Teacher practices and judgements* [ED206601]. ERIC. https://files.eric.ed.gov/fulltext/ED206601.pdf

Besnoy, K. D., Dantzler, J., Besnoy, L. R., & Byrne, C. (2016). Using exploratory and confirmatory factor analysis to measure construct validity of the Traits, Aptitudes, and Behaviors Scale (TABS). *Journal for the Education of the Gifted, 39*(1), 3-22. https://doi.org/10.1177/0162353215624160

Boonk, L., Gijselaers, H. J., Ritzen, H., & Brand-Gruwel, S. (2018). A review of the relationship between parental involvement indicators and academic achievement. *Educational Research Review, 24*, 10–30. https://doi.org/10.1016/j.edurev.2018.02.001

Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist, 32*(7), 513–531. https://doi.org/10.1037/0003-066X.32.7.513

Brown, T. A. (2015). *Confirmatory factor analysis for applied research*. Guilford.

Bryman, A., & Cramer, D. (2012). *Quantitative data analysis with IBM SPSS 17, 18 & 19: A guide for social scientists.* Routledge. https://doi.org/10.4324/9780203180990

Byrne, B. M. (2010). *Structural equation modeling with AMOS: basic concepts, applications, and programming* (multivariate applications series). Routledge.

Çetinkaya, S. (2024). Ev okuryazarlık etkinliklerine aile katılımı ölçeği'nin geliştirilmesi [Development of the family involvement in home literacy activities scale]. *Cumhuriyet Uluslararası Eğitim Dergisi, 13*(1), 120–133. https://doi.org/10.30703/cije.1325391

Çokluk, Ö., Şekercioğlu, G., & Büyüköztürk, Ş. (2012). *Multivariate statistics for social sciences: SPSS and LISREL applications [Sosyal bilimler için çok değişkenli istatistik: SPSS ve LISREL uygulamaları]* (2nd. ed.). Pegem Akademi.

DeVellis, R. F. (2016). *Scale development: Theory and applications* (4th ed.). Sage.

DeVellis, R. F., & Thorpe, C. T. (2021). *Scale development: Theory and applications*. Sage publications.

Dumont, H., Trautwein, U., Nagy, G., & Nagengast, B. (2014). Quality of parental homework involvement: Predictors and reciprocal relations with academic functioning in the reading domain. *Journal of Educational Psychology, 106*(1), 144. https://doi.org/10.1037/a0034100

Ebeoğlu Duman, M., & Akgöz Aktaş, G. (2024). The mediating role of psychological functioning and maternal gatekeeping in the relationship of work-family conflict and gender roles with co-parenting. *Current Psychology, 43*(44), 34394-34413. https://doi.org/10.1007/s12144-024-06908-3

Epstein, J. L. (2018). School, family, and community partnerships in teachers' professional work. *Journal of Education for Teaching, 44*(3), 397–406. https://doi.org/10.1080/02607476.2018.1465669

Epstein, J. L., Sanders, M. G., Sheldon, S. B., Simon, B. S., Salinas, K. C., Jansorn, N. R., & Williams, K. J. (2018). *School, family, and community partnerships: Your handbook for action.* Corwin.

Erdener, M. A. (2016). Principals' and teachers' practices about parent involvement in schooling. *Universal Journal of Educational Research, 4*(n12A), 151-159. https://doi.org/10.13189/ujer.2016.041319

Fabrigar, L. R., & Wegener, D. T. (2012). *Exploratory factor analysis.* Oxford University. https://doi.org/10.1093/acprof:osobl/9780199734177.001.0001

Fantuzzo, J., Tighe, E., & Childs, S. (2000). Family Involvement Questionnaire: A multivariate assessment of family participation in early childhood education. *Journal of Educational Psychology, 92*(2), 367–376. https://doi.org/10.1037/0022-0663.92.2.367

Field, A. (2018). *Discovering statistics using IBM SPSS statistics* (5th ed.). SAGE Publications

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39-50.

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference* (4th ed.). Allyn & Bacon.

Goretzko, D., Pham, T. T. H., & Bühner, M. (2021). Exploratory factor analysis: Current use, methodological developments and recommendations for good practice. *Current Psychology, 40*(7), 3510-3521. https://doi.org/10.1007/s12144-019-00300-2

Goulet, J., Archambault, I., Morizot, J., Olivier, E., & Tardif-Grenier, K. (2023). Validation of the Student-Rated Parental School Involvement Questionnaire: Factorial validity and invariance across time and sociodemographic characteristics. *Journal of Psychoeducational Assessment, 41*(4), 416–433. https://doi.org/10.1177/07342829231155694

Grolnick, W. S., Benjet, C., Kurowski, C. O., & Apostoleris, N. H. (1997). Predictors of parent involvement in children's schooling. *Journal of Educational Psychology, 89*(3), 538–548. https://doi.org/10.1037/0022-0663.89.3.538

Grolnick, W. S., & Slowiaczek, M. L. (1994). Parents' involvement in children's schooling: A multidimensional conceptualization and motivational model. *Child Development, 65*(1), 237–252. https://doi.org/10.2307/1131378

Gugiu, P. C., Gugiu, M. R., Barnes, M., Gimbert, B., & Sanders, M. (2019). The development and validation of the Parental Involvement Survey in their Children's Elementary Studies (PISCES). *Journal of Child and Family Studies, 28,* 627–641. https://doi.org/10.1007/s10826-018-1294-y

Gürbüztürk, O., & Şad, S. N. (2010). Turkish Parental Involvement Scale: Validity and reliability studies. *Procedia - Social and Behavioral Sciences, 2*(2), 487–491. https://doi.org/10.1016/j.sbspro.2010.03.049

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage.

Hair, J. F., Jr., Gabriel, M. L. D., & Patel, V. K. (2014). AMOS covariance-based structural equation modeling (CB-SEM): Guidelines on its application as a marketing research tool. *Revista Brasileira de Marketing, 13*(2), 44–55. https://doi.org/10.5585/remark.v13i2.2718

Hill, N. E., & Tyson, D. F. (2009). Parental involvement in middle school: A meta-analytic assessment of the strategies that promote achievement. *Developmental Psychology, 45*(3), 740–763. https://doi.org/10.1037/a0015362

Hoover-Dempsey, K. V., & Sandler, H. M. (2005). *Final performance report for OERI Grant #R305T010673: The social context of parental involvement: A path to enhanced achievement*. U.S. Department of Education, Institute of Education Sciences.

Howard, M. C. (2016). A review of exploratory factor analysis decisions and overview of current practices: What we are doing and how can we improve? *International Journal of Human-Computer Interaction, 32*(1), 51-62.

Işık, O., & Şahin, İ. (2021). Participation of primary and secondary school parents in their children's educational process [İlkokul ve ortaokul velilerinin çocuklarının eğitim sürecine katılımı]. *Journal of National Education* [*Milli Eğitim Dergisi*], *51*(235), 2061–2084. https://doi.org/10.37669/milliegitim.913835

Johnson, S. D. (2014). *Effects and perceptions of parental involvement on the mathematical achievement of students in a STEM course: A mixed-methods study* [Doctoral dissertation, The University of North Carolina at Charlotte]. ProQuest Dissertations.

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika, 39*, 31–36. https://doi.org/10.1007/BF02291575

Karagöz, Y. (2021). *Quantitative-qualitative-mixed scientific research methods with SPSS and AMOS applications and publication ethics [SPSS ve AMOS uygulamalı nicel-nitel-karma bilimsel araştırma yöntemleri ve yayın etiği].* Nobel Akademik.

Kline, R. B. (1998). Software review: Software programs for structural equation modeling: Amos, EQS, and LISREL. *Journal of Psychoeducational Assessment, 16*(4), 343-364. https://doi.org/10.1177/073428299801600407

Kline, R. B. (2023). *Principles and practice of structural equation modeling.* Guilford.

Liu, F., Black, E., Algina, J., Cavanaugh, C., & Dawson, K. (2010). The validation of one parental involvement measurement in virtual schooling. *Journal of Interactive Online Learning, 9*(2), 105–132.

Liu, C., Wang, S., Xie, H., & Wang, X. (2026). Home-rearing environment and early math achievement: Longitudinal mediation through children's self-regulation and math anxiety. *Early Education and Development, 37*(2), 347-370. https://doi.org/10.1080/10409289.2025.2559428

Lomax, R. G. (2004). *A beginner's guide to structural equation modeling*. Psychology Press.

Lyons, C. W., & Higgins, A. (2014). The role of emotions and interpersonal relationships in educational reform: A behaviour management case study. In *Interpersonal relationships in education: From theory to practice* (pp. 111–132). Sense Publishers. https://doi.org/10.1007/978-94-6209-701-8_8

MacCallum, R. C., Widaman, K. F., Preacher, K. J., & Hong, S. (2001). Sample size in factor analysis: The role of model error. *Multivariate Behavioral Research, 36*(4), 611–637. https://doi.org/10.1207/S15327906MBR3604_06

Mardianti, D. (2025). Parental assistance in creating a conducive learning environment [Pendampingan orang tua dalam membangun lingkungan belajar yang kondusif]. *JANU: Journal of Community Service Nusantara* [*JANU: Jurnal Abdimas Nusantara*], *2*(01), 07–17. https://doi.org/10.70294/ae1y9k96

Masal, E., Takunyacı, M., & Şevik, M. Ş. (2019). Family involvement in secondary schools: Adaptation of the Short Form of The Parent-Teacher-Student Scale into Turkish. *Journal of Interdisciplinary Education: Theory and Practice, 1*(1), 29–41.

Mohd Hanafiah, N. I., Rosly, N. S., & Ahmad, N. (2024). Relationship between parents' involvement with students' interest and achievements in mathematics learning. *Jurnal Intelek [Intellect Journal], 19*(2), 218–229. https://doi.org/10.24191/ji.v19i2.26633

Nunnally, J. C. (1978). An overview of psychological measurement. In B. B. Wolman (Ed.), *Clinical diagnosis of mental disorders: A handbook* (pp. 97–146). Plenum. https://doi.org/10.1007/978-1-4684-2490-4_4

Oluwatelure, T. A., & Oloruntegbe, K. O. (2010). Effects of parental involvement on students' attitude and performance in science. *African Journal of Microbiology Research, 4*(1), 1-9.

Özcan, B. N. (2016). Investigation of parents' beliefs and involvement in their children's mathematics learning process [Ebeveynlerin çocuklarının matematik öğrenme süreçlerindeki inanç ve katılımının incelenmesi]. *International Journal of Educational Sciences* [*Uluslararası Eğitim Bilimleri Dergisi*], *(8),* 105–117.

Özcan, B., Delil, A., & Göğebakan Yıldız, D. (2018). Development of the Family Support in Mathematics Homework Scale. In Ö. T. Kara (Ed.), *Current field education research*, (pp. 127–140). Akademisyen Kitabevi.

Özdemir, A. Ş., & İnci, A. (2024). Examining the effect of parental support and education provided to parents. *Participatory Educational Research, 11*(3), 201–219. https://doi.org/10.17275/per.24.42.11.3

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879. https://doi.org/10.1037/0021-9010.88.5.879

Santillan, V. I., Callaman, M. R., & English, M. A. (2023). Development and validation of the Parental Involvement Scale (PIS). *Journal of Community Development Research (Humanities and Social Sciences)*, *16*(4), 1–15. https://doi.org/10.14456/jcdr-hs.2023.34

Saris, W. E., & Gallhofer, I. N. (2014). *Design, evaluation, and analysis of questionnaires for survey research.* John Wiley & Sons. https://doi.org/10.1002/9781118634646

Şencan, H. (2005). *Reliability and validity in social and behavioral measurements [Sosyal ve davranışsal ölçümlerde güvenilirlik ve geçerlilik].* Seçkin.

Tabachnick B. G., & Fidell L. S. (2013). *Using multivariate statistics* (6th ed.). Pearson.

Tang, T. T., & Tran, D. H. T. (2023). Parental influence on high school students' mathematics performance in Vietnam. *Eurasia Journal of Mathematics, Science and Technology Education, 19*(4), em2249. https://doi.org/10.29333/ejmste/13068

Tianyu, Z., & Masnan, A. H. (2023). The impact of parental involvement and self-efficacy in anchoring the psychological resilience among Chinese adolescents with learning difficulties: Mediating role of achievement motivation. *South Asian Journal of Social Sciences & Humanities, 4*(6), 16–49. https://doi.org/10.48165/sajssh.2023.4602

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes (Vol. 86).* Harvard University.

Walker, J. M., Wilkins, A. S., Dallaire, J. R., Sandler, H. M., & Hoover-Dempsey, K. V. (2005). Parental involvement: Model revision through scale development. *The Elementary School Journal, 106*(2), 85–104. https://doi.org/10.1086/499193

Wang, M. T., & Sheikh-Khalil, S. (2014). Does parental involvement matter for student achievement and mental health in high school? *Child Development, 85*(2), 610–625. https://doi.org/10.1111/cdev.12153

Worthington, R. L., & Whittaker, T. A. (2006). Scale development research: A content analysis and recommendations for best practices. *The Counseling Psychologist, 34*(6), 806–838. https://doi.org/10.1177/0011000006288127

Xia, X., Hackett, R. K., & Webster, L. (2021). A multidimensional examination of Chinese family involvement in early childhood education: Validation of the Chinese version of the Family Involvement Questionnaire. *International Journal of Early Years Education, 29*(2), 124–138. https://doi.org/10.1080/09669760.2020.1742672

Yampolskaya, S., & Payne, T. (2025). Assessing parental involvement in children's learning: Initial validation of the Parent Involvement Survey. *Journal of Child and Family Studies, 34*(1), 141–149. https://doi.org/10.1007/s10826-024-02961-5

Yosef, Y., Hasmalena, H., & Sucipto, S. D. (2021). Development of Parental Efficacy Scale to measure parents' involvement capabilities in elementary education. *Islamic Guidance and Counseling Journal, 4*(1), 43–54. https://doi.org/10.25217/igcj.v4i1.956

Yuan, H., Kleemans, T., & Segers, E. (2026). Parental numeracy expectations, home numeracy activities, and children's early numeracy skills in Mainland China across urban and rural areas. *Early Education and Development, 37*(1), 66-86. https://doi.org/10.1080/10409289.2025.2519554

Yurtbakan, E., & Akyıldız, S. (2020). Family-school perception and participation scale: A validity and reliability study [Aile okul algısı ve katılımı ölçeği: Bir geçerlik ve güvenirlik çalışması]. *Bayburt Faculty of Education Journal [Bayburt Eğitim Fakültesi Dergisi], 15*(30), 328–346. https://doi.org/10.35675/befdergi.686853

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice, 41*(2), 64-70. https://doi.org/10.1207/s15430421tip4102_2