Article

Homework Purposes in Eighth Grade Students: Identifying Student Profiles and Their Relationship with Homework Effort, Completion, and Achievement

Jianzhong Xu[1] and José Carlos Núñez[2]

1 Mississippi State University, USA / University of Macau, China.
2 Universidad de Oviedo / Universidad Autónoma de Chile, Chile.

ARTICLE INFO

ABSTRACT

Background: The main objective of the research was (1) to identify different profiles of students based on three purposes they had for homework (academic, self-regulatory and approval-seeking) and (2) to analyze their relationship with the homework effort, completion, and math achievement. **Method:** The study involved 3,018 eighth-grade students from various areas in China. Data were analyzed with *Mplus* using Latent Profile Analysis (LPA). **Results:** As hypothesized, four different profiles were identified: *High Profile* (high in all purposes; 13.39%), *Moderate Profile* (moderate in all purposes; 56.63%), *Low Profile* (low in all purposes; 26.04%), and *Very Low Profile* (very low in all purposes; 3.94%). Belonging to a certain profile was related to the homework effort, completion, and math achievement: the higher the purposes, the greater the homework effort, completion, and higher math performance. **Conclusions:** The results of our study suggest certain similarities and consistency between individual groups (similar profiles) at different ages (i.e., eighth and eleventh graders). Belonging to one or the other profile may have different consequences or implications both for the student's behavior (for example, in terms of their involvement in homework and academic achievement) and for the educational practice of teachers and families.

Razones Para Hacer los Deberes Escolares: Identificación de Perfiles y su Asociación con el Esfuerzo Dedicado, los Deberes Completados y el Rendimiento

RESUMEN

Antecedentes: El principal objetivo de la investigación ha sido (1) identificar diferentes perfiles de estudiantes a partir de tres de sus propósitos para realizar deberes (académico, auto-regulación y de búsqueda de aprobación) y (2) analizar su relación con el esfuerzo dedicado a la realización de los deberes, la cantidad de deberes finalizados y el rendimiento en matemáticas. **Método:** El estudio involucró a 3,018 estudiantes de octavo grado de diferentes áreas geográficas de China. Los datos se analizaron mediante Análisis de Perfiles latentes (LPA). **Resultados:** Se identificaron cuatro perfiles diferentes: alto en los tres propósitos (13,39%), moderado en los tres propósitos (56,63%), bajo en los tres propósitos (26,04%) y muy bajo en los tres propósitos (3,94%). Pertenecer a un determinado perfil se relaciona significativa y positivamente con el esfuerzo dedicado a los deberes, la cantidad de deberes finalizados y con el rendimiento en matemáticas. **Conclusiones:** La pertenencia a uno u otro perfil puede tener diferentes consecuencias o implicaciones tanto para el comportamiento del alumno (por ejemplo, en cuanto a su implicación en la realización de los deberes y respecto del rendimiento académico) como para la práctica educativa de los profesores y las familias.

Commonly defined as "tasks assigned to students by school teachers that are meant to be carried out during non-school hours" (Cooper, 1989, p. 7), homework is a widespread instructional activity across countries (Fan et al., 2017; Fernández-Alonso et al., 2015, 2022; Warton, 2001). It is an important aspect of daily life for many school-age children (Cooper et al., 2006; Corno & Xu, 2004; Dettmers et al., 2011; Fan et al., 2017), as they are often assigned homework for nearly every class they take (Corno, 2011). Hence, it seems obvious and logical that the value of homework perceived by children has important implications for homework practice and research (Rodríguez et al., 2020; Warton, 2001; Xu, 2020; Xu & Corno, 2022), as the value individuals attach to the outcomes of an activity exerts powerful influences on their effort, persistence, and achievement (Wigfield et al., 2015). According to expectancy-value theory (Eccles & Wigfield, 2002), value is defined as the degree to which an individual perceives a task is useful and worthwhile; it centers on the question "Do I Want to Do This Task?" (Wigfield et al. 2015, p. 659). An individual who is convinced that a task is useful and worthwhile is more likely to exert effort and to be successful in the task (Rodríguez et al., 2019). Thus, according to expectancy-value theory, the value children attach to homework is "critical for ... the effort they will contribute to the endeavor and to the persistence they will display" (Warton, 2001, p. 157).

Extant literature often focuses on the value of homework from the perspectives of adults (e.g., the public, educators, and parents; Bempechat, 2004; Rosário et al., 2019a, 2019b; Suárez et al., 2022; Van Voorhis, 2004; Sun et al., 2020a). Over the last 100 years, homework is a perennial topic of the public debate; its value, for example, has been linked to concerns about the U.S.'s ability to compete in a global economy (Gill & Schlossman, 2004). The value of homework has been linked to homework purposes perceived to be important by parents, teachers, administrators, and researchers (Cooper, 1989; Van Voorhis, 2004; Sun et al., 2020b). Yet, many homework purposes advocated by adults (e.g., public relations and parent-teacher communications) matter little to children (Warton, 2001; Xu, 2005, 2023).

Two notable exceptions to the lack of attention to the student viewpoint consist of one study with children in grade 3 (Xu & Corno, 1998) and another study with children in grades 6-8 (Xu & Yuan, 2003). In both studies, parents and teachers mentioned two purposes for homework: academic (to help children better understand the materials covered in class), self-regulatory (to help children develop self-regulatory capacities such as study skills and personal responsibility). While children in the above two studies agreed one purpose with parents and teachers (academic), they listed another purpose that was important from their perspectives – approval-seeking (to please parents and teachers, and to comply with adult expectations). Furthermore, different from 3rd children (Xu & Corno, 1998), certain children in grades 6-8 (Xu & Yuan, 2003) identified another purpose – self-regulatory (e.g., "it [doing homework] makes you more responsible and independent").

Based on expectancy-value theory (Eccles & Wigfield, 2002) and extant literature pertaining to homework purpose (e.g., Xu & Corno, 1998; Xu & Yuan, 2003), two recent studies have validated math homework purposes perceived by students (Sun et al., 2020a, 2020b). Sun and her colleagues examined the validity of the Math Homework Purpose Scale (MHPS) based on 585 7th graders (Sun et al., 2020a) and 854 9th graders (Sun et al., 2020b). The results of these studies showed that the MHPS consisted of three subscales:

academic, self-regulatory, and approval-seeking. Furthermore, concurrent validity evidence from both studies revealed that academic and self-regulatory purposes were positively associated with math homework effort, completion, and achievement.

Nevertheless, although previous studies using a variable-centered approach provides insights into the direct links of each homework purpose reported by students with other important constructs (e.g., homework behavior and academic achievement), it overlooks or ignores the possibility that (a) children are likely to have multiple purposes for doing homework at the same time, (b) distinct constellations of homework purposes may coexist in the population, and (c) these distinct constellations might relate to differences in other constructs (e.g., homework completion).

To our knowledge, there is only one study that was interested in the analysis of these two questions (Xu, 2023). The goal of this investigation was to identify profiles of students drawn from three purposes of homework: academic, self-regulatory, and approval-seeking. A total of 750 eleventh-grade students in China participated in the study. The results of the latent profile analysis showed a solution of four different groups, or profiles, of students: very low (very low in the three purposes; 5.73%), low (low in the three purposes; 30.40%), medium (moderate in the three purposes; 54.40%), and high (high in the three purposes; 9.47%). The profile membership was significantly related to effort and task completion (with a medium effect size): in general, the higher the purposes, the greater the effort and task completion.

Using a person-centered approach to identify the profiles of homework purposes, this study extends extant literature on homework purpose. These results provide a deeper understanding of how these three homework purposes coexist within students of eleven grade. For example, though the relation between the three homework purposes appeared to be very strong, it was observed that while academic and self-regulation purposes are presented at the same level in the four homework profiles, approval-seeking purpose appear somewhat lower or higher (depending on the profile). These results were interpreted by Xu as partially consistent with the hypothesis that as both academic purpose and self-regulatory purpose reflect self-focused motives, but approval-seeking purpose represent other-focused motive.

Given that there are differences in the relevance of purposes for doing homework in eleventh graders, it is possible that such differences are even greater in younger students. So, as Xu (2023) suggests, it would be beneficial to pursue this line of research involving elementary and middle school students. So, the purpose of the current study is to expand the knowledge provided by Xu (2023), specifically (i) to identify homework purpose profiles in a sample of middle school students (8th graders), regarding the possible combinations of academic, self-regulatory, and approval-seeking purposes, and (ii) to see if they differ in homework effort, completion, and math achievement.

Taking into account the data derived from the study by Xu (2023), and that motivational patterns could already be well developed at 11-12 years (Montero et al., 2001), we expect that the same four homework profiles obtained with eleventh grade students will also be identified in eighth grade students (although the level of purposes within each profile may vary significantly). On the other hand, in line with theoretical expectations (e.g., task value; Wigfield et al., 2015) and related homework literature using variable-centered approach (Epstein & Van Voorhis, 2012; Sun et al., 2020a, 2020b;

Xu, 2005), we expect that, in general, the students with a high level of homework purposes would expend more homework effort, complete more homework, and score higher on math achievement.

Method

Participants

Participants were 3,018 8th graders (96 classes; 45.6% female; 100% Han nationality). They came from three different areas in China, including central, southeastern, and southwestern. To reflect a wide range of socioeconomic backgrounds, students were sampled from eight regular public schools, which were randomly selected from nineteen regular public schools allowing us access for our data collection. The mean age for participants was 13.7±0.4 years. Education level was 10.6 years for mothers and 11.4 years for fathers. Regarding math homework practices, 76.9% participants worked on math assignments four or more days a week. They spent a mean of 34 minutes ($SD = 25$) on math assignments daily. These math homework practices are generally consistent with recent research in China (Xu et al., 2017).

Measures

Math homework purposes. This scale consisted of academic, self-regulatory, and approval-seeking purposes (Sun et al., 2020a, 2020b). Four items measured academic purpose, concerning reinforcement of school learning (e.g., "Doing math homework helps me understand what is going on in class"). Three items measured self-regulatory purpose, concerning promoting desirable self-regulatory attributes (e.g., "Doing math homework helps me learn to work independently"). Three items measured approval-seeking purpose, regarding seeking approvals from teachers, peers, and parents (e.g., "Doing math homework brings me family approval"). Response options for all ten items varied from 1 (*strongly disagree*) to 4 (*strongly agree*). In their study with 7th graders, Sun et al. (2020b) reported that math homework purposes consisted of academic purpose ($\alpha = .71$), self-regulatory purpose ($\alpha = .76$), and approval-seeking purpose ($\alpha = .85$). Likewise, in our current investigation with 8th graders, math homework purposes contained academic purpose ($\alpha = .76$; $\omega = .76$), self-regulatory purpose ($\alpha = .85$; $\omega = .85$), and approval-seeking purpose ($\alpha = .89$; $\omega = .89$).

Math homework effort. Three items assessed students' math homework effort, informed by extant literature (Flunger et al., 2017; Xu et al., 2018; Xu, 2020). These items tapped into their initiatives to follow through math assignments (e.g., "I always try to finish my math assignments"; $\alpha = .81$; $\omega = .82$). Response options ranged from 1 (*strongly disagree*) to 4 (*strongly agree*).

Math homework completion. Students responded to one statement regarding homework completion, drawn from relevant studies (Cooper et al., 2006; Yang & Xu, 2018). It asked: "Some students often complete math homework on time, others rarely do. How much of your assigned math homework do you usually complete?" Ratings contained 1 (*none*), 2 (*some*), 3 (*about half*), 4 (*most*), and 5 (*all*). This item has been found to give valid information regarding homework completion. For instance, Xu (2017) found that, in line with theoretical predictions, it was positively related to homework expectancy, value, effort, and achievement.

Math achievement. Standardized math achievement was assessed nearly eight months following the administration of the measures (as discussed above). The assessment was aligned with national curriculum (Ni et al., 2011) to assess skills and knowledge (e.g., fraction, axial symmetry, linear function, parallelogram, parallelogram, quadratic radical, triangle, and data analysis). It consisted of short-answer and multiple-choice items, and students were allowed to 120 minutes to complete the test. The reliability estimate was $\alpha = .88$.

Parent education. Students were asked, "What is the highest level of education completed by your father/guardian?" and "What is the highest level of education completed by your mother/guardian?" Responses were coded: elementary school (6), middle school (9), high school (12), some college (14), college graduate (16), some graduate school (18), and graduate degree (19). As parent education for father and mother were highly related ($r = 0.76$, $p < 0.001$), a variable labeled "parent education" was developed by averaging father's education and mother's education.

Prior achievement. We obtained students' grades in math from teachers' school logs at the end of the previous year (grade 7) to measure prior math knowledge. The grades were based on a 5-point letter system, varying from F (fail) to A (excellent). Specifically, they were coded as F (1 point), D (2 points), C (3 points), B (4 points), and A (5 points).

Procedure

We sought and gained approval from families for children to participate in our present study. Several research assistants administered the measures during a typical class, and math teachers were requested to step out of the classroom during the administration. Taken together, the participation rate was close to 90% (88.7%).

Data Analyses

LPA was used to identify underlying latent subgroups of students within the dataset based on academic, self-regulatory, and approval-seeking purposes. All analyses were carried out with robust maximum likelihood estimator in Mplus 8.8, which corrects for non-normality in the measures (Muthén & Muthén, 1998-2012). Because 3018 participants were nested in 96 classes, a design-based correction of standard errors was carried out using analysis code the "type is complex" in *Mplus*.

Our decision for selecting the optimal number of profiles was based on a combination of fit indices, parsimony, latent profile separation, and interpretability (Flunger et al., 2015; Hickendorff et al., 2018; Nylund et al., 2007). These include Akaike information criterion (AIC), Bayesian information criterion (BIC), sample-adjusted Bayesian information criterion (SSA-BIC), Lo-Mendell-Rubin adjusted likelihood ratio test (LMRT), sample size for each profile, entropy value, and the interpretability of the solutions based on substantive theory or theoretical predication. In general, the solution with smaller AIC, BIC, and SSA-BIC indicates better relative fit. A significant LMRT test indicates that a K profile model fits significantly better in comparison with a K-1 profile model. Profiles that include less than 5% of the sample are viewed unsuitable and not feasible, reflecting excessive profiling extraction (Wolter et al., 2019). Entropy value (from 0 to 1) is used to determine the classification accuracy of the solution (> 0.80 reflecting high

separation among profiles; Ullrich-French & Cox, 2020). As the final step to investigate the appropriateness of the solution, we carried out three analyses of variance (ANOVAs) to examine whether there were statistically significant differences among the profiles on each of the measures included in the LPA (academic, self-regulatory, and approval-seeking purposes).

After identifying profiles as a function of three homework purposes, we tested the validity of the classification derived from the LPA, by examining differences across the profile memberships in three external measures of homework effort, completion, and achievement. Taking into account the relevance of socio-family factors as well as the previous performance of the students in school involvement and current and future performance of the students, the education of the parents and the previous performance of the students were included as covariates in this study. This was accomplished by employing the auxiliary variable option in Mplus (Asparouhov & Muthén, 2021). To interpret the effect sizes, we applied the following guidelines (Cohen, 1988), considering $\eta^2 = 0.01$ ($d = 0.20$), $\eta^2 = 0.059$ ($d = 0.50$), and $\eta^2 = 0.138$ ($d = 0.80$) as representing a small, medium, and large effect size.

Results

Table 1 presents descriptive statistics of all measures (i.e., means, standard deviations, skew, and kurtosis). Additionally, it includes Pearson correlations among all measures; all of them were found to be significantly, positively correlated.

Identification of Profiles

The fit of several latent profile models was examined (see Table 2), which was halted in five classes. First, according to the following indices (i.e., AIC, BIC, SSA-BIC, LMRT, and entropy), the four-profile solution yielded a better fit as compared with the two-profile solution and the three-profile solution. Although the four-profile model included one profile less than 5% of the cases (profile 3, $n = 119$, 3.94%), this profile presented rather distinctive information regarding three homework purposes (i.e., students in this profile had standardized scores on all three homework purposes well over one standard deviation below the mean; see Table 5 and Figure 1). Second, although the five-profile solution yielded somewhat better fit indices than the four-profile solution, it included two profiles less than 5% of the sample (profile 1, $n = 119$, 3.94%; $n = 119$; profile 4, 3.94%; see Table 2). In addition, the five-profile solution did not provide better entropy value (0.943) compared with the four-profile model (0.949). With respect to the

classification accuracy of the four-profile solution, as displayed in Table 2, the entropy for the solution was 0.949, thus reaching a level of entropy that is viewed as high (e.g., 0.800).

Furthermore, the findings of the ANOVAs indicated statistically significant differences between the four profiles in the three criterion variables: academic purpose (F [3, 3014] = 597.689; $p < .001$; $\eta^2 = .373$; $d = 1.54$); self-regulatory purpose (F [3, 3014] = 10990.678; $p < .001$; $\eta^2 = .916$; $d = 6.60$); and approval-seeking purpose (F [3, 3014] = 327.941; $p < .001$; $\eta^2 = .246$; $d = 1.14$). The effect size was very large across these three criterion variables (especially for self-regulatory purpose). The results of Scheffé post hoc tests indicated that all four profiles differed significantly from each other on each of the homework purposes, thereby providing further support for the distinctiveness of these homework purpose profiles.

Hence, taking into account the fit indices, sample size for each profile, and the interpretability, the findings of the ANOVAs examining the contribution of the three criterion variables that made up the profiles to the differentiation among profiles, the four-class model seemed to be the optimal solution for our present study.

Description of the Four Profiles

Table 3 displays the mean scores of participants belonging to the four latent profiles. Profile 1 contained 26.04% of the sample ($n = 786$) and was referred to Low Profile because of their low mean scores on each homework purpose ($z = -0.43$ to -0.98; see Figure 1). Profile 2 consisted of 13.39% of the sample ($n = 404$) and was referred to High Profile because of their high mean scores on each homework purpose, with standardized scores about one standard deviation above the means ($z = 0.96$ to 1.68; see Figure 1). Profile 3 included 3.94% of the sample ($n = 119$) and was referred to Very Low Profile because of their very low mean scores on each homework purpose ($z = -1.40$ to -2.49; see Figure 1). Profile 4 was made of a large group of students (56.63%; $n = 1702$) and was referred to Moderate Profile because their scores on each homework purpose were close to the means ($z = 0.03$ to 0.23; see Figure 1).

Profile Membership Relations to External Variables of Homework Effort, Completion, and Achievement

The equality of the means of external variables of homework effort, completion, and math achievement was examined across the four profiles. Table 4 includes the mean scores across latent profiles on homework effort, completion, and math achievement. Table 5 includes chi-square statistics for pairwise differences between latent profiles on homework effort, completion, and math achievement.

Table 1.
Descriptive Statistics and Pearson Correlations Among the Measures.

Variable	M	SD	Skewness	Kurtosis	1	2	3	4	5
1 Academic purpose	2.97	0.56	-0.48	1.34	----				
2 Self-regulatory purpose	2.79	0.67	-0.26	0.31	.60**	----			
3 Approval-seeking purpose	2.54	0.73	-0.05	-0.13	.49**	.52**	----		
4 Homework effort	3.19	0.60	-0.74	1.34	.27**	.22**	.14**	----	
5 Homework completion	3.97	0.95	-0.87	0.38	.26**	.21**	.13**	.22**	----
6 Math achievement	63.33	26.43	-0.81	-0.20	.25**	.14**	.07**	.24**	.21**

$N = 3018$. **$p < .01$.

Figure 1.
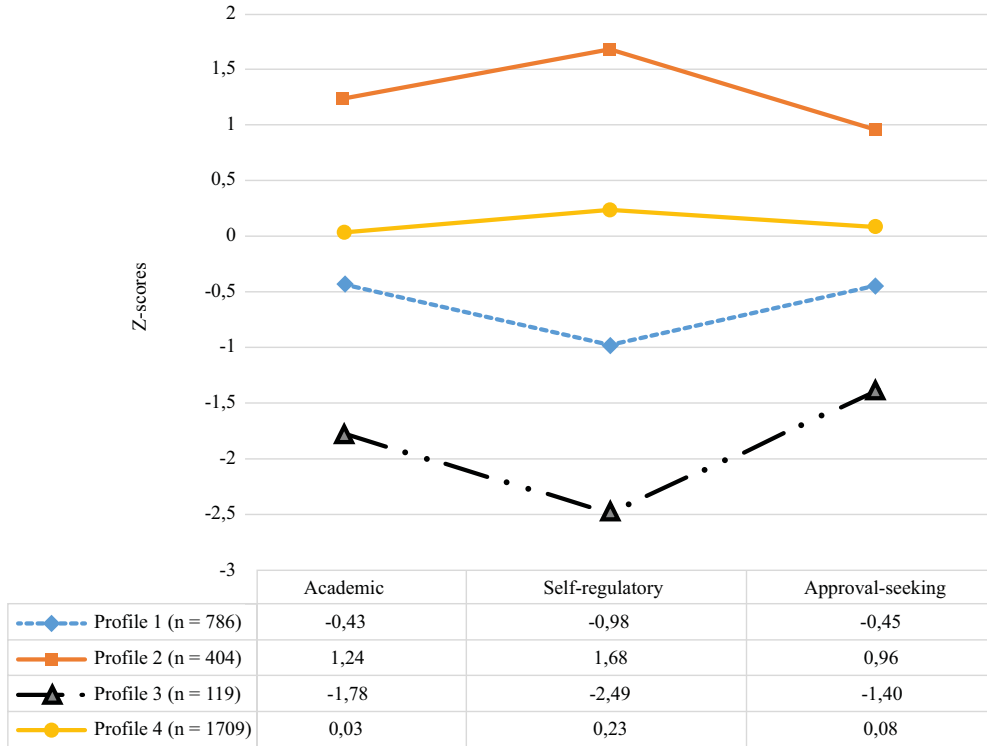*Latent profile analysis of homework purposes: Four-profile solution.*

	Academic	Self-regulatory	Approval-seeking
Profile 1 (n = 786)	-0,43	-0,98	-0,45
Profile 2 (n = 404)	1,24	1,68	0,96
Profile 3 (n = 119)	-1,78	-2,49	-1,40
Profile 4 (n = 1709)	0,03	0,23	0,08

Table 2.
Fit Indices for Identifying Latent Profiles (n = 3018).

	Profiles of Math Homework Purposes			
	2	**3**	**4**	**5**
AIC	16514.195	15280.857	14421.993	14151.994
BIC	16574.318	15365.030	14530.216	14284.266
SSA-BIC	16542.544	15320.547	14473.023	14214.363
Entropy	.832	.889	.949	.943
LMPT	1262.015***	1203.777***	840.635***	269.588***
n in each profile	P1 = 2611	P1 = 224	P1 = 786	P1 = 119
	P2 = 407	P2 = 370	P2 = 404	P2 = 786
		P3 = 2424	P3 = 119	P3 = 1702
			P4 = 1709	P4 = 119
				P5 = 292
Number of profiles with $n \leq 5\%$	0	0	1	2

Note: AIC = Akaike's Informational Criterion; BIC = Bayesian Information Criterion; SSA-BIC = Sample-Size Adjusted BIC; LMRT = Lo-Mendell-Rubin adjusted maximum likelihood ratio test. Tech14 option (Parametric bootstrapped likelihood ratio test; BLRT) is not available for the clustering option in Mplus (i.e., TYPE = MIXTURE COMPLEX).
***$p < .001$.

Taken together, results revealed that profile membership was significantly related to homework effort, completion, and math achievement, with small to medium effect size. Across homework time, completion, and math achievement, *High Profile* had significantly higher scores than *Moderate Profile*, which in turn had significant higher scores than *Low Profile*. Results further revealed that *Low Profile* had significant higher scores in homework effort

than *Very Low Profile*. Although the differences in homework completion and math achievement between *Low Profile* and *Very Low Profile* were not statistically significant, a clear trend was observed in that *Very Low Profile* had lower scores in both homework completion and math achievement than *Low Profile*.

Table 3.
Description of Latent Profiles.

			Confidence Intervals	
	M	**SE**	**Lower 5%**	**Higher 5%**
Profile 1: Low (n = 786)				
Academic	2.73	0.03	2.69	2.77
Self-regulatory	2.13	0.01	2.11	2.15
Approval-seeking	2.21	0.03	2.16	2.26
Profile 2: High (n = 404)				
Academic	3.66	0.03	3.61	3.71
Self-regulatory	3.91	0.01	3.89	3.93
Approval-seeking	3.23	0.06	3.14	3.33
Profile 3: Very Low (n = 119)				
Academic	1.98	0.10	1.81	2.15
Self-regulatory	1.12	0.02	1.08	1.16
Approval-seeking	1.53	0.07	1.41	1.64
Profile 4: Moderate (n = 1709)				
Academic	2.98	0.01	2.96	3.01
Self-regulatory	2.94	0.01	2.93	2.95
Approval-seeking	2.60	0.02	2.56	2.63

Table 4.
Mean Scores Across Latent Profiles on Homework Effort, Completion, and Math Achievement (n = 3018).

	Profile 1: Low (n = 786)	Profile 2: High (n = 404)	Profile 3: Very Low (n = 119)	Profile 4: Moderate (n = 1709)	Overall chi-square test value (df = 3)	Effect size (d)
	M (SE)	M (SE)	M (SE)	M (SE)		
Homework effort	3.09b (0.02)	3.45d (0.03)	2.86a (0.08)	3.21c (0.01)	102.592***	0.38
Homework completion	3.75a (0.04)	4.36c (0.04)	3.57a (0.12)	4.01b (0.02)	92.976***	0.36
Math achievement	59.02a (1.02)	71.59c (1.10)	54.14a (2.84)	63.99b (0.64)	64.909***	0.30

Means with the same superscript in a row are not statistically different at α = .05.
***$p < .001$

Table 5.
Chi-Square Test Statistics for Pairwise Differences Between Latent Profiles.

	Profile Comparison	Chi-Square Test Statistic (p-value)
Homework effort	1 (Low) vs. 2 (High)	110.211, (< .001)
	1 (Low) vs. 3 (Very Low)	7.917, (= .005)
	1(Low) vs. 4 (Moderate)	21.430, (< .001)
	2 (High) vs. 3 (Very Low)	52.035, (< .001)
	2 (High) vs. 4 (Moderate)	66.791, (< .001)
	3 (Very Low) vs. 4 (Moderate)	19.551, (< .001)
Homework completion	1 (Low) vs. 2 (High)	112.525, (< .001)
	1 (Low) vs. 3 (Very Low)	1.999, (= 157)
	1(Low) vs. 4 (Moderate)	35.874, (< .001)
	2 (High) vs. 3 (Very Low)	36.773, (< .001)
	2 (High) vs. 4 (Moderate)	49.154, (< .001)
	3 (Very Low) vs. 4 (Moderate)	12.646, (< .001)
Math achievement	1 (Low) vs. 2 (High)	70.496, (< .001)
	1 (Low) vs. 3 (Very Low)	2.593, (= .107)
	1(Low) vs. 4 (Moderate)	16.775, (< .001)
	2 (High) vs. 3 (Very Low)	32.954, (< .001)
	2 (High) vs. 4 (Moderate)	35.126, (< .001)
	3 (Very Low) vs. 4 (Moderate)	11.470, (= .001)

Discussion

Our investigation extends prior research on homework purpose by adopting a person-centered approach to identify the possible combinations of math homework purposes and to examine diffe-rences among the empirically derived combinations or profiles. First, the results from PLA confirm the hypotheses formulated based on the data of Xu (2023). Specifically, also four profiles of students were identified: *High Profile* (high in all purposes; 13.39%), *Moderate Profile* (moderate in all purposes; 56.63%), *Low Profile* (low in all purposes; 26.04%), and *Very Low Profile* (very low in a ll purposes; 3.94%). These four homework purpose profiles are similar to those obtained in Xu (2023), both in the combination of purposes and in the percentage of students in each profile. In short, the profiles are very similar.

Second, consistent with theoretical expectation and related prior research using a variable-centered approach (Epstein & Van Voorhis, 2012; Sun et al., 2020a, 2020b; Wigfield et al., 2015;

Xu, 2005), we found that the profile of students with a high level of homework purposes (i.e., our *High Profile learners*) were those who expended most homework effort, completed most homework, and scored highest on math achievement. In contrast, the profile of students with a low level of homework purposes (i.e., our *Low Profile* and *Very Low Profile learners*) were those who expended least homework effort, completed least homework, and scored lowest on math achievement.

Third, whereas the above findings were consistent with a previous study applying a person-centered approach with high school students (Xu, 2023), the current study extended these findings to middle school students. These findings are particularly noteworthy given that we controlled two important background variables – parent education and prior math knowledge – in our current study, neither variable was controlled in the previous study (Xu, 2023).

Our findings regarding these four profiles and their associations with homework effort, completion, and student achievement suggests that (a) homework purposes perceived by students matter in the homework process, and (b) students with a low or high level of one homework purpose (e.g., academic) are likely to be associating with a low or high level of other homework purposes (e.g., self-regulatory and approval-seeking). Applying a person-centered approach offers a deeper understanding of how these three homework purposes coexist within children, moving beyond stating that these purposes are positively correlated. The homework purpose profiles could help researchers, educators, and parents consider the impact of academic, self-regulatory, and approval-seeking purposes in the homework process.

Hence, it would be beneficial to simultaneously attend to all three purposes (academic, self-regulatory, and approval-seeking). In addition to Warton's proposition (2001) that "if students are to be convinced of the value of homework and invest their time and effort in it, then teachers and parents will need to be aware of the types of work most likely to lead to academic improvement" (p. 157), teachers and families will need to be mindful of the types of homework feedback and support most likely to result in both academic improvement and the development of self-regulatory habits and skills. Such attention is especially important for middle school students relating to their math homework, as student attitude toward homework plays a more and more important role in homework completion and academic achievement (Cooper et al., 1998; Xu, 2022). Yet, as children make transition from elementary to secondary school, math value beliefs tends to decrease (Jacobs et al., 2002; Regueiro et al., 2017; Wigfield et al., 2015) and their attitude toward homework becomes more negative (Xu, 2004).

In particular, our results that students have different homework purpose profiles imply that teacher and parent support ought to be differentiated. Students in High Profile may need less external support, yet encouraging them to articulate and share their homework purposes (e.g., what homework means to them) may benefit students in this profile as well as students in other profiles. For remaining learners (with students in *Low Profile* and *Very Low Profile* in particular), it would be helpful for teachers to carefully selecting and assigning high-quality (e.g., to show students the importance and relevance of homework to understand the material covered in class), to make homework assignments more interesting for students (e.g., activity and content interest, Corno & Xu, 2004), and to provide high-quality homework feedback (e.g., useful and positive feedback

according to the needs of students in these profiles). It would also be helpful to provide professional development opportunities for teachers, as teacher education programs tend to focus on the quality of classroom instruction (e.g., planning, implementing, and assessing), but not on the quality of homework practice (e.g., regarding homework quality, the quality of homework feedback, and autonomy support; Rosário et al., 2018; Xu, 2016).

Like the vast majority of educational research, this research is not exempt from some limitations. Although the results of this study with eighth-grade students coincide with those also obtained by Xu (2023), with eleventh-grade students, it would be beneficial to pursue this line of research involving elementary school students and in other achievement domains, as there are developmental differences in task value perceived by students across different domains (e.g., language arts and sports; Jacobs et al., 2002). Likewise, the results of our study are likely to be generalizable to other collectivist cultures for the following reason. Academic and self-regulatory purposes represent self-focused motive, whereas approval-seeking purpose reflects other-focused motive (Cooper et al., 2016; Sun et al., 2021; Xu, 2023). The findings regarding non-overlapping profiles of these homework purposes from the present study and the previous study (Xu, 2023) suggest that academic and self-regulatory purposes might have become more other-focused (or less self-focused) in collectivist cultures such as China, where self is frequently defined as its roles for the good of the community and the family (Chen et al., 2006), and where interdependence is more highly valued than independence (Hofstede, 2003). Nevertheless, it would be beneficial to continue this line of research in cross-cultural settings, as homework purposes perceived by children are likely to be influenced by cultural norms and expectations (e.g., concerning the value of homework, effort, hard work, and conformity; Cai, 2003; Sun et al., 2020a). Finally, it would be beneficial to conduct qualitative studies (e.g., involving purposive samples of children from Very Low Profile, Low Profile, Moderate Profile, and High Profile), for example, using focus group methodology (e.g., Rosário et al., 2019a, 2019b), to better understand the combination of homework purposes from the student viewpoint in each profile, and consequently what new insights may be gained from this line of research to promote the value of homework for children.

References

Asparouhov, T., & Muthén, B. (2021). *Auxiliary variables in mixture modeling: Using the BCH method in Mplus to estimate a distal outcome model and an arbitrary secondary model.* https://www.statmodel.com/examples/webnotes/webnote21.pdf

Bempechat, J. (2004). The motivational benefits of homework: A social-cognitive perspective. *Theory into Practice, 43*, 189-196. https://doi.org/10.1207/s15430421tip4303_4

Cai, J. (2003). Investigating parental roles in students' learning of mathematics from a cross-national perspective. *Mathematics Education Research Journal, 15*, 87-106. https://doi.org/10.1007/BF03217372

Chen, H., Jackson, T., & Huang, X. (2006). The negative physical self-scale: Initial development and validation in samples of Chinese adolescents and young adults. *Body Image, 3*(4), 401–412. https://doi.org/10.1016/j.bodyim.2006.07.005

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences.* Lawrence Erlbaum.

Cooper, H. (1989). *Homework.* Longman.

Cooper, H., Lindsay, J. J., Nye, B., & Greathouse, S. (1998). Relationships among attitudes about homework, amount of homework assigned and completed, and student achievement. *Journal of Educational Psychology, 90*, 70-83. https://doi.org/10.1037/0022-0663.90.1.70

Cooper, M. L., Kuntsche, E., Levitt, A., Barber, L., & Wolf, S. (2016). A motivational perspective on substance use: Review of theory and research. In K. J. Sher (Ed.), *Oxford handbook of substance use disorders* (pp. 375–421). Oxford University Press.

Cooper, H., Robinson, J. C., & Patall, E. A. (2006). Does homework improve academic achievement? A synthesis of research, 1987-2003. *Review of Educational Research, 76*, 1-62. https://doi.org/10.3102/00346543076001001

Corno, L. (2011). Studying self-regulation habits. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 361-375). Routledge.

Corno, L., & Xu, J. (2004). Doing homework as the job of childhood. *Theory into Practice, 43*, 227-233. https://doi.org/10.1207/s15430421tip4303_9

Dettmers, S., Trautwein, U., Ludtke, O., Goetz, T., Frenzel, A. C., & Pekrun, R. (2011). Students' emotions during homework in mathematics: Testing a theoretical model of antecedents and achievement outcomes. *Contemporary Educational Psychology, 36*, 25-35. https://doi.org/10.1016/j.cedpsych.2010.10.001

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology, 53*, 109-132. https://doi.org/10.1146/annurev.psych.53.100901.135153

Epstein, J., & Van Voorhis, F. (2012). The changing debate: From assigning homework to designing homework. In S. Suggate & E. Reese (Eds.), *Contemporary debates in child development and education* (pp. 263-273). Routledge.

Fan, H., Xu, J., Cai, Z., He, J., & Fan, X. (2017). Homework and students' achievement in math and science: A 30-year meta-analysis, 1986-2015. *Educational Research Review, 20*, 35-54. https://doi.org/10.1016/j.edurev.2016.11.003

Fernández-Alonso, R., Álvarez-Díaz, M., García-Crespo, F. J., Woitchach, P., & Muñiz, J. (2022). Should we help our children with homework? A meta-analysis using PISA data. *Psicothema, 34*, 56-65. https://doi.org/10.7334/psicothema2021.65

Fernández-Alonso, R., Suárez-Álvarez, J., & Muñiz, J. (2015). Adolescents' homework performance in mathematics and science: Personal factors and teaching practices. *Journal of Educational Psychology, 107*, 1075-1085. https://doi.org/10.1037/edu0000032

Flunger, B., Trautwein, U., Nagengast, B., Lüdtke, O., Niggli, A., & Schnyder, I. (2015). The Janus-faced nature of time spent on homework: Using latent profile analyses to predict academic achievement over a school year. *Learning and Instruction, 39*, 97-106. https://doi.org/10.1016/j.learninstruc.2015.05.008

Flunger, B., Trautwein, U., Nagengast, B., Lüdtke, O., Niggli, A., & Schnyder, I. (2017). A person-centered approach to homework behavior: Students' characteristics predict their homework learning type. *Contemporary Educational Psychology, 48*, 1-15. https://doi.org/10.1016/j.cedpsych.2016.07.002

Gill, B. P., & Schlossman, S. L. (2004). Villain or savior? The American discourse on homework, 1850-2003. *Theory into Practice, 43*, 174-181. https://doi.org/10.1207/s15430421tip4303_2

Hickendorff, M., Edelsbrunner, P. A., McMullen, J., Schneider, M., & Trezise, K. (2018). Informative tools for characterizing individual differences in learning: Latent class, latent profile, and latent transition analysis. *Learning and Individual Differences, 66*, 4-15. https://doi.org/10.1016/j.lindif.2017.11.001

Hofstede, G. (2003). *Cultures and organizations: Software of the mind.* Profile Books.

Jacobs, J. E., Lanza, S., Osgood, D. W., Eccles, J. S., & Wigfield, A. (2002). Changes in children's self-competence and values: Gender and domain differences across grades one through twelve. *Child Development, 73*, 509-527. https://doi.org/10.1111/1467-8624.00421

Montero, I., de Dios, M. J., & Huertas, J. A. (2001). El desarrollo de la motivación en el contexto escolar: un estudio a través del habla privada [The development of motivation in the school context: a study through private speech]. *Estudios de Psicología, 22*(3), 305-318, https://doi.org/10.1174/021093901753581367

Muthén, L. K., & Muthén, B. O. (1998-2012). *Mplus user's guide* (7th ed.). Muthén & Muthén.

Ni, Y., Li, Q., Li, X., & Zhang, Z. H. (2011). Influence of curriculum reform: An analysis of student mathematics achievement in Mainland China. *International Journal of Educational Research, 50*, 100-116. https://doi.org/10.1016/j.ijer.2011.06.005

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling, 14*, 535-569. https://dx.doi.org/10.1080/10705510701575396

Regueiro, B., Valle, A., Núñez, J. C., Rosário, R., Rodríguez, S., & Suárez, N. (2017). Changes in involvement in homework throughout compulsory secondary education. *Cultura y Educación, 29*(2), 254-278. https://doi.org/10.1080/11356405.2017.1306988

Rodríguez, S., Núñez, J. C., Valle, A., Freire, C., Ferradás, M. D. M., & Rodríguez-Llorente, C. (2019). Relationship between students' prior academic achievement and homework behavioral engagement: The mediating/moderating role of learning motivation. *Frontiers in Psychology, 10*, Article 1047. https://doi.org/10.3389/fpsyg.2019.01047

Rodríguez, S., Piñeiro, I., Regueiro, B., & Estévez, I. (2020). Intrinsic motivation and perceived utility as predictors of student homework engagement. *Revista de Psicodidáctica, 25*, 93-99. https://doi.org/10.1016/j.psicod.2019.11.001

Rosário, P., Cunha, J., Nunes, A. R., Moreira, T., Núñez, J. C., & Xu, J. (2019a). "Did you do your homework?" Mathematics teachers' homework follow-up practices at middle school level. *Psychology in the Schools, 56*, 92-108. https://doi.org/10.1002/pits.22198

Rosário, P., Cunha, J., Nunes, T., Nunes, A. R., Moreira, T., & Núñez, J. C. (2019b). Homework should be…but we do not live in an ideal world": Mathematics teachers' perspectives on quality homework and on homework assigned in elementary and middle schools. *Frontiers in Psychology, 10*, Article 224. https://doi.org/10.3389/fpsyg.2019.00224

Rosário, P., Núñez, J. C., Vallejo, G., Nunes, T., Cunha, J., Fuentes, S., & Valle, A. (2018). Homework purposes, homework behaviors, and academic achievement. Examining the mediating role of students' perceived homework quality. *Contemporary Educational Psychology, 53*, 168-180. https://doi.org/10.1016/j.cedpsych.2018.04.001

Suárez, N., Fernández, E., Regueiro, B., Rosário, P., Xu, J., & Núñez, J. C. (2022). Parental involvement in homework during Covid-19 confinement. *Psicothema, 34*, 421-428. https://doi.org/10.7334/psicothema2021.532

Sun, M., Du, J., & Xu, J. (2020a). Math Homework Purpose Scale for preadolescents: A psychometric evaluation. *Current Psychology, 39*, 1740-1748. https://doi.org/10.1007/s12144-018-9870-2

Sun, M., Du, J., & Xu, J. (2020b). Math Homework Purpose Scale: Measurement invariance and latent mean differences across gender. *Swiss Journal of Psychology, 79*, 47-54. https://doi.org/10.1024/1421-0185/a000234

Sun, M., Du, J., & Xu, J. (2021). Are homework purposes and student achievement reciprocally related? A longitudinal study. *Current Psychology, 40*(10), 4945-4956. https://doi.org/10.1007/s12144-019-00447-y

Ullrich-French, S., & Cox, A. E. (2020). The use of latent profiles to explore the multi-dimensionality of self-compassion. *Mindfulness, 11*, 1483-1499. https://doi.org/10.1007/s12671-020-01365-y

Van Voorhis, F. L. (2004). Reflecting on the homework ritual: Assignments and designs. *Theory into Practice, 43*, 205-212. https://doi.org/10.1207/s15430421tip4303_6

Warton, P. M. (2001). The forgotten voices in homework: Views of students. *Educational Psychologist, 36*, 155-165. https://doi.org/10.1207/S15326985EP3603_2

Wigfield, A., Eccles, J. S., Fredricks, J. A., Simpkins, S., Roeser, R. W., & Schiefele, U. (2015). Development of achievement motivation and engagement. In M. E. Lamb & R. M. Lerner (Eds.), *Handbook of child psychology and developmental science, Vol. 3. Socioemotional processes* (7th ed., pp. 657-700). Wiley.

Wolter, I., Ehrtmann, L., Seidel, T., & Drechsel, B. (2019). Social or economic goals? The professional orientation of students enrolled in STEM and non-STEM majors in university. *Frontiers in Psychology, 10*, Article 2065. https://doi.org/10.3389/fpsyg.2019.02065

Xu, J. (2004). Family help and homework management in urban and rural secondary schools. *Teachers College Record, 106*, 1786-1803. https://doi.org/10.1111/j.1467-9620.2004.00405.x

Xu, J. (2005). Purposes for doing homework reported by middle and high school students. *Journal of Educational Research, 99*, 46-55. https://doi.org/10.3200/JOER.99.1.46-55

Xu, J. (2016). A study of the validity and reliability of the Teacher Homework Involvement Scale: A psychometric evaluation. *Measurement, 93*, 102-107. https://doi.org/10.1016/j.measurement.2016.07.012

Xu, J. (2017). Homework Expectancy Value Scale for high school students: Measurement invariance and latent mean differences across gender and grade level. *Learning and Individual Differences, 60*, 10-17. https://doi.org/10.1016/j.lindif.2017.10.003

Xu, J. (2020). Longitudinal effects of homework expectancy, value, effort, and achievement: An empirical investigation. *International Journal of Educational Research, 99*, 101507. https://doi.org/10.1016/j.ijer.2019.101507

Xu, J. (2023). Empirically derived profiles of homework purposes in eleventh grade students: A latent profile analysis. *Current Psychology*. https://doi.org/10.1007/s12144-021-01987-y

Xu, J. (2022). Investigating factors that influence math homework purposes: A multilevel analysis. *Journal of Experimental Education, 90*(4), 862-883. https://doi.org/10.1080/00220973.2020.1810604

Xu, J., & Corno, L. (1998). Case studies of families doing third-grade homework. *Teachers College Record, 100*, 402-436.

Xu, J., & Corno, L. (2022). Extending a model of homework: a multilevel analysis with Chinese middle school students. *Metacognition and Learning, 17*(2), 531-563. https://doi.org/10.1007/s11409-022-09296-w

Xu, J., Du, J., Wu, S., Ripple, H., & Cosgriff, A. (2018). Reciprocal effects among parental homework support, effort, and achievement? An empirical investigation. *Frontiers in Psychology, 9*, Article 2334. https://doi.org/10.3389/fpsyg.2018.02334

Xu, J., Fan, X, Du, J., & He, M. (2017). A study of the validity and reliability of the Parental Homework Support Scale. *Measurement, 95*, 93-98. https://doi.org/10.1016/j.measurement.2016.09.045

Xu, J., & Yuan, R. (2003). Doing homework: Listening to students', parents', and teachers' voices in one urban middle school community. *School Community Journal, 13*(2), 25-44.

Yang, F., & Xu, J. (2018). Homework expectancy value scale: Measurement invariance and latent mean differences across gender. *Journal of Psychoeducational Assessment, 36*, 863-868. https://doi.org/10.1177/0734282917714905