Chapter 4
Cluster Analysis Results for TIMSS 2015 Mathematics Motivation by Grade and Jurisdiction

Abstract A person-centered approach can be used to identify the motivational profiles of grade four and grade eight students participating in successive cycles of IEA's Trends in International Mathematics and Science Study (TIMSS); such analyses may be a powerful route to developing a better understanding of student motivation patterns and their interaction with achievement and other background variables. This chapter presents results for TIMSS 2015, which provided the most comprehensive motivational data for measuring students' enjoyment of, confidence in, and value for mathematics. A two-step cluster approach was applied in each of the 12 jurisdictions, and at both grades, illustrating in detail the techniques applied to all three TIMSS administrations. Visual inspection of variable distributions by cluster, and descriptive and inferential statistics across diverse samples highlight some cross-culturally robust patterns. Consistent with variable-centered findings, clusters that had consistently high scores for all motivational variables outperformed those with consistently low motivation scores on the TIMSS mathematics achievement test. However, clusters with inconsistent motivational profiles tended to have higher mean mathematics score when students' confidence in their ability to do mathematics was strong.

Keywords Cluster differences · Consistent profiles · Inconsistent profiles · Motivation clusters · Person-centered approach

4.1 Introducing the Person-Centered Approach

We used a person-centered approach to study the motivational profiles of the grade four and grade eight students participating in TIMSS. Our two-step cluster analysis used the variables enjoyment of, confidence in, and value for mathematics (this last variable was available only for grade eight). As an exploratory procedure, various solutions with between three and six clusters (between three and five for grade four) were examined for each sample. Chapter 3 reviews the judgement criteria for deciding the number of extracted clusters. We repeated the analysis for all 12 jurisdictions, for both grades, for the TIMSS 1995, 2007, and 2015 administrations.

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In this chapter, we present results by jurisdiction for the TIMSS 2015 grade four and grade eight samples in alphabetical order by country. In TIMSS 2015, motivation scales contained more items than earlier administrations (see Chap. 3). Scale scores were derived after advanced latent variable methodology was completed for the 2015 motivation variables and for the home resources measure (latent variable scores had been unavailable in previous administrations). In the TIMSS 2007 and 1995 cycles, simpler procedures were used for scoring: averages of items were estimated to generate the motivation variables, and single items were used as proxies for socioeconomic background. The distributions of motivation variables by cluster and jurisdiction, and descriptive statistics with statistical tests by cluster and jurisdiction for the TIMSS 1995 and 2007 administrations are provided in Appendices B and C. We present summaries of the cluster analysis results for all administrations and grades, along with trend comparisons, in Chap. 5.

4.2 Cluster Analysis Results for the TIMSS 2015 Administration at Grade Four by Jurisdiction

Grade four students responded to two motivation scales in the TIMSS 2015 administration: (1) confidence, and (2) enjoyment in mathematics. Scores on the two scales were cluster analyzed, and solutions of three to five clusters were examined in each sample. Based on the criteria presented in Chap. 3, a solution was chosen.

We here present a detailed description of the clusters that were produced in relation to the grade four TIMSS 2015 mathematics results for each country. Boxplots depict the distribution of scores for the two motivational variables within each cluster, and the width of each boxplot represents the size of the cluster. Descriptive statistics by cluster are presented for cluster size, mean achievement, gender composition, and mean home resources for learning. In all tables presented in this chapter (and Appendix C), the procedure "Percentages and Means" in the IEA IDB Analyzer was used to obtain weighted means by cluster for PVs and for home resources (using student weight).

4.2.1 Australia

Four clusters were identified in the Australian sample (Fig. 4.1). A small cluster of students (cluster 1) responded very strongly on confidence and strongly on enjoyment; the second cluster had high enjoyment ratings, while the remaining clusters had consistently moderate or low distributions of enjoyment and confidence. Mean achievement differed significantly across most groups, with the highest performance appearing in the cluster with the highest confidence scores (Table 4.1). Performance was lower in clusters with lower motivation scores. There were fewer girls in the more motivated and better performing clusters. Although relatively high

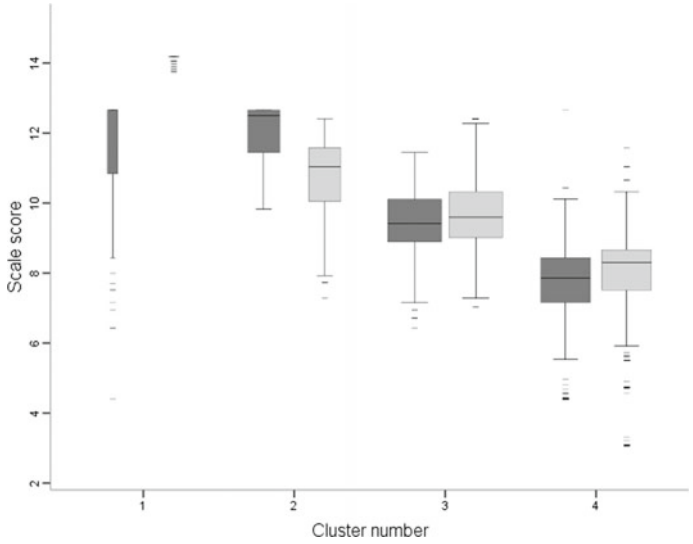

Fig. 4.1 Distributions of motivation variables by cluster for Australia, TIMSS 2015 grade 4
Notes Dark gray = enjoyment, light gray = confidence. Box width represents relative cluster size

Table 4.1 Descriptive statistics by cluster for Australia, TIMSS 2015 grade 4

Cluster characteristics	Cluster number			
	1	2	3	4
Size (%)	7.0	21.9	36.9	34.1
Mean plausible value	581.0[a]	536.1[b]	524.3[b]	485.8[c]
Female students in cluster (%)*	32.1	42.3	48.8	56.8
Mean home resources for learning scale score	12.0[a]	11.4[a,b]	11.5[a,b]	11.3[b]

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$
*Chi-square test of independence of gender × cluster was significant ($\chi^2(3) = 121.109$, $p < 0.001$)

for all Australian clusters, fewer home resources for learning were found in the lower motivation groups; differences were not always statistically significant among groups.

4.2.2 Canada-Ontario

Cluster analysis resulted in five clusters for Ontario (Fig. 4.2). The smallest cluster (cluster 5) had very high confidence and high enjoyment distributions, and had the highest mean achievement. Comparison of clusters 3 and 4, which both had moderate

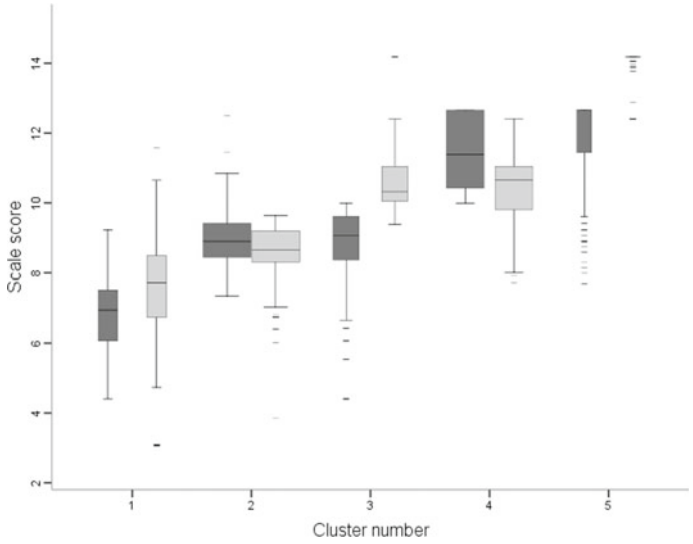

Fig. 4.2 Distributions of motivation variables by cluster for Ontario, TIMSS 2015 grade 4
Notes Dark gray = enjoyment, light gray = confidence. Box width represents relative cluster size

confidence endorsements, revealed that achievement was higher for cluster 3, even though enjoyment was markedly lower compared to cluster 4. Students in cluster 2 reported similar levels of enjoyment to those in cluster 3, but had lower confidence scores, and significantly lower achievement scores. There were more boys in the more motivated clusters, while the level of home resources for learning was significantly lower in the lower performing clusters (Table 4.2).

Table 4.2 Descriptive statistics by cluster for Ontario, TIMSS 2015 grade 4

Cluster characteristics	Cluster number				
	1	2	3	4	5
Size (%)	13.3	32.9	17.7	25.9	10.2
Mean plausible value	479.9^{a}	485.5^{a}	542.5^{b}	525.8^{c}	564.8^{d}
Female students in cluster (%)*	52.9	53.7	46.0	43.8	40.2
Mean home resources for learning scale score	$11.1^{a,b}$	11.0^{a}	$11.5^{c,d}$	$11.3^{b,c}$	11.6^{c}

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$
*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 45.268$, $p < 0.001$)

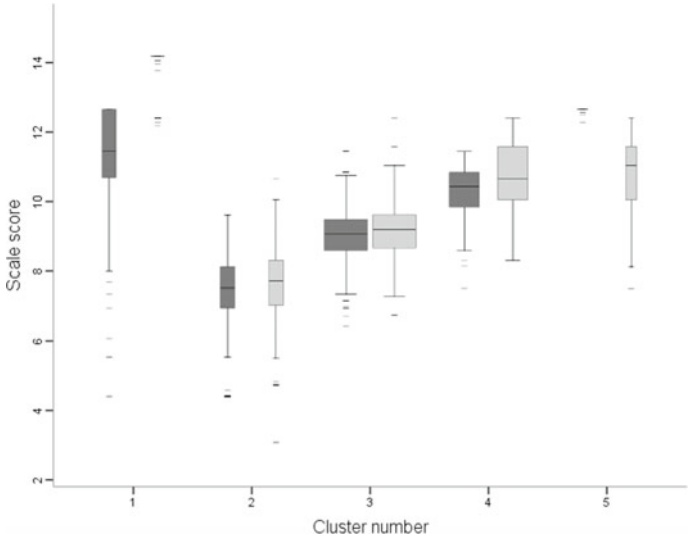

Fig. 4.3 Distributions of motivation variables by cluster for Quebec, TIMSS 2015 grade 4
Notes Dark gray = enjoyment, light gray = confidence. Box width represents relative cluster size

Table 4.3 Descriptive statistics by cluster for Quebec, TIMSS 2015 grade 4

Cluster characteristics	Cluster number				
	1	2	3	4	5
Size (% of total number of students)	12.3	12.7	38.5	26.7	9.8
Mean plausible value	577.5^{a}	498.0^{c}	520.8^{d}	552.4^{b}	544.2^{b}
Female students in cluster (%)*	36.6	63.6	55.9	45.4	38.4
Mean home resources for learning scale score	$11.3^{a,b}$	$10.8^{a,b}$	10.9^{b}	11.2^{a}	$11.0^{a,b}$

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$
*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 84.995$, $p < 0.001$)

4.2.3 Canada-Quebec

Five clusters were extracted from the Quebec sample (Fig. 4.3). Cluster 1 had very high confidence and high enjoyment score distributions, and had the highest mean achievement score. Clusters 4 and 5 had similar confidence score distributions and mean achievement did not differ significantly, despite the difference in enjoyment of mathematics between these two clusters. Clusters 2 and 3 had lower motivation distributions and lower achievement scores. Boys were overrepresented in the three higher motivation clusters, and girls overrepresented in the lower motivation clusters

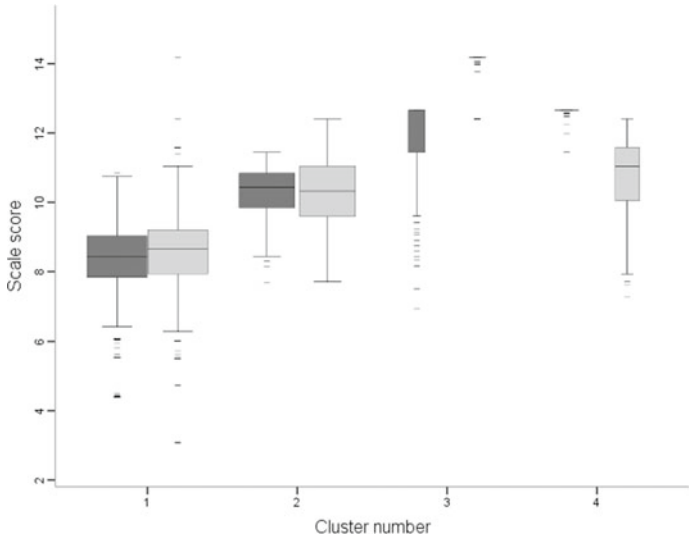

Fig. 4.4 Distributions of motivation variables by cluster for England, TIMSS 2015 grade 4
Notes Dark gray = enjoyment, light gray = confidence. Box width represents relative cluster size

(Table 4.3). Differences in levels of home resources for learning were small and not always statistically significant.

4.2.4 England

Of the four clusters found in the English sample, the smallest in size (cluster 3) had very high endorsements of confidence and high scores on enjoyment; it was also the cluster with the highest mean achievement (Fig. 4.4). Comparing clusters 2 and 4, which had similar distributions on confidence, cluster 2 had lower endorsements of enjoyment, and higher (but not significantly) mean achievement score. There were more boys in the high motivation groups and more girls in the lower performing groups (Table 4.4). The variable home resources for learning was not available for the English sample.

4.2.5 Hong Kong

Five clusters were identified in Hong Kong (Fig. 4.5). Confidence and enjoyment distributions were fairly consistent within most clusters, except in cluster 1, which was the best for mean achievement, and cluster 3, which had high endorsement for enjoyment. Mean achievement was positively associated with confidence scores at the

Table 4.4 Descriptive statistics by cluster for England, TIMSS 2015 grade 4

Cluster characteristics	Cluster number			
	1	2	3	4
Size (% of total number of students)	38.4	35.5	10.7	15.5
Mean plausible value	524.1[a]	560.5[b]	582.1[c]	544.3[b]
Female students in cluster (%)*	58.3	51.5	34.0	42.2

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$
*Chi-square test of independence of gender × cluster was significant ($\chi^2(3) = 97.897$, $p < 0.001$)

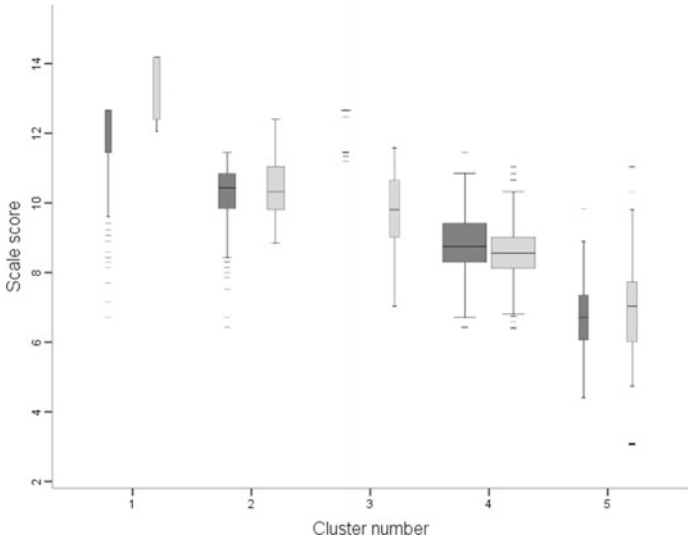

Fig. 4.5 Distributions of motivation variables by cluster for Hong Kong, TIMSS 2015 grade 4
Notes Dark gray = enjoyment, light gray = confidence. Box width represents relative cluster size

cluster level. Cluster 4 comprised half of the sample, and it was balanced with respect to gender (Table 4.5). The three higher motivation clusters were predominantly male, while cluster 5 contained more girls than boys. The levels of home resources for learning were slightly higher in the higher motivation groups, but differences were small.

Table 4.5 Descriptive statistics by cluster for Hong Kong, TIMSS 2015 grade 4

Cluster characteristics	Cluster number				
	1	2	3	4	5
Size (% of total number of students)	7.6	20.0	11.2	50.4	11.0
Mean plausible value	665.8^{a}	646.3^{a}	619.1^{b}	600.9^{c}	581.6^{d}
Female students in cluster (%)*	25.9	37.0	31.3	51.3	58.2
Mean home resources for learning scale score	10.9^{a}	$10.5^{a,b}$	$10.2^{b,c}$	10.1^{c}	$10.3^{a,b,c}$

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$

*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 144.738$, $p < 0.001$)

4.2.6 Hungary

Five clusters were extracted from the Hungarian sample (Fig. 4.6). When the motivation variable distributions were high, mean achievement was also high. Clusters 2 and 4 had similar confidence scores, but mean achievement was higher in cluster 2, despite enjoyment scores being lower than in cluster 4. There were more boys than girls in the high motivation and high achievement clusters (Table 4.6). Significant differences were identified for the home resources for learning variable, with higher levels for this variable being associated with the higher achieving clusters.

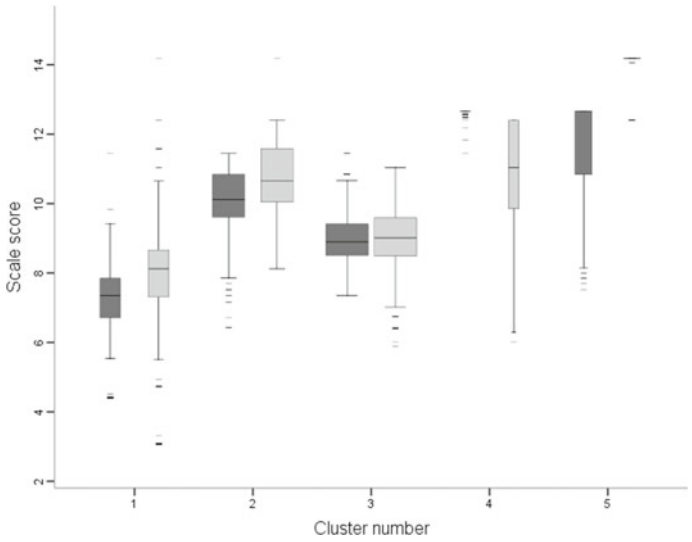

Fig. 4.6 Distributions of motivation variables by cluster for Hungary, TIMSS 2015 grade 4
Notes Dark gray = enjoyment, light gray = confidence. Box width represents relative cluster size

Table 4.6 Descriptive statistics by cluster for Hungary, TIMSS 2015 grade 4

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	16.6	26.3	34.7	8.6	13.8
Mean plausible value	486.7[a]	557.0[b]	505.5[c]	533.4[d]	590.4[e]
Female students in cluster (%)*	55.7	47.8	54.5	41.8	39.2
Mean home resources for learning scale score	10.3[a,b]	10.6[b]	10.1[a]	10.0[a]	11.0[c]

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$

*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 71.670$, $p < 0.001$)

4.2.7 Iran

Of the five clusters extracted from the Iranian sample, cluster 5 had high scores on the two motivation variables and high mean achievement (Fig. 4.7). Clusters 3 and 4 had similar distributions for confidence and similar mean achievement, despite different levels of enjoyment for mathematics. The same was true for clusters 1 and 2, which contained students who had lower levels of motivation and achievement. Gender composition was not significantly different across clusters in the Iranian

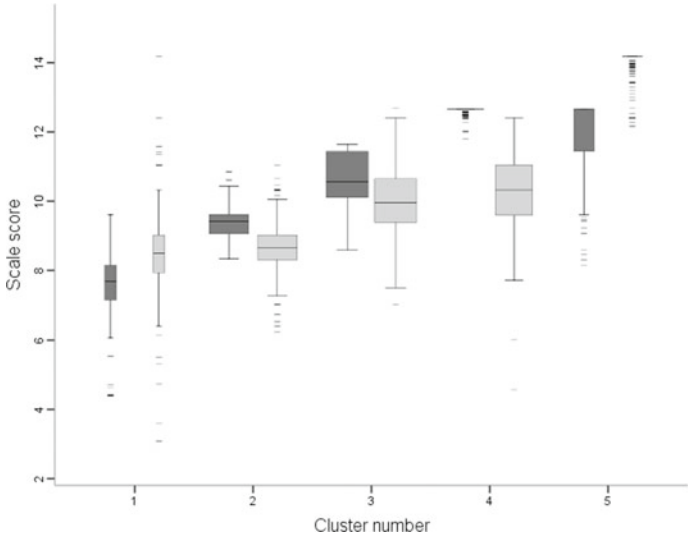

Fig. 4.7 Distributions of motivation variables by cluster for Iran, TIMSS 2015 grade 4
Notes Dark gray = enjoyment, light gray = confidence. Box width represents relative cluster size

Table 4.7 Descriptive statistics by cluster for Iran, TIMSS 2015 grade 4

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	7.5	26.4	28.1	24.5	13.5
Mean plausible value	$398.6^{a,b}$	386.1^{a}	$435.4^{b,c}$	$440.8^{c,d}$	463.2^{d}
Female students in cluster (%)*	44.3	49.5	48.1	49.2	52.4
Mean home resources for learning scale score	8.7^{a}	8.1^{b}	$8.3^{a,b}$	$8.3^{a,b}$	$8.5^{a,b}$

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$

*Chi-square test of independence of gender × cluster was not significant ($\chi^2(4) = 5.239$, $p = 0.264$)

sample (Table 4.7). Differences in the home resources for learning variables were small across the clusters.

4.2.8 Japan

A consistent pattern of motivation score distributions was found across the four Japanese clusters (Fig. 4.8). Clusters with students who reported higher confidence and enjoyment of mathematics had significantly higher mean achievement, more

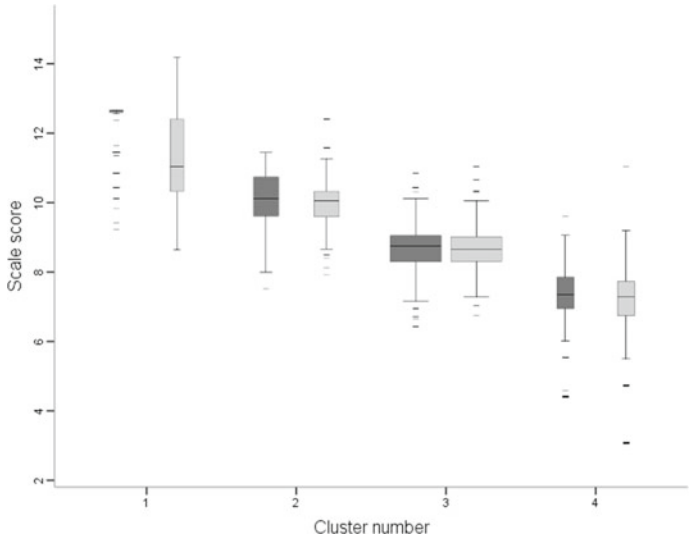

Fig. 4.8 Distributions of motivation variables by cluster for Japan, TIMSS 2015 grade 4
Notes Dark gray = enjoyment, light gray = confidence. Box width represents relative cluster size

Table 4.8 Descriptive statistics by cluster for Japan, TIMSS 2015 grade 4

Cluster characteristics	Cluster			
	1	2	3	4
Size (% of total number of students)	12.7	23.5	47.8	15.9
Mean plausible value	636.8^{a}	616.8^{b}	583.6^{c}	552.2^{d}
Female students in cluster (%)*	40.4	44.4	54.9	52.3
Mean home resources for learning scale score	10.7^{a}	10.4^{b}	10.1^{c}	9.9^{d}

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$

*Chi-square test of independence of gender × cluster was significant ($\chi^2(3) = 55.309$, $p < 0.001$)

home resources for learning, and contained more boys than girls compared to the clusters reporting lower motivation (Table 4.8).

4.2.9 Norway

Five clusters were identified in the Norwegian sample (Fig. 4.9). Cluster 1 had very high confidence and high enjoyment scores, and had the highest mean achievement; cluster 5 had the lowest motivation score distributions and the lowest mean

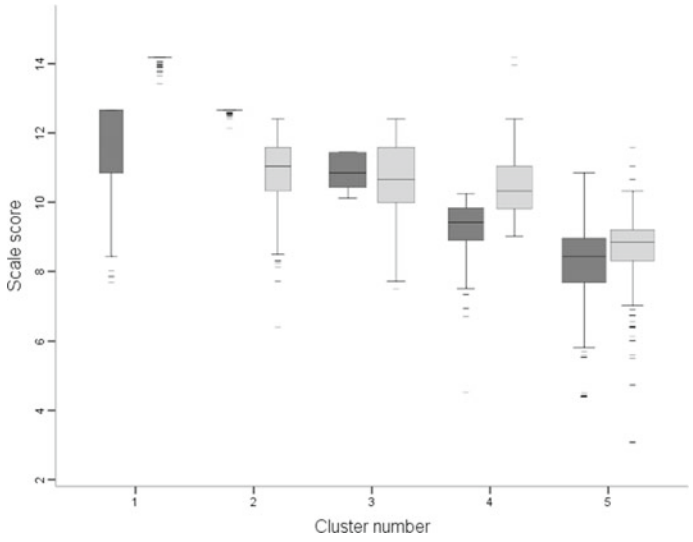

Fig. 4.9 Distributions of motivation variables by cluster for Norway, TIMSS 2015 grade 4
Notes Dark gray = enjoyment, light gray = confidence. Box width represents relative cluster size

Table 4.9 Descriptive statistics by cluster for Norway, TIMSS 2015 grade 4

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	14.3	15.5	22.4	21.3	26.4
Mean plausible value	527.3[a]	492.3[b]	499.4[b]	505.2[b]	462.5[c]
Female students in cluster (%)*	42.2	51.8	51.2	47.5	52.3
Mean home resources for learning scale score	11.5[a,b]	11.4[a,b]	11.5[a,b]	11.7[a]	11.3[b]

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$

*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 19.689$, $p = 0.001$)

achievement. For the remaining three clusters, the confidence variable distributions were largely overlapping, and scores for enjoyment were the distinguishing characteristic: enjoyment was high in cluster 2, moderate in cluster 3, and moderate-to-low in cluster 4. Nevertheless, none of the clusters differed significantly in terms of achievement (Table 4.9). A larger percentage of boys than girls was found in the highest motivation cluster, but gender differences were otherwise small. Differences in the home resources for learning variable were also small across clusters and not always statistically significant.

4.2.10 Singapore

Four clusters were identified in the Singapore sample (Fig. 4.10). Students with above average endorsement of confidence and enjoyment (cluster 4) had the highest mean achievement. Clusters 1 and 3 contained students reporting moderate or lower confidence in mathematics, and had similar mean achievement, despite higher endorsement of enjoyment in cluster 1. Cluster 2 contained students with the lowest scores for the motivation variables, the lowest mean achievement, and more girls than boys. In contrast, there were more boys than girls represented in the highest confidence cluster (cluster 4) (Table 4.10). Across the clusters, there were significant differences in the home resources for learning variable, with higher scores reported for the higher achieving clusters.

4.2.11 Slovenia

Five clusters were identified in the Slovenian sample (Fig. 4.11). Cluster 1 contained students with very high confidence and moderate-to-high enjoyment scores, and had the highest mean achievement among the clusters. Clusters 2 and 3 contained students

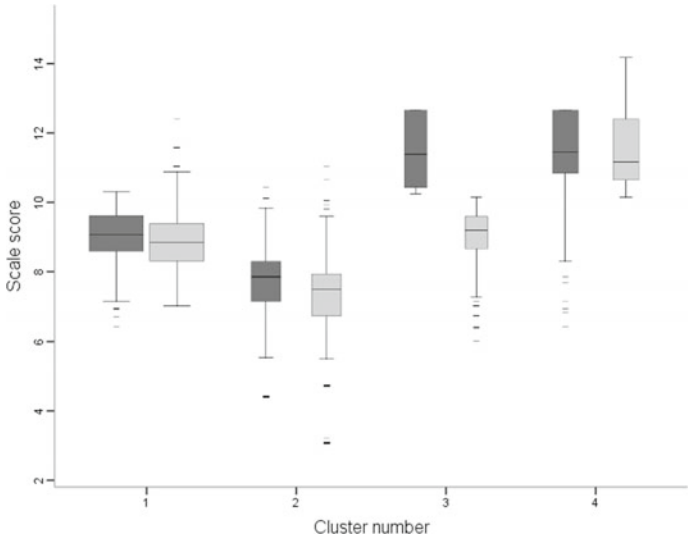

Fig. 4.10 Distributions of motivation variables by cluster for Singapore, TIMSS 2015 grade 4
Notes Dark gray = enjoyment, light gray = confidence. Box width represents relative cluster size

Table 4.10 Descriptive statistics by cluster for Singapore, TIMSS 2015 grade 4

Cluster characteristics	Cluster			
	1	2	3	4
Size (% of total number of students)	41.2	22.2	17.1	19.5
Mean plausible value	616.6[a]	575.1[b]	605.7[a]	676.6[c]
Female students in cluster (%)*	50.8	54.7	50.1	36.9
Mean home resources for learning scale score	10.8[a]	10.5[b]	10.6[b]	11.4[c]

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$
*Chi-square test of independence of gender × cluster was significant ($\chi^2(3) = 96.964$, $p < 0.001$)

with similar mean achievement, although motivation scores (particularly enjoyment in mathematics) were lower in cluster 3. The other two clusters had lower distributions of the motivation variables and lower mean achievement. There were more boys than girls in the higher motivation clusters (Table 4.11). Across the clusters, there were small differences in mean home resources for learning; clusters with higher motivation had higher levels for this variable.

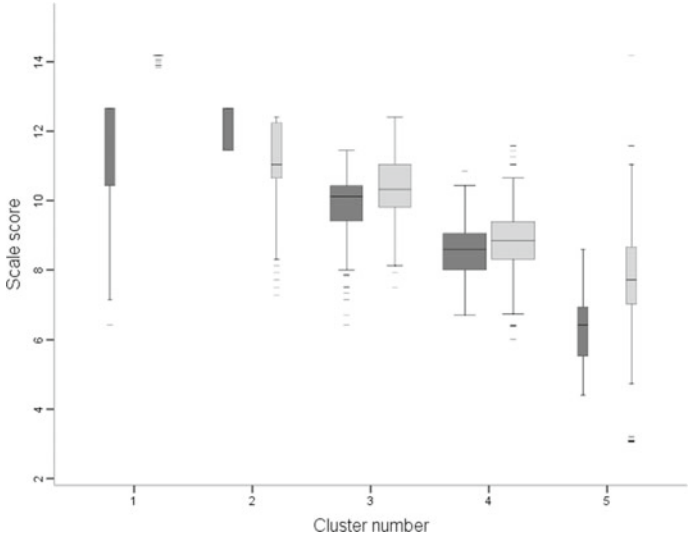

Fig. 4.11 Distributions of motivation variables by cluster for Slovenia, TIMSS 2015 grade 4
Notes Dark gray = enjoyment, light gray = confidence. Box width represents relative cluster size

Table 4.11 Descriptive statistics by cluster for Slovenia, TIMSS 2015 grade 4

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	9.2	10.1	30.4	40.8	9.5
Mean plausible value	569.0^{a}	532.5^{b}	536.9^{b}	502.2^{c}	487.1^{d}
Female students in cluster (%)*	34.0	39.5	47.9	54.5	49.9
Mean home resources for learning scale score	11.1^{a}	$10.6^{b,c}$	$10.8^{a,b,d}$	10.5^{c}	$10.6^{c,d}$

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$
*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 74.794$, $p < 0.001$)

4.2.12 USA

Of the five clusters identified in the USA sample, cluster 1, with very high confidence and moderate-to-high enjoyment scores, had a high mean achievement (Fig. 4.12). Cluster 2 also contained students with high levels of mean performance, ahead of cluster 3, which included students with strong endorsement of enjoyment in mathematics. The remaining two clusters had consistent below moderate (cluster 4) and low (cluster 5) motivation scores, and did not significantly differ in achievement. There was a significant difference in gender composition across the clusters, with

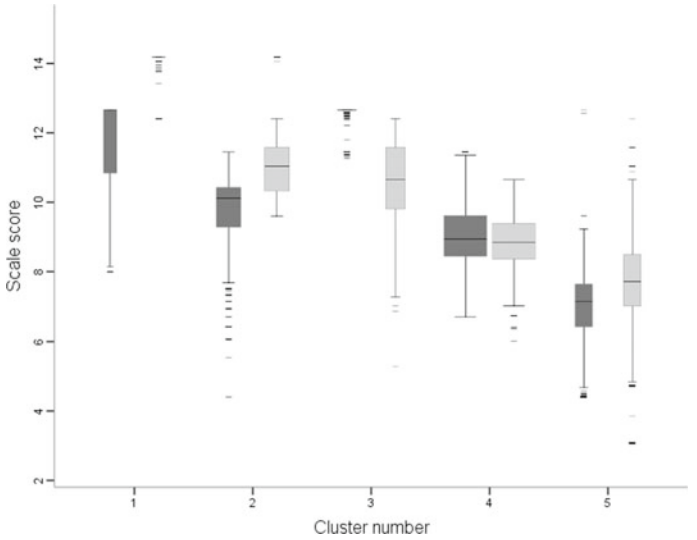

Fig. 4.12 Distributions of motivation variables by cluster for USA, TIMSS 2015 grade 4
Notes Dark gray = enjoyment, light gray = confidence. Box width represents relative cluster size

Table 4.12 Descriptive statistics by cluster for USA, TIMSS 2015 grade 4

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	11.3	20.9	16.4	36.6	14.8
Mean plausible value	589.4[a]	580.6[a]	544.8[b]	515.5[c]	509.2[c]
Female students in cluster (%)*	43.2	46.2	51.4	54.4	55.6

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$
*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 73.133$, $p < 0.001$)

more boys than girls in the two highest confidence clusters, and more girls than boys in the two lower motivation clusters (Table 4.12). The home resources for learning variable was not available for the USA sample.

4.3 Cluster Analysis Results for the TIMSS 2015 Administration at Grade Eight by Jurisdiction

Grade eight students responded to three motivation scales in the TIMSS 2015 administration: enjoyment of, confidence in, and value for mathematics. We performed cluster analyses of the scores on the three scales, and explored solutions

providing between three and six clusters for each of the 12 samples. Following the criteria we outlined in Chap. 3, a solution was selected.

We here present a detailed description of the clusters that were generated from the grade eight TIMSS 2015 mathematics results for each country. Boxplots depict the distribution of scores for the three motivational variables for each cluster, and the width of each boxplot represents the size of the cluster. Descriptive statistics by cluster are presented for cluster size, mean achievement, gender composition, homework engagement, and mean home educational resources.

4.3.1 Australia

Five clusters were extracted from the Australian sample (Fig. 4.13). The two smaller clusters consist of students who reported high scores on all variables (cluster 1) or low scores for all variables (cluster 5). The other three clusters were larger in size. Clusters 2 and 3 had similar distributions for confidence, but cluster 3 reported slightly higher scores for enjoyment and much higher value scores. Cluster 4 had moderate to low scores for all three variables.

Comparison of mean achievement for the clusters (Table 4.13) revealed significant differences: when students' motivational scores were higher, their mean achievement was also significantly higher. An interesting finding is that clusters 2 and 3 did not differ in their mean achievement scores, despite the large difference in value and

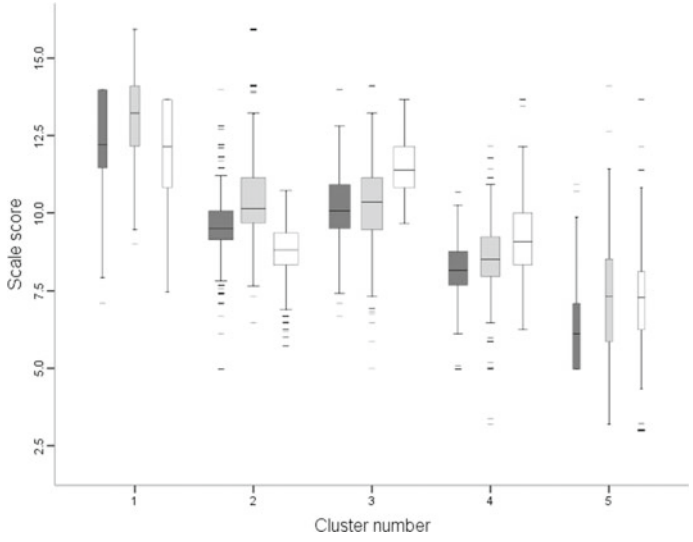

Fig. 4.13 Distributions of motivation variables by cluster for Australia, TIMSS 2015 grade 8
Notes Dark gray = enjoyment, light gray = confidence, white = value. Box width represents relative cluster size

Table 4.13 Descriptive statistics by cluster for Australia, TIMSS 2015 grade 8

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	11.5	30.5	26.0	23.3	8.7
Mean plausible value	570.5[a]	517.5[b]	519.8[b]	471.7[c]	446.0[d]
Female students in cluster (%)*	37.8	49.5	44.9	60.6	66.2
Students spending >45 min per week on homework (%)	45.9	39.0	48.6	37.1	28.0
Mean home educational resources scale score	11.6[a]	11.1[c]	11.3[b]	11.0[c]	10.7[d]

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$

*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 286.415$, $p < 0.001$)

small difference in enjoyment in favor of cluster 3. There were also significant differences between clusters with respect to gender, with boys overrepresented in high-performing clusters 1 and 3, and girls overrepresented in low-performing clusters 4 and 5. The mean levels of home educational resources also differed significantly across clusters; clusters with higher motivation scores also had more resources. There were also differences in time spent on homework: more students reported spending >45 min per week on homework in the high-performing clusters.

4.3.2 Canada-Ontario

Five clusters were extracted from the Ontario sample (Fig. 4.14). Cluster 1 includes students with high scores on all three variables. Clusters 2 and 3 present interesting patterns of moderate motivation scores, but cluster 2 students placed a high value on mathematics and cluster 3 students had high confidence in their abilities. Clusters 4 and 5 contain students with lower score distributions; although cluster 5 students had lower scores than cluster 4, they equally valued mathematics.

Clusters 1 and 3 do not differ significantly in mean achievement (Table 4.14); although enjoyment and value distributions are much lower for cluster 3 students, their confidence scores were only slightly lower than those of cluster 1 students. Cluster 2 has a much lower mean achievement despite rather high value scores. Cluster 5 has significantly lower mean achievement despite having moderate value scores, rather similar to those of clusters 3 and 4. Gender composition differed across clusters. Girls were underrepresented in cluster 1which is consistently high for all three motivation variables; meanwhile, girls were overrepresented in the least motivated cluster (cluster 5). Of note is the high-performing cluster 3, where the percentage of boys and girls is similar. Home educational resources differed as

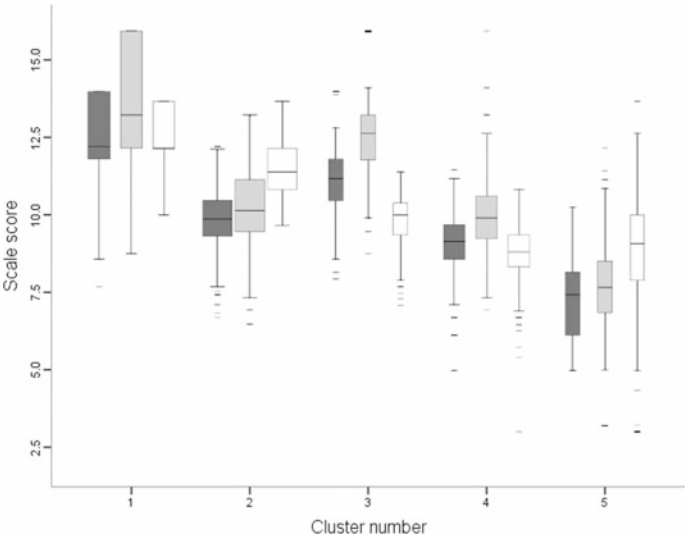

Fig. 4.14 Distributions of motivation variables by cluster for Ontario, TIMSS 2015 grade 8
Notes Dark gray = enjoyment, light gray = confidence, white = value. Box width represents relative cluster size

Table 4.14 Descriptive statistics by cluster for Ontario, TIMSS 2015 grade 8

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	21.5	29.0	14.4	21.1	14.0
Mean plausible value	567.9[a]	514.7[b]	564.6[a]	505.0[b]	462.9[c]
Female students in cluster (%)*	40.4	52.4	49.6	49.7	61.3
Students spending >45 min per week on homework (%)	57.1	65.8	52.3	57.3	58.2
Mean home educational resources scale score	11.7[a]	11.3[b]	11.4[a,b]	11.0[c]	10.9[c]

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$
*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 69.135$, $p < 0.001$)

expected, cluster 1 had higher levels of home resources than cluster 2, while cluster 4 and 5 scored low on this variable. Differences in the percentages of students engaging in homework across the clusters were not large.

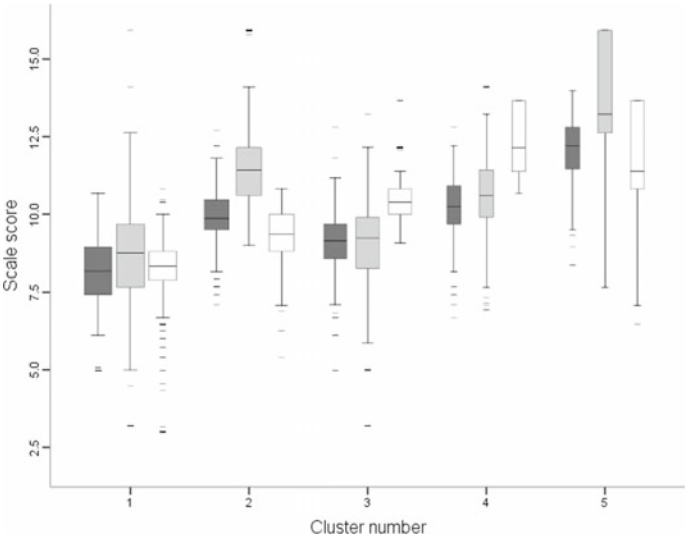

Fig. 4.15 Distributions of motivation variables by cluster for Quebec, TIMSS 2015 grade 8
Notes Dark gray = enjoyment, light gray = confidence, white = value. Box width represents relative cluster size

4.3.3 Canada-Quebec

Five clusters were extracted from the Quebec sample (Fig. 4.15). Distributions of motivation variables reveal that cluster 5 consisted of students who scored highly for all three variables, while cluster 1 consisted of students who scored low on all three variables. The middle three clusters presented some inconsistent profiles with more moderate ranges: cluster 2 was distinguished by relatively high confidence and cluster 4 by higher value scores, while cluster 3 is similar to cluster 4 but contains a lower overall distribution of scores.

Mean student performance was higher in clusters 5 and 2 with high confidence scores (Table 4.15). Students in cluster 4 placed a high value on mathematics, but their mean achievement was lower than those in cluster 5. Gender distribution varied across clusters; there were more girls than boys in the lower motivation clusters. In general, clusters with a higher motivation scores were associated with more home educational resources, and lower percentages of students who reported spending >45 min per week on homework.

4.3.4 England

Five clusters were extracted from the English sample (Fig. 4.16). Two clusters had consistent profiles: cluster 5 is students who scored highly on all motivation variables and cluster 1 is students who scored low on the motivation variables. However, cluster

Table 4.15 Descriptive statistics by cluster for Quebec, TIMSS 2015 grade 8

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	26.8	24.0	22.3	13.3	13.6
Mean plausible value	510.7^{a}	$573.4^{b,c}$	531.4^{d}	559.6^{b}	588.5^{c}
Female students in cluster (%)*	56.9	48.5	58.6	44.4	48.6
Students spending >45 min per week on homework (%)	75.4	68.1	81.1	76.3	60.0
Mean home educational resources scale score	10.6^{c}	11.0^{b}	$10.9^{b,c}$	$11.1^{a,b,c}$	11.3^{a}

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$

*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 42.725$, $p < 0.001$)

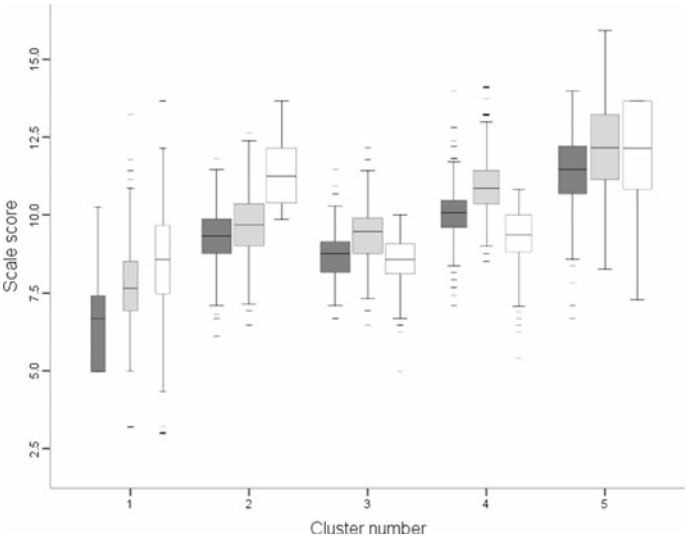

Fig. 4.16 Distributions of motivation variables by cluster for England, TIMSS 2015 grade 8
Notes Dark gray = enjoyment, light gray = confidence, white = value. Box width represents relative cluster size

5 mean student achievement was not significantly higher than that of the cluster 4 students, although cluster 4 had lower distributions for all motivational variables (Table 4.16). Clusters 2 and 3 showed much lower mean achievement despite high endorsement of value in cluster 2. As mentioned, cluster 1 had the lowest mean achievement. Gender composition differed significantly across clusters, with more boys than girls in the highest motivation clusters, and more girls than boys in clusters with lower motivation and achievement. The two highest performing clusters had also

Table 4.16 Descriptive statistics by cluster for England, TIMSS 2015 grade 8

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	11.2	23.3	23.1	20.3	22.1
Mean plausible value	466.8[c]	502.8[b]	501.5[b]	549.6[a]	556.7[a]
Female students in cluster (%)*	66.9	50.0	59.2	47.5	36.3
Students spending >45 min per week on homework (%)	19.1	27.2	22.7	26.6	33.7
Mean home educational resources scale score	10.7[c]	10.8[b,c]	10.7[c]	11.0[a,b]	11.2[a]

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$

*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 176.879$, $p < 0.001$)

significantly higher mean home educational resources than the lowest performing clusters. More students reported spending >45 min per week on homework in the high motivation clusters.

4.3.5 Hong Kong

Four clusters were extracted from the Hong Kong sample (Fig. 4.17). Patterns for the motivation variable distributions were quite consistent: for cluster 3, all distributions were high, for cluster 4, all were moderate-to-high, for cluster 2, all were moderate-to-low, and for cluster 1, all were low. Mean achievement differed significantly among clusters and was positively related to the level of the motivation variables (Table 4.17). There were significantly fewer girls than boys in the two highest motivation clusters, and more girls than boys in the other two clusters. The highest performing cluster had a significantly higher score for home educational resources score than the other three clusters; the latter were broadly similar for this SES measure. Student reported time spent on homework did not differ much across clusters.

4.3.6 Hungary

Five samples were extracted from the Hungarian sample (Fig. 4.18). Cluster 1 had high score distributions, and cluster 5 had low score distributions for all motivation variables. Cluster 2 had distinctly high confidence, but low value scores. Clusters 3 and 4 had similar enjoyment and confidence distributions, but differed in their value scores. Clusters 1 and 2 were similar in median confidence, differed for enjoyment and value, but did not significantly differ in mean achievement (Table 4.18). Clusters

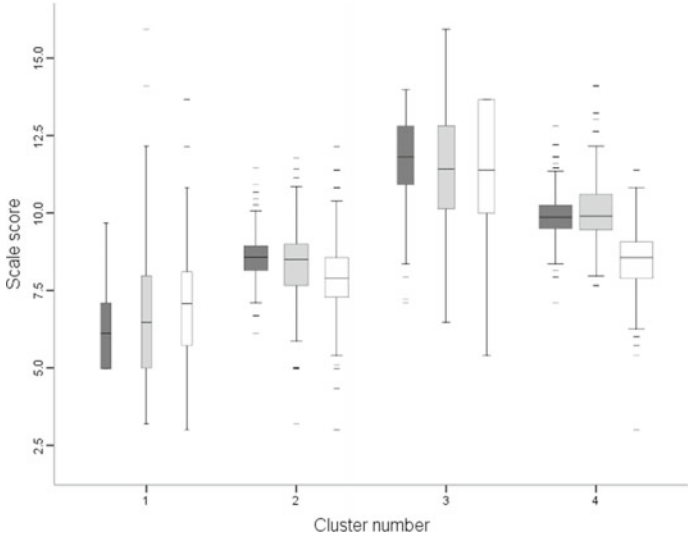

Fig. 4.17 Distributions of motivation variables by cluster for Hong Kong, TIMSS 2015 grade 8
Notes Dark gray = enjoyment, light gray = confidence, white = value. Box width represents relative cluster size

Table 4.17 Descriptive statistics by cluster for Hong Kong, TIMSS 2015 grade 8

Cluster characteristics	Cluster			
	1	2	3	4
Size (% of total number of students)	12.4	28.6	19.8	39.3
Mean plausible value	546.6[d]	572.3[c]	631.9[a]	606.7[b]
Female students in cluster (%)*	56.8	57.8	32.4	45.2
Students spending >45 min per week on homework (%)	63.0	68.2	60.5	65.6
Mean home educational resources scale score	10.0[b]	10.0[b]	10.6[a]	10.2[b]

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$
*Chi-square test of independence of gender × cluster was significant ($\chi^2(3) = 144.759$, $p < 0.001$)

3 and 4 had lower but similar mean achievement scores, but differed primarily in their assessment of value. Gender differences were prominent; cluster 1 had the highest motivation and contained more boys than girls, and cluster 5 had the lowest motivation and contained more girls than boys. Clusters 1 and 2 had significantly higher mean scores for home educational resources compared to the other three clusters. Clusters moderate in motivation and achievement reported spending more time on homework than other clusters.

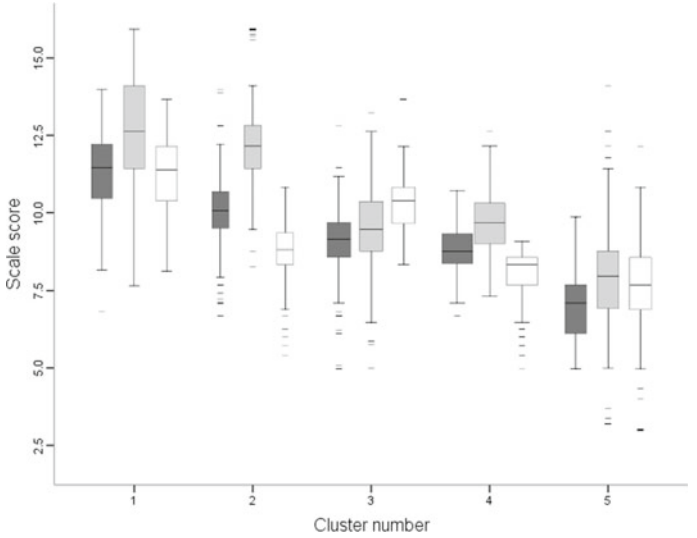

Fig. 4.18 Distributions of motivation variables by cluster for Hungary, TIMSS 2015 grade 8
Notes Dark gray = enjoyment, light gray = confidence, white = value. Box width represents relative cluster size

Table 4.18 Descriptive statistics by cluster for Hungary, TIMSS 2015 grade 8

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	18.6	14.6	20.4	27.3	19.0
Mean plausible value	570.6[a]	570.3[a]	491.8[b,c]	496.7[b]	469.7[c]
Female students in cluster (%)*	43.0	50.1	49.6	53.2	56.1
Students spending >45 min per week on homework (%)	48.0	42.2	59.1	51.8	47.9
Mean home educational resources scale score	11.4[a]	11.3[a]	10.6[b]	10.5[b]	10.5[b]

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$
*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 36.268$, $p < 0.001$)

4.3.7 Iran

Five clusters were found in the Iranian sample (Fig. 4.19). Cluster 5 had consistently high scores on all motivational variables. Cluster 4 had high scores on enjoyment and confidence, but moderate value scores. Cluster 3 had the reverse pattern, with high scores for value, and moderate enjoyment and confidence. The other two clusters had consistent profiles, with moderate-to-low (cluster 2) and low (cluster 1) score distributions for all three variables.

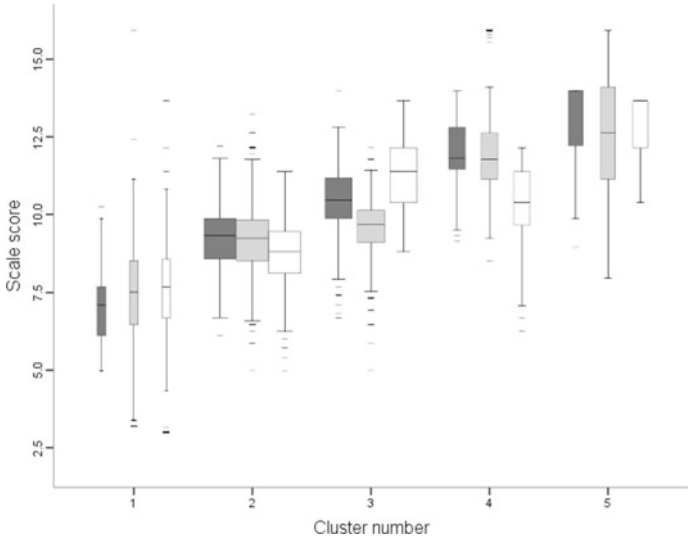

Fig. 4.19 Distributions of motivation variables by cluster for Iran, TIMSS 2015 grade 8
Notes Dark gray = enjoyment, light gray = confidence, white = value. Box width represents relative cluster size

Surprisingly, cluster 4 in Iran, with moderate scores for value, had higher mean achievement than the consistently high cluster 5 (Table 4.19). Significantly lower mean achievement was found for clusters 2 and 3, which performed, on average, equally well, despite their differences in value and enjoyment scores. Cluster 1 had the lowest mathematics achievement scores. There were significant differences in the gender composition of clusters; notably, there were equal proportions of boys and girls in the best performing cluster (cluster 4), but more boys in the more motivated and second highest performing cluster (cluster 5). The two clusters with

Table 4.19 Descriptive statistics by cluster for Iran, TIMSS 2015 grade 8

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	8.6	32.4	27.5	16.6	14.9
Mean plausible value	396.6^{d}	416.9^{c}	418.1^{c}	493.6^{b}	473.2^{a}
Female students in cluster (%)*	54.6	52.4	47.6	50.4	40.1
Students spending >45 min per week on homework (%)	49.7	55.5	59.3	65.4	67.3
Mean home educational resources scale score	$9.2^{b,c}$	9.1^{b}	9.1^{b}	9.9^{a}	$9.7^{a,c}$

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$
*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 46.370$, $p < 0.001$)

the higher achievement scores (clusters 4 and 5) had higher average levels of home educational resources, as well as more students reporting spending >45 min per week on homework than the other three groups in Iran.

4.3.8 Japan

Five clusters were derived from the Japanese sample (Fig. 4.20). Most of them had consistent profiles on the three motivation variables: cluster 2 had the lowest median scores, followed by cluster 1, then cluster 3 (which had a rather low score distribution for value), cluster 4, and, finally, cluster 5; the last had high median scores, except for the value variable.

All five clusters differed systematically on average achievement: higher mean achievement was consistent with higher enjoyment and confidence scores, but did not vary consistently with the value scores (Table 4.20). There were large differences in the gender composition of clusters: in the two more motivated clusters there were more boys than girls, while in the two lowest-performing clusters, there were more girls than boys. The level of mean home educational resources did not differ significantly for clusters 4 and 5, but were generally at lower levels in clusters with lower motivation and achievement scores. Students in Japan also reported spending more time doing homework in the clusters with lower motivation scores.

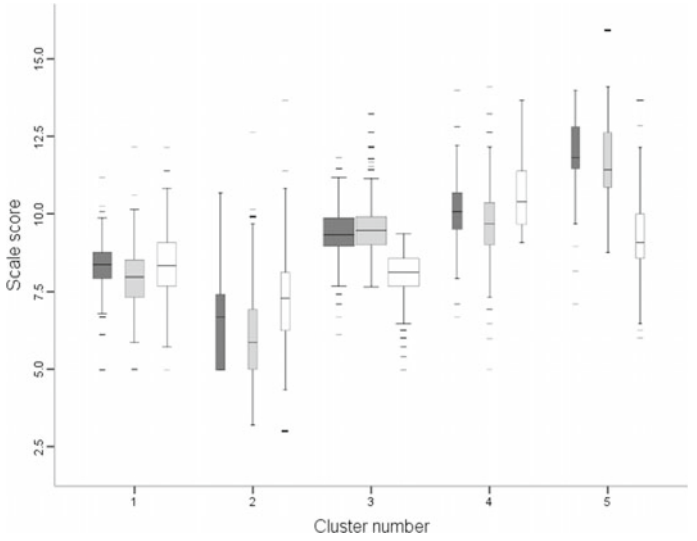

Fig. 4.20 Distributions of motivation variables by cluster for Japan, TIMSS 2015 grade 8
Notes Dark gray = enjoyment, light gray = confidence, white = value. Box width represents relative cluster size

Table 4.20 Descriptive statistics by cluster for Japan, TIMSS 2015 grade 8

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	24.6	11.7	40.2	13.0	10.5
Mean plausible value	556.4[d]	522.3[e]	596.3[c]	619.8[b]	651.5[a]
Female students in cluster (%)*	59.5	60.0	51.4	39.3	34.7
Students spending >45 min per week on homework (%)	30.8	34.9	25.1	27.1	19.8
Mean home educational resources scale score	10.8[b,c]	10.6[b]	11.0[c]	11.3[a]	11.3[a]

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$

*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 137.618$, $p < 0.001$)

4.3.9 Norway

Six clusters were extracted from the Norwegian grade eight sample (Fig. 4.21). Cluster 6 had high score distributions on all three motivation variables, cluster 5 had high confidence scores but otherwise moderate scores on the other two motivation variables, cluster 4 had a high value score, clusters 1 and 3 both had moderate-to-low scores but their mean value scores differed, and cluster 2 had generally low scores for all variables.

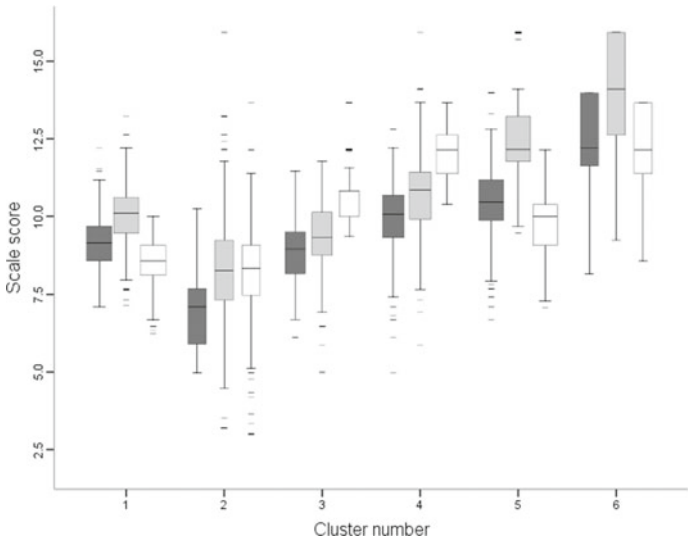

Fig. 4.21 Distributions of motivation variables by cluster for Norway, TIMSS 2015 grade 8
Notes Dark gray = enjoyment, light gray = confidence, white = value. Box width represents relative cluster size

Table 4.21 Descriptive statistics by cluster for Norway, TIMSS 2015 grade 8

Cluster characteristics	Cluster					
	1	2	3	4	5	6
Size (% of total number of students)	19.9	14.3	15.6	16.9	19.2	14.0
Mean plausible value	478.9^{b}	443.8^{d}	462.3^{c}	481.3^{b}	523.7^{a}	535.1^{a}
Female students in cluster (%)*	47.5	57.6	59.4	47.3	48.0	42.9
Students spending >45 min per week on homework (%)	56.5	63.0	62.1	61.1	51.8	50.7
Mean home educational resources scale score	$11.3^{a,b}$	11.0^{a}	$11.1^{a,b}$	11.4^{b}	11.6^{c}	11.8^{c}

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$

*Chi-square test of independence of gender × cluster was significant ($\chi^2(5) = 61.050$, $p < 0.001$)

Differences in mean achievement were significant in most pairwise comparisons, where clusters with higher motivation scores also had higher achievement scores (Table 4.21). Cluster 1 was an exception, as it (a) had higher mean achievement scores than cluster 3, despite cluster 3 having higher value scores; and (b) did not differ significantly from cluster 4, despite the latter having higher motivation scores, particularly for value. Females were again underrepresented in the higher motivation clusters and overrepresented in the lower motivation clusters. Mean home educational resources also differed significantly across the clusters; in particular, the two higher performing clusters reported higher mean levels for home educational resources than the other clusters for this SES measure. In clusters with higher motivation scores, fewer students spent >45 min per week on homework.

4.3.10 Singapore

Six clusters were extracted from the Singapore sample (Fig. 4.22). Cluster 1 had high score distributions on all three motivation variables and for cluster 2 there were also high, but the value distribution scores were lower than in cluster 1. Cluster 3 had a consistently moderate profile, and cluster 6 was similarly moderate, but the value distribution scores were again lower than in cluster 3. Cluster 4 had consistently low score distributions for all three variables, and for cluster 5 these were even lower.

Mean achievement comparisons in Singapore indicate some interesting patterns. When we compared clusters 1 and 2, we found that the latter cluster performed better on average in TIMSS despite the lower distribution scores for enjoyment and especially for value (Table 4.22). Similarly, students in cluster 6 performed better than those in cluster 3, despite having lower value scores. The clusters with low and very low patterns of motivation scores also scored low on mean achievement. The only important difference in gender composition was noted for cluster 1, which contained significantly more boys than girls. Mean home educational resource levels

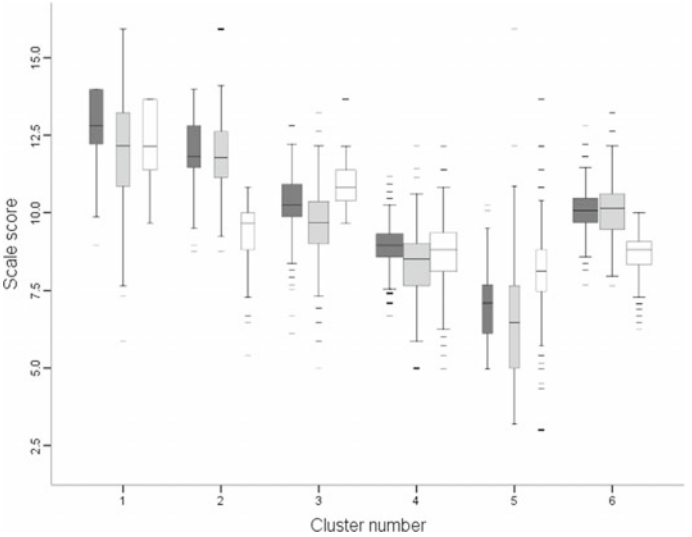

Fig. 4.22 Distributions of motivation variables by cluster for Singapore, TIMSS 2015 grade 8
Notes Dark gray = enjoyment, light gray = confidence, white = value. Box width represents relative cluster size

Table 4.22 Descriptive statistics by cluster for Singapore, TIMSS 2015 grade 8

Cluster characteristics	Cluster					
	1	2	3	4	5	6
Size (% of total number of students)	12.6	12.3	18.4	24.6	9.5	22.7
Mean plausible value	652.3^{a}	666.6^{b}	616.8^{c}	597.0^{d}	559.0^{e}	632.6^{f}
Female students in cluster (%)*	38.8	48.6	49.1	52.6	52.0	48.5
Students spending >45 min per week on homework (%)	77.5	75.3	79.2	76.9	69.3	75.5
Mean home educational resources scale score	10.6^{a}	$10.6^{a,b}$	$10.4^{a,b}$	10.2^{c}	10.0^{c}	10.4^{b}

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$
*Chi-square test of independence of gender × cluster was significant ($\chi^2(5) = 41.695$, $p < 0.001$)

did not differ much, but some differences were significant, especially between the high motivation clusters and the low motivation clusters. Compared to the other clusters, a lower percentage of students in the least motivated cluster (cluster 5) reported spending >45 min per week on homework.

4.3.11 Slovenia

Six clusters were extracted from the Slovenian sample (Fig. 4.23). These included a high motivation cluster (cluster 1), a moderate cluster with slightly higher confidence scores (cluster 2), a moderate cluster with high value scores (cluster 3), an inconsistent profile of low confidence and value, with very low enjoyment (cluster 4), a cluster that scored consistently low for all three variables (cluster 5), and another cluster that scored low on value and very low for enjoyment and confidence (cluster 6).

Mean achievement comparisons in Slovenia revealed that the consistently high profile cluster 1 had the highest mean achievement, followed by cluster 2, which had moderate motivation scores (Table 4.23). Interestingly, clusters 3, 4, and 5 did not differ significantly, despite the large differences among these clusters, particularly in the enjoyment and value score distributions. The very low confidence and enjoyment cluster 6 had the lowest mean achievement score. The clusters differed notably in their gender composition; cluster 1 contained more boys than girls, and cluster 6 contained more girls than boys. The mean home educational resources scale score differed among clusters in most comparisons with higher scores in the clusters with the higher motivation distributions. Higher percentages of students reported spending >45 min per week on homework in the clusters with the lower motivation and achievement scores.

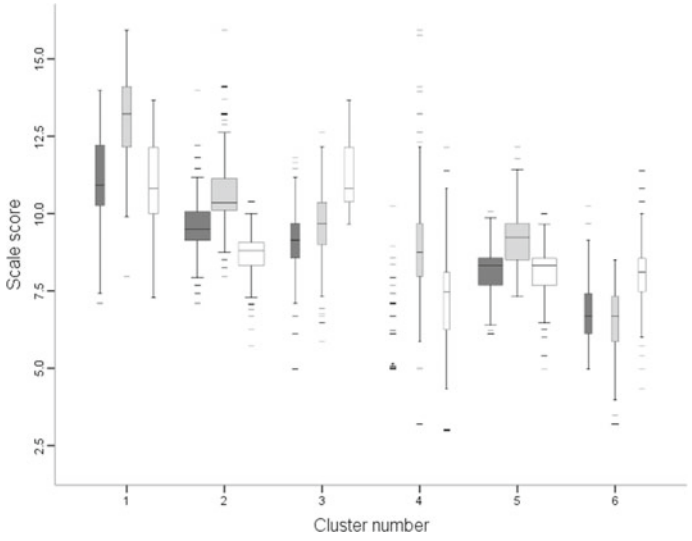

Fig. 4.23 Distributions of motivation variables by cluster for Slovenia, TIMSS 2015 grade 8
Notes Dark gray = enjoyment, light gray = confidence, white = value. Box width represents relative cluster size

Table 4.23 Descriptive statistics by cluster for Slovenia, TIMSS 2015 grade 8

Cluster characteristics	Cluster					
	1	2	3	4	5	6
Size (% of total number of students)	11.2	31.3	11.2	7.4	29.9	9.0
Mean plausible value	577.0[a]	538.8[b]	503.5[c]	492.0[c]	496.4[c]	465.1[d]
Female students in cluster (%)*	42.5	47.8	44.2	41.7	50.5	61.1
Students spending >45 min per week on homework (%)	41.6	61.0	68.8	70.5	71.7	77.6
Mean home educational resources scale score	11.3[a]	10.9[b]	10.9[b]	10.7[b,c]	10.6[c]	10.4[c]

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$

*Chi-square test of independence of gender × cluster was significant ($\chi^2(5) = 42.523$, $p < 0.001$)

4.3.12 USA

Five clusters were extracted from the USA sample (Fig. 4.24). Cluster 4 had consistently high scores for all three motivational variables, and cluster 5 was similar, but with slightly lower scores on all variables. There were two clusters with moderate scores for confidence and enjoyment, which differed in their value scores; cluster 3 had a low score distribution for the value variable, while cluster 2 had a higher score

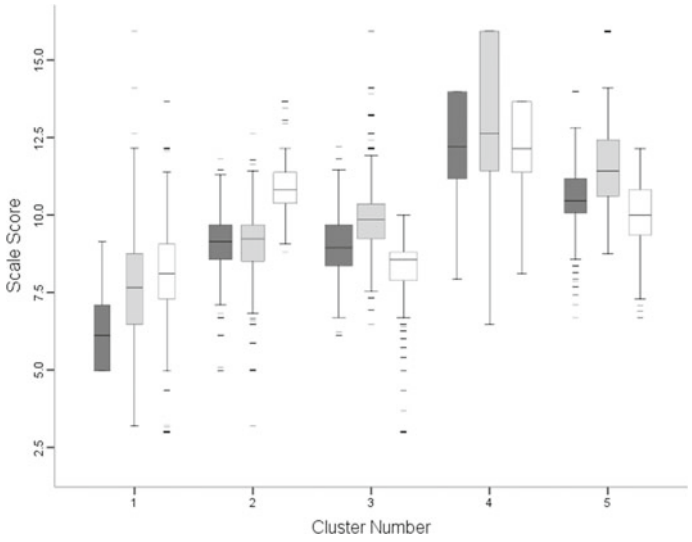

Fig. 4.24 Distributions of motivation variables by cluster for USA, TIMSS 2015 grade 8
Notes Dark gray = enjoyment, light gray = confidence, white = value. Box width represents relative cluster size

Table 4.24 Descriptive statistics by cluster for USA, TIMSS 2015 grade 8

Cluster characteristics	Cluster				
	1	2	3	4	5
Size (% of total number of students)	14.9	21.3	25.3	17.8	20.7
Mean plausible value	479.5[a]	494.1[b]	509.7[c]	558.9[d]	553.1[d]
Female students in cluster (%)*	57.9	54.0	47.6	44.0	51.1
Students spending >45 min per week on homework (%)	56.8	57.9	52.7	50.9	52.0
Mean home educational resources scale score	10.7[a]	10.8[a]	10.7[a]	11.2[b]	11.1[b]

Notes Different superscripts (a, b, c, etc.) indicate significantly different mean PV or home resources for learning based on t-statistics in pairwise comparisons. Due to multiple comparisons conducted in each sample, a difference was considered significant if $|t| > 3.29$

*Chi-square test of independence of gender × cluster was significant ($\chi^2(4) = 81.820$, $p < 0.001$)

distribution for the value variable. Cluster 1 had consistently low scores for all three motivational variables.

Clusters 4 and 5 did not differ significantly in their mean achievement scores despite the notable differences in the enjoyment and value distribution scores (Table 4.24). Cluster 3 had a significantly lower achievement on average, and cluster 2 had even lower mean achievement, despite high endorsement of the value of mathematics. Cluster 1 had the lowest average achievement score. There were significant differences in the gender composition of clusters; again there were more boys than girls in the highest motivation score cluster and more girls than boys in the lowest motivation score clusters. Levels of mean home educational resources were significantly higher for the two highest performing clusters. Reported time spent on the homework differed only slightly between clusters in the USA.