Annex B

METHODS AND TECHNIQUES OF ANALYSIS

A note regarding Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

ANNEX B
METHODS AND TECHNIQUES OF ANALYSIS

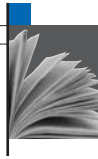
Multilevel latent class analyses

Multilevel latent class analyses were performed using four indicators: instructional leadership; distributed leadership; time spent on educational leadership; and educational leadership practice policy. By means of a latent class analyses, it was studied whether the principals of lower secondary schools can be classified systematically into a restricted number of groups (also called clusters or classes) based on the patterns in the principals' scores on the four indicators. The aim of the analyses is to maximise the between-group heterogeneity and the within-group homogeneity. This means, in this case, that principals who belong to the same cluster are as similar as possible with respect to observed values on the four indicators. On the other hand, principals who belong to different clusters have a scoring on the four indicators as dissimilar as possible. Latent class analyses have some important advantages over the traditional kind of cluster analyses: 1) the scoring of the indicators may have different levels of measurement, 2) the indicators may be correlated and 3) the analyses are model based. The third advantage implies that the model fit and the loading of the indicators to the clustering can be tested. Furthermore, the cluster membership probability is calculated for every principal, before the principal is allocated to the cluster with the highest membership probability. The basic idea of multilevel latent class analysis is that the hierarchical structure of the TALIS database is also taken into account: the principals (level 1 units) are nested within countries (level 2 units). It is assumed that the probability of belonging to a certain group class (cluster on a higher level) may differ across countries and economies. More technical details are to be found in Vermunt (2008). The multilevel latent class analyses are performed using the software package Latent Gold (version 4.5) (Vermunt and Magidson, 2005).

To make sure that the contribution of each country in the multilevel latent class analyses is the same, the final school weight (SCHWGT) was standardised per system. This is done by dividing SCHWGHT by the system mean SCHWGHT with, as a result, the average new school weight variable equalling one in each country and economy. The extremely peaked distribution of the scoring for distributed leadership and instructional leadership caused severe clustering interpretation problems. One value in the centre of the distribution contained about 10% of all observed distributed leadership scores and appeared to be a cluster in itself. Therefore, it was decided to recode the scoring of distributed leadership and also instructional leadership and time spent on educational leadership into corresponding variables with, respectively, 15[1], 11[2] and 16[3] ordinal categories.

The setting of the number of principal clusters (L1) ranged between two and five. The setting of the number of system group classes ranged between one and five (L2). The best solution of the latent class analyses is determined in the first place by a good overall fit of the model with a restricted number of clusters and group classes. The following criteria are used:

- the Bayesian Information Criterion (BIC) is relatively low
- the percentage of classification error is below 15%
- the classification certainty (entropy R^2, measuring the between-group heterogeneity) is at least 0.75
- a cluster of principals contains at least 10% of the units
- the cluster solution at both levels is parsimonious.



In the second place, the model solutions with respect to clustering principals and group classification of countries and economies for the best-fitting models are compared using the following criteria:

- a class of countries and economies contains at least 10% of the units
- each indicator contributes significantly to the clustering or classification (Wald test, $\alpha = 0.01$)
- the clusters and classes are interpretable.

With this, the lines suggested by Lukočienė, Varriale and Vermunt (2010), Collins and Lanza (2010), and Vermunt (2003) were generally followed.

Results

The main results of the first step in the multilevel latent class analyses are presented in Table B.1.

Table B.1 Model fit statistics of the multilevel latent class analyses for ISCED-2 principals

	Model specification	BIC(LL)	N parameters	Classification error	Entropy R^2
Model 1	2-Cluster 1-GClass	83518.53	46	0.1742	0.44
Model 2	3-Cluster 1-GClass	83333.79	51	0.2063	0.47
Model 3	4-Cluster 1-GClass	83297.75	56	0.2365	0.42
Model 4	5-Cluster 1-GClass	83282.73	61	0.2227	0.37
Model 5	2-Cluster 2-GClass	82445.77	48	0.1221	0.57
Model 6	3-Cluster 2-GClass	82312.58	54	0.1342	0.49
Model 7	4-Cluster 2-GClass	82229.74	60	0.2047	0.5
Model 8	5-Cluster 2-GClass	82239.05	66	0.2523	0.48
Model 9	2-Cluster 3-GClass	82337.98	50	0.1119	0.59
Model 10	3-Cluster 3-GClass	81822.15	57	0.1612	0.6
Model 11	4-Cluster 3-GClass	81400.17	64	0.1198	0.74
Model 12	5-Cluster 3-GClass	81297.95	71	0.1525	0.72
Model 13	2-Cluster 4-GClass	82273.79	52	0.1086	0.61
Model 14	3-Cluster 4-GClass	81693.93	60	0.1607	0.77
Model 15	4-Cluster 4-GClass	81138.11	68	0.1396	0.74
Model 16	5-Cluster 4-GClass	81191.63	76	0.1548	0.69
Model 17	2-Cluster 5-GClass	82265.26	54	0.1068	0.62
Model 18	3-Cluster 5-GClass	81639.57	63	0.1593	0.77
Model 19	4-Cluster 5-GClass	80926.58	72	0.1225	0.77
Model 20	5-Cluster 5-GClass	80922.44	81	0.148	0.73

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Table B.1 shows that the BIC decreases continuously as the number of group classes (GClass) and clusters increases. This indicates that the more cluster and group groups are differentiated, the better the overall model fit is. So, Model 20, with five principal clusters and five country and economy group classes, seems to be the best fitting model presented in Table B.1. However, when the other criteria for model fit are examined, another conclusion is drawn. In accordance with the selecting procedure presented by Vermunt (2003), the focus is on the lowest level (principals) before looking at a higher level in the analyses (countries and economies). Model 20 resulted in a solution with a larger proportion of estimation error (15%), a lower entropy R^2 (0.73) and is more complex when compared to Model 11, 14, 15, 18 and 19 with a similar fit. Comparing these latter models, it turns out that Model 11 has the best combination of fit criteria and is the less complex. The classification error and entropy R^2 of Model 11 are, respectively, 12% and 0.74. Model 11 is chosen to be the best model of all presented models in Table B.1.

The next step in the analysis is to determine whether Model 11 with the best overall fit also meets the second set of criteria. The sizes of the three country/economy group classes are, respectively, 52%, 31% and 17%. Therefore, all classes are bigger than the minimum level 10% of the total number of systems. All indicators contribute significantly to the four principal clusters (Wald tests: all $p < 0.001$) and – more important when the number of units is large – the loading of three of the four indicators are considered as relevant. The loading (R^2) of instructional leadership is 0.25, of distributed leadership 0.51, of time spent on educational leadership 0.07 and of educational leadership practice policy 0.25. These values for loading indicate that distributed leadership can be considered as the most important, followed by instructional leadership. The time a principal spends on educational leadership is the less relevant value for the clustering.

The last mentioned criterion of step 2 in the latent class analyses might even be the most important: the interpretability of the principal clusters. If the four clusters can be defined well based on the scoring of the four indicators for school leadership, then the cluster solution is interpretable. Tables B.2 to B.5 present, for each indicator, the distribution of the principals' scores over the four clusters. The area that is shaded grey indicates the categories of the indicator with the highest proportion of principals (Table B.2, B.3, B.4: > 5%; Table B.5: > 20%).

Table B.2 Distribution of principals, by cluster, for distributed leadership

Distributed leadership	Cluster 1 (%)	Cluster 2 (%)	Cluster 3 (%)	Cluster 4 (%)
3-4	0.0	0.2	0.0	0.3
4-5	0.0	0.0	0.0	0.1
5-6	0.0	0.4	0.0	0.5
6-7	0.0	0.4	0.0	0.5
7-8	0.0	3.3	0.0	3.9
8-9	0.0	14.1	0.0	15.7
9-10	0.0	13.6	0.0	14.3
10-11	0.0	20.0	0.0	19.9
11-12	0.3	43.9	0.5	41.3
12-13	54.3	4.0	65.4	3.5
13-14	16.1	0.0	16.0	0.0
14-15	5.2	0.0	4.3	0.0
15-16	8.2	0.0	5.5	0.0
16-17	11.7	0.0	6.5	0.0
17-18	4.1	0.0	1.9	0.0
Mean	13.7	10.4	13.3	10.3

Note: The area that is shaded indicates the categories of the indicator with the highest proportion of principals: > 5%.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Table B.2 indicates that the principals in Clusters 1 and 3 are characterised as principals with a high level of distributed leadership. The principals in Clusters 2 and 4 have a medium or low level of distributed leadership.

The principals classified in Clusters 1 and 2 can be specified as principals with a relatively high level of instructional leadership, as opposed to principals in Clusters 3 and 4 (Table B.3).

Table B.3 Distribution of principals, by cluster, for instructional leadership

Instructional leadership	Cluster 1 (%)	Cluster 2 (%)	Cluster 3 (%)	Cluster 4 (%)
5-6	0.0	0.1	1.6	2.4
6-7	0.1	0.3	2.8	3.9
7-8	0.3	0.8	3.9	4.8
8-9	4.7	10.0	29.3	32.9
9-10	7.0	11.5	19.9	20.3
10-11	7.7	9.9	10.1	9.3
11-12	45.6	46.5	27.7	23.2
12-13	10.0	8.0	2.8	2.1
13-14	6.8	4.3	0.9	0.6
14-15	16.6	8.2	1.0	0.6
15-16	1.2	0.5	0.0	0.0
Mean	11.9	11.2	9.8	9.5

Note: The area that is shaded indicates the categories of the indicator with the highest proportion of principals: 5%.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Table B.4 Distribution of principals, by cluster, for the percentage of time a principal spends on educational leadership

Percentage of time spent on educational leadership	Cluster 1 (%)	Cluster 2 (%)	Cluster 3 (%)	Cluster 4 (%)
0-5	2.4	2.2	7.9	6.6
6-10	11.5	10.8	25.3	22.7
11-15	10.3	9.9	15.3	14.8
16-20	29.9	29.4	30.3	31.2
21-25	13.1	13.1	9.0	9.9
26-30	20.5	21.1	9.6	11.3
31-35	3.9	4.1	1.2	1.6
36-40	4.9	5.2	1.1	1.4
41-45	0.7	0.8	0.1	0.2
46-50	1.8	2.0	0.2	0.3
51-55	0.2	0.2	0.0	0.0
56-60	0.6	0.7	0.0	0.1
61-65	0.0	0.1	0.0	0.0
66-70	0.2	0.2	0.0	0.0
71-75	0.0	0.1	0.0	0.0
76-80	0.0	0.1	0.0	0.0
Mean	23.4	23.9	17.4	18.3

Note: The area that is shaded indicates the categories of the indicator with the highest proportion of principals: > 5%.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Table B.4 demonstrates the unimportance of the indicator for the percentage of time spent on educational leadership for the clustering of the principals. The clusters differ little with respect to this indicator. In Cluster 1 and 2, the principals spend, on average, a bit more than 20% of their time on educational leadership activities. In Cluster 3 and 4, this average percentage is somewhat lower: 18%.

Table B.5 Distribution of principals, by cluster, for educational leadership practice policy

Educational leadership practice policy	Cluster 1 (%)	Cluster 2 (%)	Cluster 3 (%)	Cluster 4 (%)
0	0.6	0.6	13.6	17.1
1	13.2	13.2	45.2	47.2
2	86.2	86.3	41.3	35.7
Mean	1.9	1.9	1.3	1.2

Note: The area that is shaded indicates the categories of the indicator with the highest proportion of principals: > 20%).

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

The educational leadership practice policy of Clusters 1 and 2 is the most elaborated (Table B.5). Almost 90% of the principals reported that they were engaged in the development of both educational goals/educational programmes for his or her school and a professional development plan. In Clusters 3 and 4, this percentage is much lower (41% and 36%).

The inspection of the clustering results also reveals that the typology of the principals is quite strongly related to the typology of the countries. Table B.6 shows the distribution of the principal clustering over the country and economy group classes.

Table B.6 Distribution of principals, by principal cluster and country and economy group classes

	Country and economy group class 1 (%)	Country and economy group class 2 (%)	Country and economy group class 3 (%)
Principal cluster 1	72	18	17
Principal cluster 2	16	8	72
Principal cluster 3	9	46	1
Principal cluster 4	3	28	11
Total	100	100	100

Note: The area that is shaded indicates the categories of the indicator with the highest proportion of principals: > 20%).

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

The principals who belong to the 18 systems of Country and Economy Group Class 1 are mainly (70%) classified in Cluster 1. Most of the principals of Country and Economy Group Class 2 (56%, N=12 systems) are classified in Cluster 3 and 4. Principals of Country and Economy Group Class 3 (N=6 countries) are mainly (72%) attributed to Cluster 2. This is marked in Table B.6 by the grey cells.

Summarising the above presented results reveals a clear characterisation of the principal clusters and country and economy group classes. Table B.7 provides this. The sign indicates whether the principals in the particular cluster scored below average (–), on average (o) or above average (+). The percentage of time a principal spends on educational leadership is not presented because of its weak contribution to the clustering solution.

Table B.7 Summary of the four clustering solutions from the multilevel latent class analyses

Principal Cluster 1:		**Principal Cluster 2:**	
▪ distributed leadership:	+	▪ distributed leadership:	–
▪ instructional leadership:	+	▪ instructional leadership:	+
▪ educational leadership practice policy:	+	▪ educational leadership practice policy:	+
Mainly originate from country **class 1**:		Mainly originate from country **class 3**:	
Abu Dhabi (United Arab Emirates)		England (United Kingdom)	
Alberta (Canada)		Israel	
Australia		Italy	
Brazil		Japan	
Bulgaria		New Zealand	
Chile		Slovak Republic	
Czech Republic			
Georgia			
Korea			
Latvia			
Mexico			
Malaysia			
Poland			
Romania			
Russian Federation			
Serbia			
Singapore			
Shanghai (China)			
Principal Cluster 3:		**Principal Cluster 4:**	
▪ distributed leadership:	+	▪ distributed leadership:	–
▪ instructional leadership:	–	▪ instructional leadership:	–
▪ educational leadership practice policy:	o	▪ educational leadership practice policy:	o
The following countries **(country class 2)** have principals who can mainly be classified as cluster 3 or 4 principals:			
Croatia			
[Cyprus][1]			
Denmark			
Estonia			
Finland			
Flanders (Belgium)			
France			
Iceland			
Netherlands			
Portugal			
Spain			
Sweden			

Note by Turkey: The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Multilevel analyses

In this report, it is investigated, for lower secondary education (ISCED 2), whether aspects of school leadership are related to professional learning community on the one hand and positive learning climate on the other. In addition, it is studied whether these effects are still demonstrable if accounting for school context and teacher characteristics and whether the relationships in lower secondary education (ISCED 2) are different from primary education (ISCED 1) and upper secondary education (ISCED 3).

Working out the research questions in detail lead to extensive multilevel analyses. Data from principals and teachers in lower secondary education (ISCED 2) in TALIS 2013 are used for the main analyses. The principal dataset and teacher dataset are matched by, successively, the unique country, school and teacher identifiers (IDCNTRY, IDSCHOOL and IDTEACH).

All multilevel analyses are performed with the software packet MLwin (version 2.19) (Rasbash et al., 2012). The hierarchical structure of the TALIS 2013 dataset is taken into account by differentiating three levels. Teachers (level 1) are nested within schools (level 2), and schools are nested within countries (level 3). The sampling design of TALIS 2013 is considered in the analyses by using the final teacher weight (TCHWGT) and final school weight (SCHWGT) as raw weights at, respectively, levels 1 and 2. The described procedure of the multilevel analyses for ISCED 2 is replicated for the ISCED 1 and ISCED 3 datasets of TALIS 2013.

Five aspects of a professional learning community are specified: collaborative professional activity; reflective dialogue; collective focus on student learning; deprivatised practice by feedback of another teacher; and shared sense of purpose; and two are specified for the learning climate within a school: classroom disciplinary climate and positive teacher student relationships. This means that there are seven response variables, all coming from the teacher questionnaire and measured on a continuous scale. A basic kind of multilevel model was used, namely random intercept models (Snijders and Bosker, 2012). The procedure is as follows and was repeated for all response variables. First, an empty model is estimated (Model 0). Such a model reveals the basic estimates for the random parts of the model: the variance at levels 1, 2 and 3. The variances of the empty model are the starting point to calculate the explained percentage of total variance of the more elaborated models. Secondly, distributed leadership and instructional leadership are added as predictors to the empty model (Model 1). With Model 1, the gross effects of the two most important school leadership aspects on professional community and learning climate are estimated. The third step in the multilevel analyses is adding school context characteristics to Model 1 as covariates. A set of seven predictors are added simultaneously: location, type and size of the school, percentage of students who speak a foreign language, with special educational needs and a low socio-economic status (SES), and school autonomy. This reveals Model 2. The model indicates the restricted net effect of school leadership aspects on professional learning community and learning climate. The fourth step is expanding Model 2 with teacher characteristics. Ten characteristics are added as a set of covariates: teacher's gender, employment status, number of years teaching, formal education, efficacy in classroom management, efficacy in instruction, efficacy in student engagement, teaching science and/or humanities subjects and teacher's autonomy. This results in Model 3, the most extensive model to estimate the net effect of school leadership aspects on professional learning community and learning climate.

Additionally, several extra multilevel analyses were performed to investigate whether integrated school leadership is more strongly related to professional learning community and learning climate than are distributed leadership or integrated leadership separately. For the construction of integrated leadership, the results of the latent class analyses are used. Four clearly different clusters of principals and four group

classes of countries and economies could be differentiated. Based on the scoring on three of four aspects of school leadership, a principal is assigned to the cluster with the highest probability. A principal's cluster number and country and economy group class number are considered as measures of integrated leadership. They are saved and added to the dataset for the multilevel analyses. The same procedure was then followed for the multilevel analyses as described above (Model 0 to 3) with only one exception: the predictors distributed leadership and integrated leadership in Model 1 to 3 are replaced by the principal's cluster number and country and economy group class number. The results of the models with integrated leadership are compared with similar models with distributed leadership and integrated leadership.

Notes

1. SPSS syntax: recode PDISLEADS (3.000000000 thru 4=3.5) (4.000000001 thru 5=4.5) (5.000000001 thru 6=5.5) (6.000000001 thru 7=6.5) (7.000000001 thru 8=7.5) (8.000000001 thru 9=8.5) (9.000000001 thru 10=9.5) (10.000000001 thru 11=10.5) (11.000000001 thru 12=11.5) (12.000000001 thru 13=12.5) (13.000000001 thru 14=13.5) (14.000000001 thru 15=14.5) (15.000000001 thru 16=15.5) (16.000000001 thru 17=16.5) 17.000000001 thru 18=17.5) into PDISLEADS_cat.

2. SPSS syntax: recode PINSLEADS (5.000000000 thru 6=5.5) (6.000000001 thru 7=6.5) (7.000000001 thru 8=7.5) (8.000000001 thru 9=8.5) (9.000000001 thru 10=9.5) (10.000000001 thru 11=10.5) (11.000000001 thru 12=11.5) (12.000000001 thru 13=12.5) (13.000000001 thru 14=13.5) (14.000000001 thru 15=14.5) (15.000000001 thru 16=15.5) into PINSLEADS_cat.

3. SPSS syntax: recode TC2G19B (0 thru 5 =5) (6 thru 10=10) (11 thru 15=15) (16 thru 20=20) (21 thru 25=25) (26 thru 30=30) (31 thru 35=35)(36 thru 40=40) (41 thru 45=45) (46 thru 50=50) (51 thru 55=55) (56 thru 60=60) (61 thru 65=65) (66 thru 70=70) (70 thru 75=75) (76 thru 80=80) into TC2G19B_cat.

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