

Report from the FP7 project:

Assess Inquiry in Science, Technology and Mathematics Education



ASSISTME

Educational system factors influencing student assessment methods in science, technology and mathematics education

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A main goal of the ASSIST-ME project is to find out effective combinations of formative and summative assessment methodologies. As the project is based on the existing assessment procedures and methodologies used in a range of educational systems in Europe, we need to identify differences that occur between European countries.

Such differences are described in Eurydice (2011) and other European projects (S-TEAM, ESTABLISH, PRIMAS). The project aims to use this data and combine it with data on variables that are found, as part of the project, to have an effect and impact on the promotion of inquiry-based STM education, to characterize educational systems in Europe.

A first set of ten dimensions (see Table 1.1.6 of ASSIST-ME project) had served as a starting point. As the ASSIST-ME consortium represents a broad spectrum of educational systems, at least one of the participant countries is a paradigmatic example for one end or for the other of each dimension. For example: France represents a typical centralized system but Switzerland a typical de-centralized system; Germany has very strong streaming from the beginning of grade 5 (in 13 out of 16 federal states) but Finland has no streaming at all until after the end of grade 9.

This identification of paradigmatic examples is not sufficient to provide the consortium and especially WP4, 5 and 6 with systemic information needed for trial implementations. Consequently, the UJF-LSE research team as WP3 leader had been in charge of describing and characterising the consortium educational systems with respect to variables and factors relevant to both formative and summative assessment in STM.

A first stage has led to elaborate a matrix of five main dimensions that are split in fifty-six variables and to propose a survey among the whole consortium. The current report represents the second stage of the study. It will aim at distinguishing few clusters of countries that are similar with respect to each dimension.

This second stage will lead to map out the consortium with respect to relevant variables that might influence the uptake of formative and summative assessment strategies in IBE in STM.

The first part is devoted to the methodology framework. The second part presents the results of the analysis of the survey with respect to each of the five dimensions of the matrix. For each dimension the differences between the data provided by the partners and the point of view of each NSP are made explicit if necessary. The third part consists of recommendations for the project.

Executive summary

This report aims to provide the consortium with systemic information needed for trial implementations of formative and summative assessment (FA/SA) methods in inquiry based science, technology and mathematics education (IBSTME).

It consists in mapping out the partners' countries following five dimensions that results from a previous survey through the consortium (deliverable 3.1). That led to the elaboration of an online questionnaire which was responded by each partner; each dimension is filled out by a set of close-ended questions and one open-ended question (deliverable 3.2). A first report presenting the results of the online questionnaire was delivered to each member in order to be commented by some national experts (deliverable 3.3). Thus, the characterization and the comparison of the educational systems results from a quantitative and qualitative methods. The quantitative approach relies on close-ended questions, which allows us to compare the different educational systems on the same basis. The researchers' answers to the questionnaire was analysed using a quantitative method. This is based on multiple correspondence analysis (MCA) with countries as subjects and questions from one dimension at a time as variables. The qualitative approach consists on analyzing the open-ended questions and the comments from the experts in order to grasp the fine details of each educational system and to moderate the results from the close-ended questions.

The outcomes of this study are twofold. A first part is related to the National Stakeholders Panel (NSP), and a second to the Teacher Expert Panel (TEP) and the Local Working Groups (LWG).

Regarding to the NSP,

Two ways to reinforce the understanding of ASSIST-ME methods and goals appear depending on the system organization and management:

- Centralized countries need to interact mainly with the central deciders: Cyprus (CYP), France (FR) and Germany (GER) if we only take into account the Schleswig-Holstein German State of the ASSIST-ME partner.
- Decentralized countries need to interact mainly with schools and teachers. This is the case for United-Kingdom (UK), Denmark (DK) and Finland (FIN)
- Two countries move between these two poles depending of variables and criteria. This is the case for Switzerland (SW) and Czech Republic (CZ).

The uptake of IBSTME and FA appears as strongly external to teacher culture in any countries. Nevertheless, regarding in-service teachers, except for CYP, these two subjects are part of some CPD programs since 5 years at least. Thus, except for CYP, the members need to reflect with NSP about two questions:

- How to renew the CPD programs towards IBSTME and FA/SA in order to emphasize the interest of the combination of these two approaches? The teacher population is quite experienced and this entails that CPD programs need to be innovative.
- Is it necessary to enhance the part of IBST and FA/SA in CPD programs?

The uptake of the competence model is very diverse. Some members cannot rely on any habit or skills in the use of a competence model by teachers (DK, SW and UK). Some cannot rely on the uptake of the competence model by secondary schools teachers (CYP, CZ, DK and FR). Most of members need to emphasize this uptake in science education (GER, SW) and others in mathematics education (CYP, DK, FR). In UK the competence model isn't very developed, thus the linkage with science and mathematics education is very poor. In CZ, the situation is opposite but as in other countries the teachers are not very trained to use this model.

We suggest that each NSP reflects on this specific point –the role of competences in education– in order to orientate the final dissemination process towards the best targets.

Teachers in schools

In order to promote FA/SA methods within IBSTME, ASSIST-ME may rely on:

- **Teachers' habit to collaborate** in most of the countries.
- **Monitoring of students' learning** at a school level (CYP, CZ, DK, FR, UK).
- **Heads of school's responsibility** in improving educational outcomes and in orientating teachers towards relevant CPD programs in most countries.

Thus, we suggest supporting this collaboration through the design and use of FA/SA methods that will be designed by ASSIST-ME.

On another hand, we suggest that specific methods were designing for primary teachers since science is an integrated subject at this level in most countries. This design need also to take into account that mathematics is a specific subject, separated from science and technology, in all countries and for all levels.

Developing day-to-day assessment, as part of formative assessment, is a crucial point in all countries. In some countries teachers may rely on resources that already exist (CYP and DK);

in this case, we suggest minding the alignment of these actual resources with the formative assessment methods that will be produced by the ASSIST-ME project. In the other countries teachers are not used to rely on this kind of resources. Thus, the project needs to carefully foresee how to facilitate the uptake of the resources by teachers.

Summative assessment is a crucial matter in all countries. In some countries teachers have a role in the design of summative assessment (FIN, FR, SW and UK) thus the resources that will be produced by the project might be useful for them. In the other countries where the local authorities have a role in the design of summative assessment, exchanges with each NSP are required in order to connect the ASSIST-ME methods with the national rules.

1. Objectives

This deliverable aims to map out the partners' countries following the dimensions presented in the deliverable 3.3. The goal is to provide the consortium and especially WP4, 5 and 6 with systemic information needed for trial implementations.

2. Methods

The overall methodology for characterizing and comparing the educational systems relies on a quantitative and qualitative method. The quantitative approach relies on close-ended questions, which allows comparing different educational systems on the same ground. The qualitative approach consists on open-ended questions in order to grasp the fine details of each educational system and to moderate the results from the close-ended questions. This approach has led to the construction of an on line questionnaire (Annex 1) organized in five dimensions. Each dimension is filled out by a set of close-ended questions and one open-ended question.

The questionnaire was answered online by the researchers of the partners' countries. A document was produced (deliverable 3.3) which sums up, for each country, the answers to the questionnaire. For each country, some important stakeholders were asked to react to and comment the deliverable 3.3.

The researchers' answers to the questionnaire was analysed using a quantitative method. A total of 111 questions were asked. All the analysis presented are based on multiple correspondence analysis (MCA) with countries as subjects and questions from one dimension at a time as variables. As MCA deals with a set of categorical variables, non-categorical variables were previously recoded as categorical dichotomous variables (low and high) based on their distribution (mainly their median). If they were only some "not relevant" or missing data for a country on a block of questions, these answers were treated as supplementary points in the MCA. If, for one block of questions, all or most of the answers of a country were "not-relevant" or missing data, the country was dropped out of the MCA. For that purpose, a hierarchical cluster analysis was done previously to the MCA to identify the influence of the "not-relevant" or missing data on the grouping of the countries.

3. Table of variables

The final table of variables is organized in five dimensions:

1. System organisation and management
2. Schools organisation and management
3. Teacher education and professional development
4. Science education
5. Form of student assessment

Dimensions	Variables
1- System organisation and management	Centralization of educational system Curriculum Funding and resources management Teaching profession
	Structure of educational system age for choosing a career track number of students per class ratio public/private schools local targeting of resources school performance monitoring
2- Schools organisation and management	Teacher collaboration dedicated in-school structure dedicated time to collaborate teacher small groups exchanges / student learning and engagement
	Leadership teacher /decision making at school level teacher /decision making at regional level students, parents, and community /school school leaders /instruction improvement school leaders / teacher evaluation school leaders / teacher development program
	Student performances monitoring school data collecting for monitoring student progress teacher recording of student progress for internal use record / student difficulties (nature and recommendations)
3- Teacher education and professional development	Education (initial) teacher education level (required & actual) model of initial teacher education part of ECTS / educational courses part of IBST part of FA/SA
	Training (CPD) in-service education mandatory CPD programs (design & evaluation) part of IBST part of FA/SA
	Teacher population characteristics ratio age

	ratio experience length
4- Science education	Role of competence model competence model explicit or implicit specific competencies related to IBSTME competencies related to Formative Assessment
	Importance of science and math subject in the curriculum STM: separate or integrated subjects amount of time allocated STM connection with other subjects
	Importance of IBSTME IBSTME mentioned in STM curriculum IBSTME mentioned in STM textbook p IBSTME resources for teachers part of inquiry based methods in science teaching part of practical work in science teaching
5- Form of student assessment	Day-to-day assessment designing, performing and correcting day-to-day students' assessment students' progress communication students involvement in assessment of their own (and others') performance dedicated meetings for helping students and parents to make sense of the assessment information consequences of evaluation on students' career
	Summative assessment designing, performing and correcting SA teachers involvement in SA design consequences of evaluation on students' career
	Students' career and grade retention grade retention allowance grade retention limitation grade retention frequency coping with students who encounter difficulties

Table 1: Dimensions and variables that influence FA and SA in STME

4. Results

We present the analysis for all of the dimensions. The analyses presented stress the differences and the proximities between the countries. But it doesn't emphasize what is common to all of them. Thus some variables do not appear through the analysis. This disappearance can result from two causes:

- Responses are quite different but aren't sufficiently diverse for distinguishing responses.
- Responses are similar.

For the project, it is essential to identify the shared characteristics of the partners. Thus we will mention these similarities along the results.

4.1. System organisation and management

We could presume that when the curriculum is designed at the national level, without any school autonomy, teachers are reluctant to develop effective new teaching strategies.

Depending on the diversity of the school context (school intake, class size, funding and curricula) within the country, variability in the development of IBE in STM or FA/SA might be observed.

4.1.1. Variables

Dimensions	Variables
1- System organisation and management	Centralization of educational system Curriculum Funding and resources management Teaching profession
	Structure of educational system age for choosing a career track number of students per class ratio public/private schools local targeting of resources school performance monitoring

Table 2: Variables for the dimension system organization and management

4.1.2. Curriculum and textbooks

A cluster analysis (see annex 1) and a correspondence analysis produces two groups of

countries as shown in the figure below. The first group is the centralized countries and comprises Cyprus (CYP), France (FR) and Germany¹ (GER). The second group is decentralized and comprises United Kingdom (UK), Finland (FIN), Switzerland (SW), Czech Republic (CZ) and Denmark (DK).

FIN and DK are characterized by a higher independence of teacher (on curriculum implementation), UK and SW are characterized by independence of teacher associated with schools' independence and CZ is characterized by schools being independent in curriculum implementation.

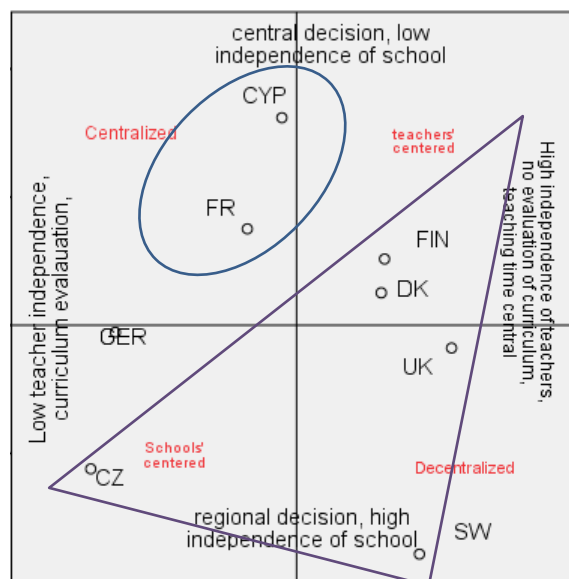


Figure 1: Correspondence analysis for text books and curriculums

4.1.3. Funding and expenditures

A correspondance analysis shows that CYP, FR GER and CZ are caracterized by low financial autonomy, class size decision centralized and central or regional authorities in charge of expenditures, school funding not based on students' success, low financial autonomy in upper secondary education (US) and funding for examination centralized in US and vocational and technical secondary education (VTS). DK differs from these countries by a high financial autonomy in US and school funding based on student's success and SW by high financial autonomy, local class size decision and school or local authorities in charge of expenditures. Finally UK and FIN form a group where school funding is based on students' success; there is

¹ For Germany, only the state of Schleswig-Holstein was taken into account

high financial autonomy in US, High financial autonomy, local class size decision and school or local authorities in charge of expenditures

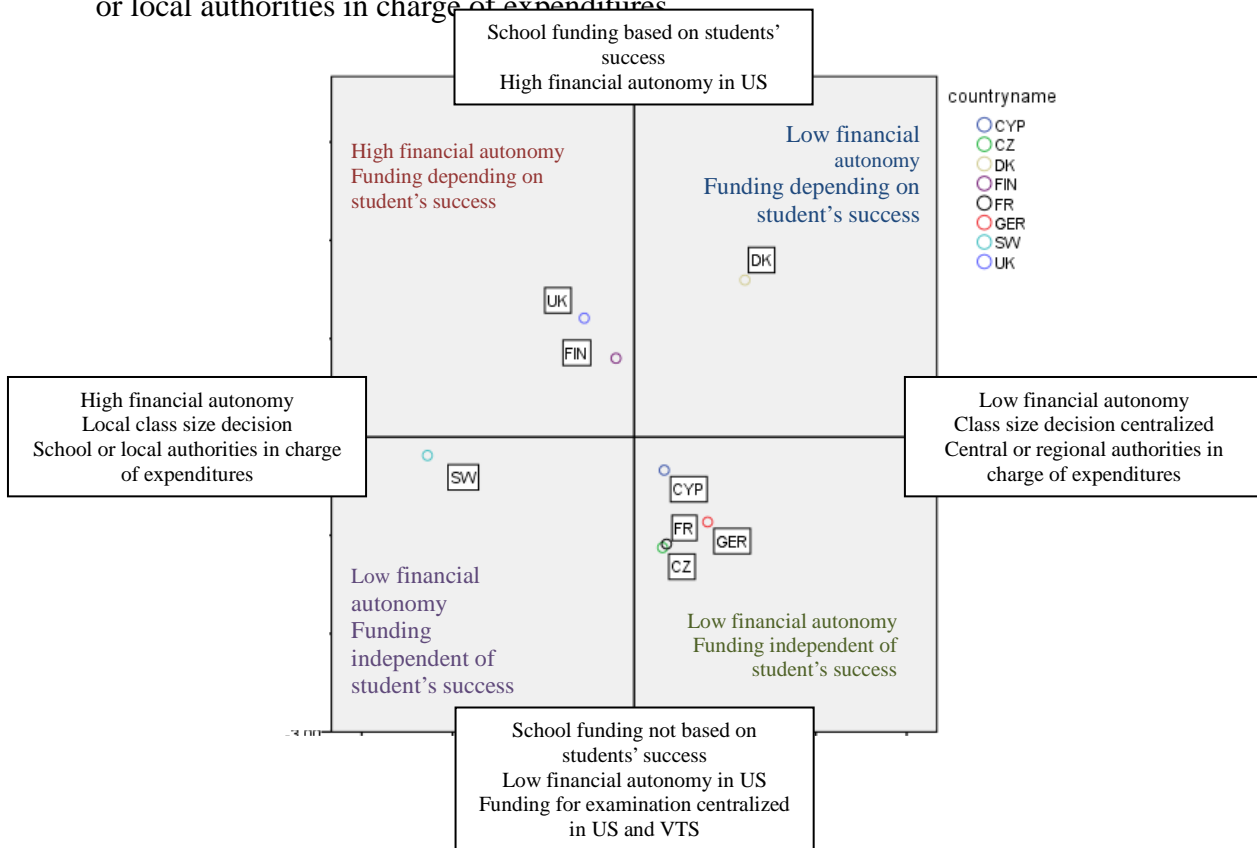


Figure 2: Correspondence analysis for funding and expenditures

4.1.4. Teacher management

A cluster analysis (see annex 2) and a correspondence analysis (figure below) produces four groups of countries. The first group (UK, DK and FIN) corresponds to countries where teachers are not civil servants and have short or medium term contracts. The second group (CYP, FR and GER) to countries where teachers are civil servants and central authorities are in charge of hiring. The third group (CZ) corresponds to countries where teachers are not civil servant and hired on long term contracts. Finally the fourth group (SW) to countries where the situation of teachers is dependent on the local context (and hence are not represented on the figure 3): Local authorities and schools are in charge of teacher hiring. Teachers can be hired for short, medium or long contracts. After two years, temporary employments are converted to indefinite employment – at least in some schools.

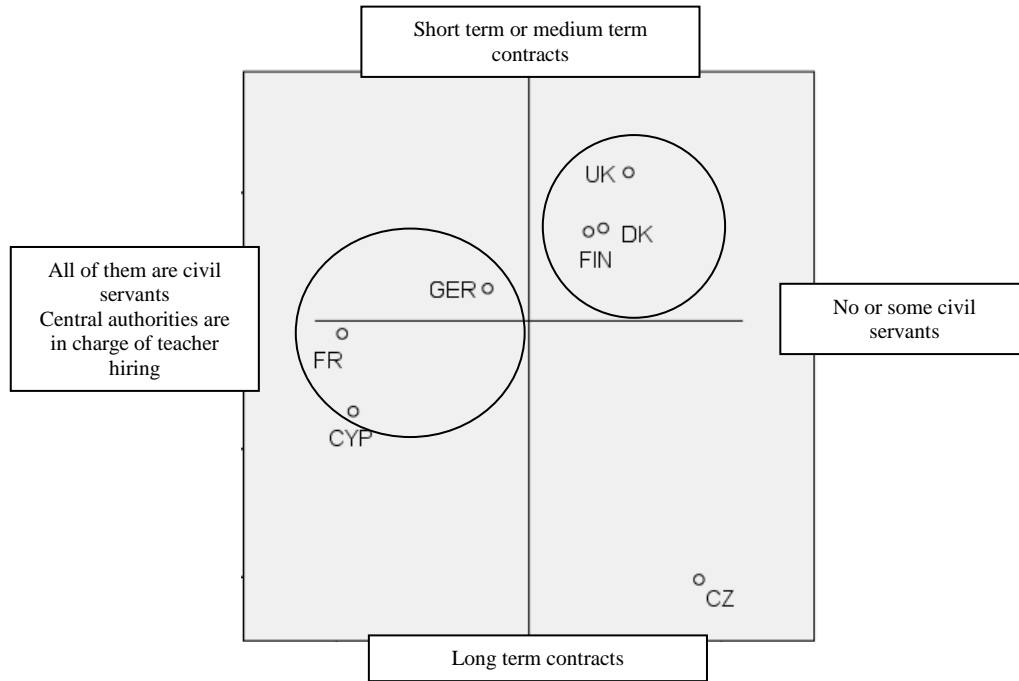


Figure 3: Correspondence analysis for teacher management

4.1.5. Ration public/private

For this variable we present the answers of the different countries in the form of a table.

	Primary (% of private schools)	Lower Secondary (% of private schools)	Upper Secondary (% of private schools)	VTS (% of private schools)
CYP		32	45	
CZ	3	5	26	26
DK	10	10	1	
FIN	1	1	1	1
FR	14	25	40	40
GER	10	10	14	3
SW		15	31	45
UK	15	30	30	

The part of private schools increases with the education level for most of the countries. It is quite high at secondary level for CYP, FR and SW, and very low for FIN.

4.1.6. Characterization of the partners countries in regards to the system organisation and management

With regards to the organization and management of their educational system, three groups of countries results from these analysis.

Firstly, CYP, FR and GER (if we consider only the German State of the ASSIST-ME partner: Schleswig-Holstein) are centralized countries regarding all the variables that underpin this dimension.

Secondly, UK, DK and FIN are decentralized countries regarding all the variables of this dimension.

Thirdly, two countries are specific. SW has a system organization and management that is not characterized by a centralized/decentralized dimension. CZ is characterized as centralized following some of the variables and decentralized following the others.

4.1.7. Implications for ASSIST-ME project

From these results we might highlight two ways to promote FA methods depending on the system organization and management.

The countries which are:

- Centralized need to interact mainly with the central deciders. This is the case for Cyprus, France and Germany.
- Decentralized need to interact manly with schools and teachers. This is the case for UK, Denmark and Finland
- Two countries move between these two poles depending of variables and criteria. This is the case for Switzerland and Czech Republic

4.2. Schools organization and management

We could presume that when the system is collective leadership oriented, teachers have the opportunity to cooperate, and they are motivated in taking into account students' diversity of wills, needs and knowledge.

Dimensions	Variables
2- Schools organisation and management	Teacher collaboration dedicated in-school structure dedicated time to collaborate teacher small groups exchanges / student learning and engagement
	Leadership teacher /decision making at school level teacher /decision making at regional level students, parents, and community /school school leaders /instruction improvement school leaders / teacher evaluation school leaders / teacher development program
	Student performances monitoring school data collecting for monitoring student progress teacher recording of student progress for internal use record / student difficulties (nature and recommendations)

Table 3: variables for the dimension schools organization and management

4.2.1. Teacher collaboration

A cluster analysis (see annex 2) and a correspondence analysis shows three groups of countries. The first group (UK and FIN) corresponds to countries where there are no or few possibilities for teachers' collaboration. The second group (SW and CZ) are countries which offers some possibilities of teachers' collaboration. Finally the last group (GER, FR, CYP and DK) are countries which offer a lot of possibilities for teachers' collaboration.

Concerning FIN, the answer to the questionnaire about teacher collaboration and the feedback from the Finnish experts about this question are not consistent. The answer to the questionnaire was: "teachers do not collaborate", the feedback to this question by the expert group was: "teachers do collaborate".

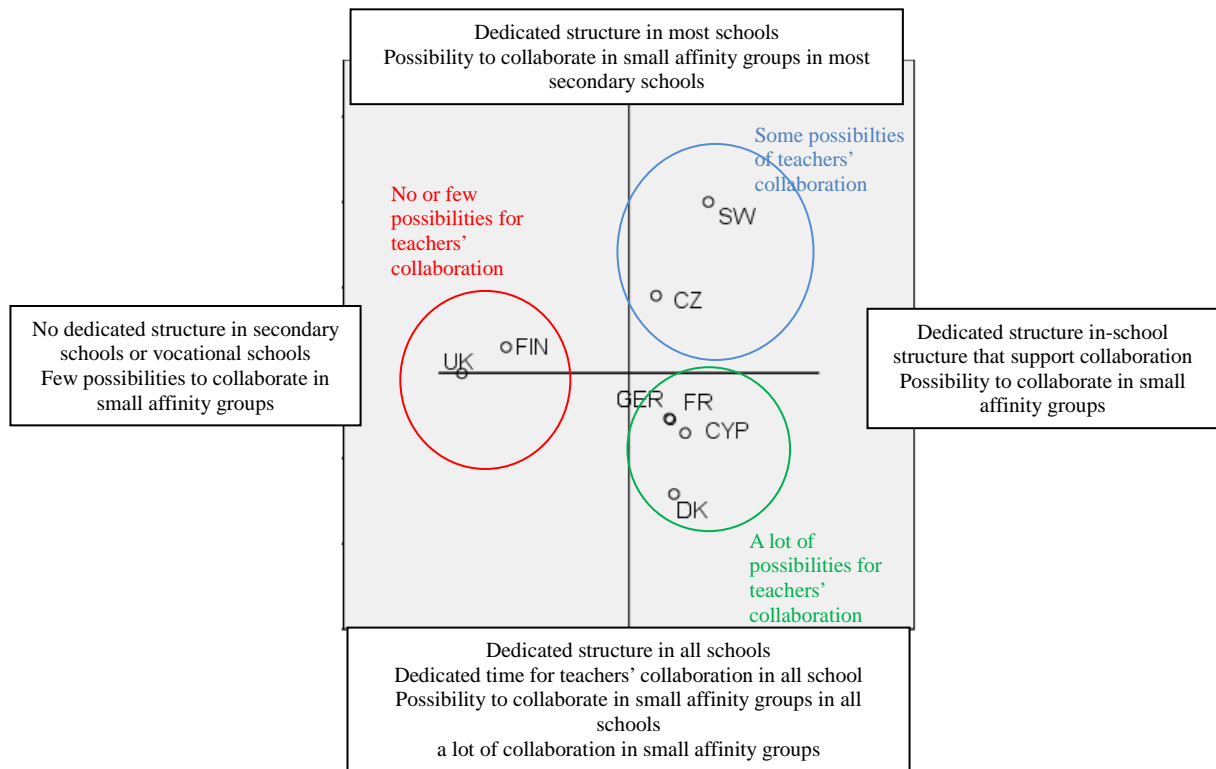


Figure 4: Correspondence analysis for teacher collaboration

4.2.2. School leaders

A first cluster analysis shows two groups with CZ being very different from the other countries. This is due to a “not relevant” answer to one question. CZ will therefore be dropped out for these variables.

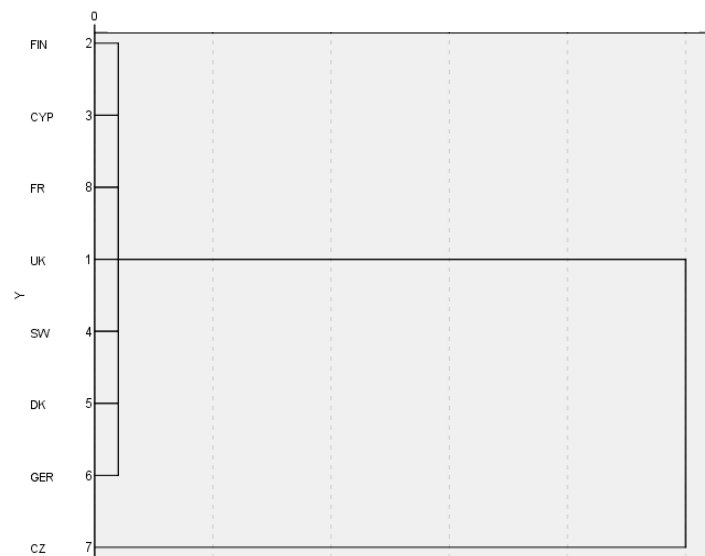


Figure 5: Cluster analysis for school leaders (with CZ)

Without CZ the result of the cluster analysis are clearer with a two group structure.

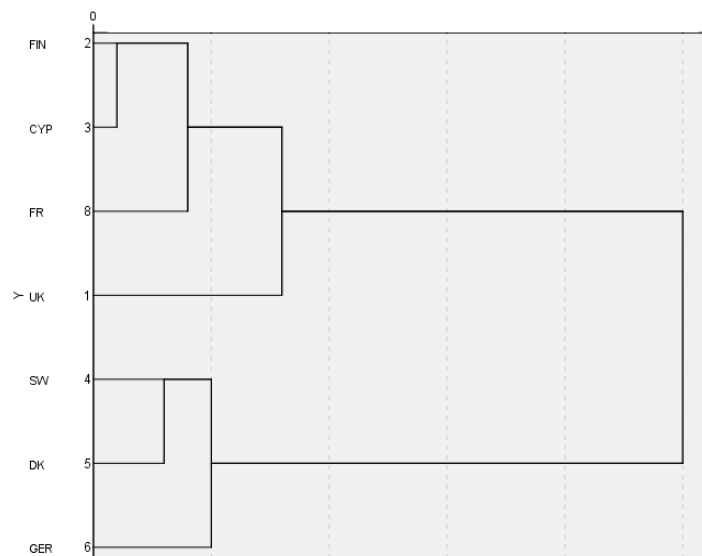


Figure 6: Cluster analysis for school leaders (without CZ)

A multiple correspondence analysis gives more details on the role of school leaders² showing four groups.

Four categories appear from the analysis of the partners' answers to the questionnaire, depending of the role that is expected from teacher leaders (head of school,) in the improvement of instruction, and in the teacher development process:

- No role at all (France)
- Only a role with respect of improvement of instruction (CYP, DK, FIN).
- In some schools, they are expected to be involved in the improvement of instruction, and in the teacher development process (UK, SW)
- In all schools, they are expected to be involved in the improvement of instruction, and in the teacher development process (GER)

Thus, with respect to the development of new approaches and methods for improving science education, it could be essential that ASSIST-ME find a way for contacting and interacting with school leaders. This is very relevant for all the countries except for France (and may be for Czech Republic).

² School Leaders = principal, director, headmaster, head teacher or head (OECD, 2008 p. 18)

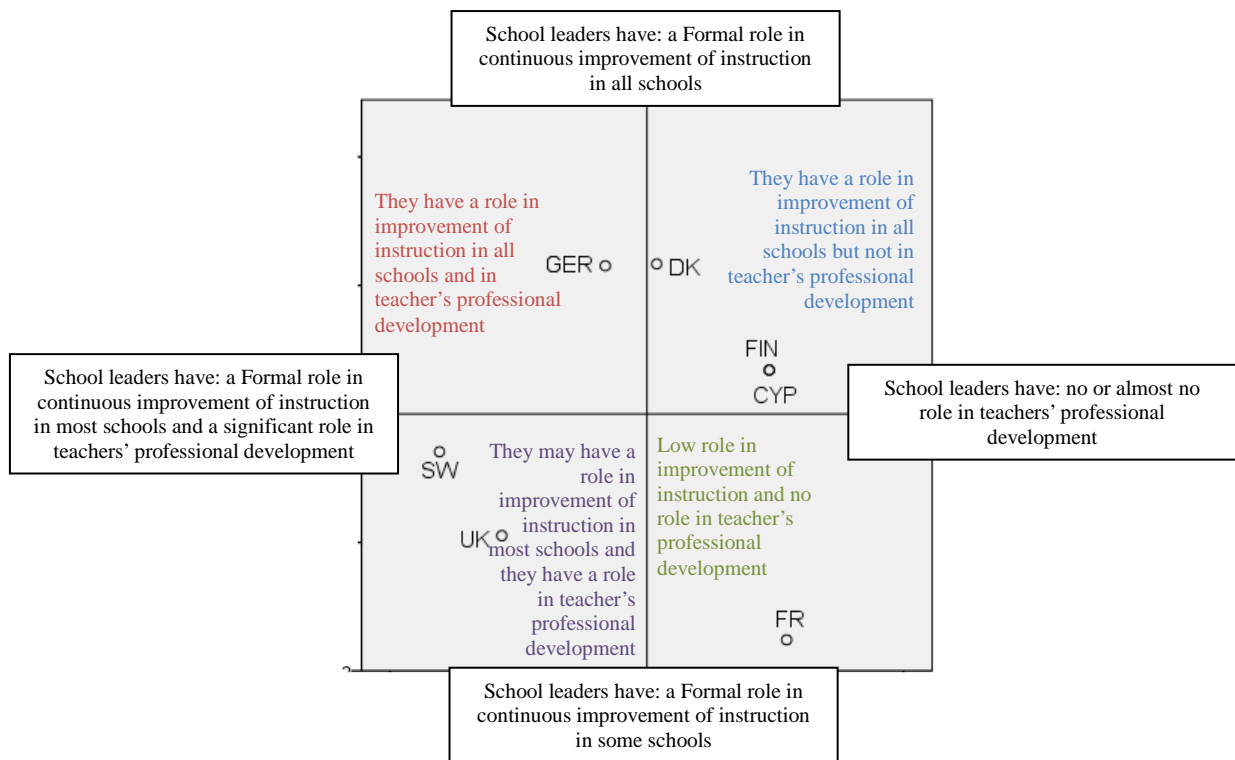


Figure 7: Correspondence analysis for school leaders

4.2.3. Influence of teachers' and parents' organizations on the decision making process and optimal functioning mapping out

A cluster analysis leads to a two group figure showing that Finland has very different answers on that group of questions (a lot of “not-relevant” answers). Finland will be drop out of the analysis.

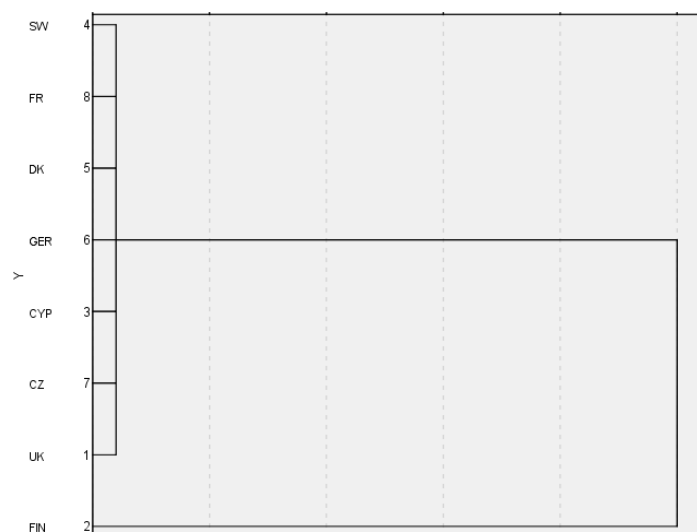


Figure 8: Cluster analysis for influence of teachers' and parents' organization (with FIN)

A second cluster analysis without Finland shows that a classification in at least 2 group is

possible.

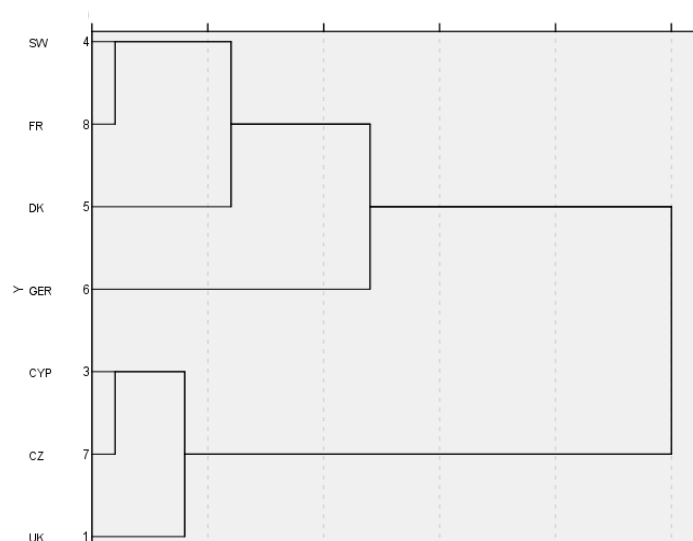


Figure 9: Cluster analysis for influence of teachers' and parents' organization (without FIN)

A multiple correspondence analysis gives more details on the influence of teachers, teachers' organizations and students or parents' organizations on the decision making process regarding school initiatives and the optimal functioning of school. It shows 3 groups:

- CYP and UK where no or almost no role is expected from teachers', students' or parents' organizations in the decision-making process;
- FR, DK, CZ and GER give a formal role for students' or parents' organizations in all schools but not for teachers' organizations;
- SW seems to be the only country where teachers' organization have a role in the decision-making process of local school initiatives but where the students' or parents' organizations have formal ways to provide input regarding the optimal functioning of school in only some schools.

We note that the role of teachers in the decision-making process regarding local school initiatives does not affect the grouping process showing that there are little differences from one country to the other regarding this variable.

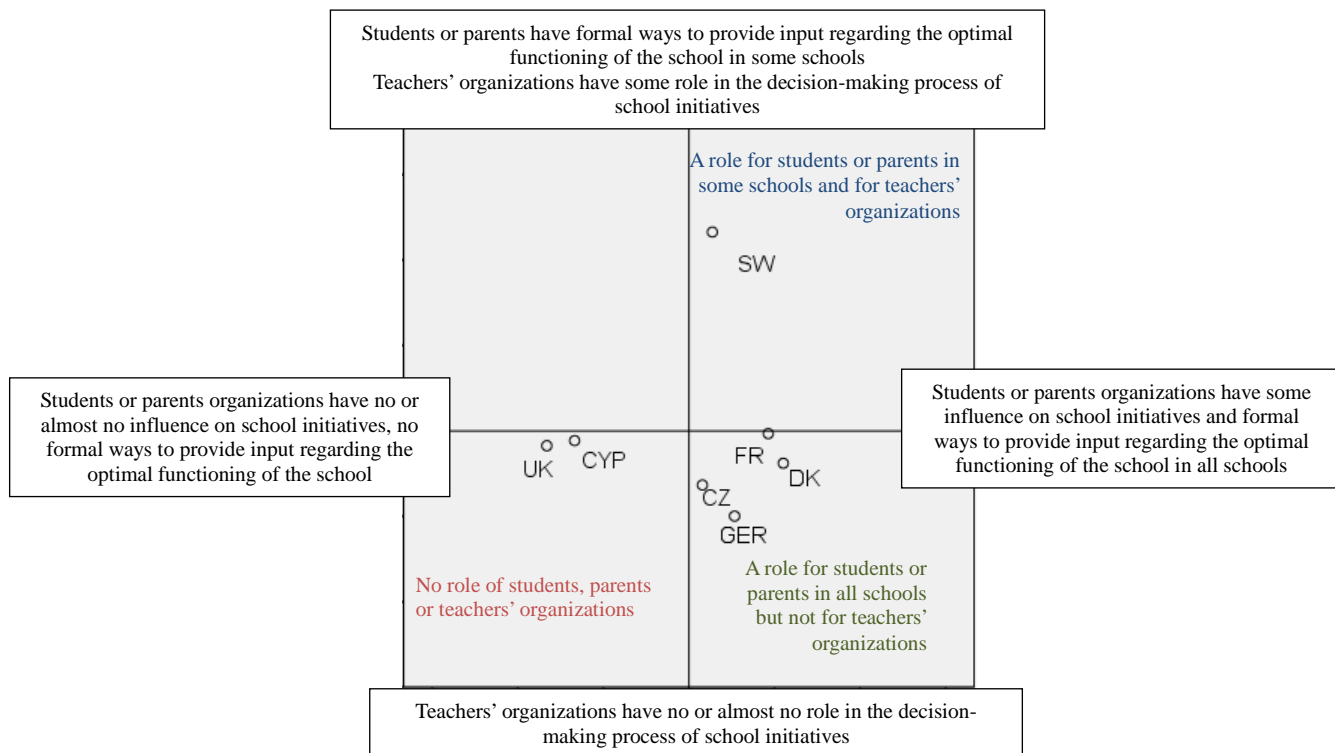


Figure 10: Correspondence analysis for influence of teachers' and parents' organization

4.2.4. Student monitoring

A cluster analysis (see annex 2) shows a three group structure:

- GER, SW and FIN
- FR, UK and CZ
- CYP and DK

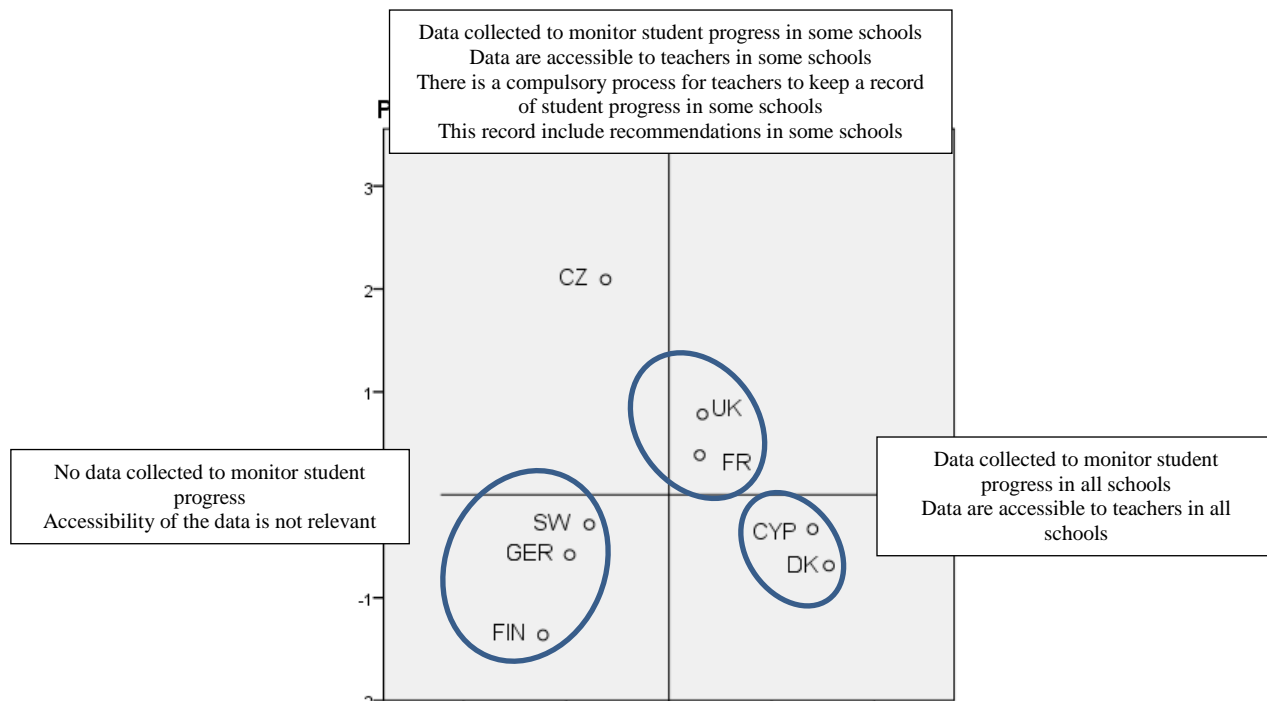


Figure 11: Correspondence analysis for student monitoring

The multiple correspondence analysis shows a first group for which no data to monitor student’s progress is collected (SW, GER and FIN), a second group in which data to monitor student progress is collected and data are accessible to teachers in all schools (CYP and DK), and a third group for which there is no data collection even though data are collected in all schools and available to teachers (FR and UK). Finally a last group appears (CZ) for which there is data collecting in some schools which are available to teachers. This record includes recommendations in some schools.

4.2.1. Characterization of the partners countries regarding the schools organization and management

The overall results of this dimension are summarized in the table below. We roughly rank each dimension from a low to a high level regarding to the importance of the variable within the educational system.

	Low		High
Teacher collaboration	FIN UK	CZ SW	CYP DK FR GER
Responsibility of school leaders towards instructional improvement and teacher continuing development	FR	CYP DK FIN	GER SW UK
Involvement of teachers’ and parents’	CYP UK	CZ DK FR	SW

associations		GER	
Monitoring of students' learning by schools	FIN GER SW	CZ FR UK	CYP DK

4.2.2. Implications for ASSIST-ME project

In order to promote FA/SA methods within STME, ASSIST-ME may rely on:

- The teachers' habit to collaborate in most of the countries; thus the design and use of FA/SA tools need to be coherent with the support of this collaboration. This might be easier in the countries where teachers are used to monitor the students' learning at a school level (CYP, CZ., DK, FR, UK).
- The heads of school's responsibility in improving educational outcomes and in orientating teachers towards relevant CPD programs in most countries.

The role of teachers' unions and parents' associations within these processes are less important (except in SW).

4.3. Teacher education and professional development

The data about teacher characteristics in terms of education, training and experience will provide information on:

- 1/ the possible part of teacher population trained in IBSTME
- 2/ the type of teacher education to be recommended.

Dimensions	Variable
3- Teacher education and professional development	Education (initial) teacher education level (required & actual) model of initial teacher education part of ECTS / educational courses part of IBST part of FA/SA
	Training (CPD) in-service education mandatory CPD programs (design & evaluation) part of IBST part of FA/SA
	Teacher population characteristics ratio age ratio experience length

Table 4: variables for the dimension teacher education and professional development

4.3.1. IBST and FA in initial training

A cluster analysis (Annex 2) leads to a 3 group figure showing that CYP has its own model, while SW, GER FIN and FR share a common teacher initial education model for IBST and assessment. A third model is adopted by DK, CZ and UK.

A multiple correspondence analysis gives more details on teacher initial education linked to IBST and assessment. It is more developed in GER, FIN, SW, FR et CYP (but it's quite new in this last country) than in DK, UK and CZ where it has a smaller place in teacher initial education.

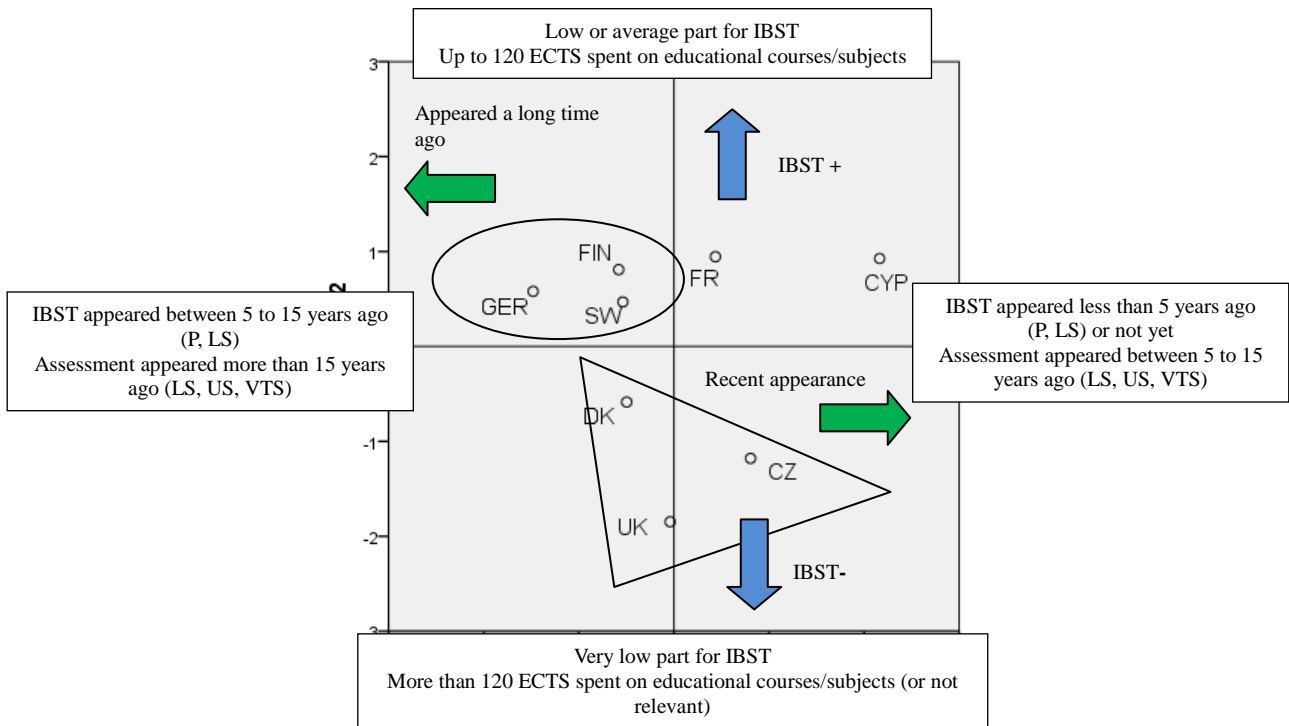


Figure 12: Correspondence analysis for IBST and FA in initial training

4.3.2. Part of IBST and FA/SA in CPD

A first cluster analysis shows that 6 educational systems (GER, CZ, FR, SW, FIN and DK) are similar in terms of part of inquiry based learning in CPD program, appearance of inquiry based learning in CPD program, part of assessment in CPD program and appearance of assessment in CPD program. UK and even more CYP appear to be different from the 6 previous educational systems.

A multiple correspondence analysis gives more details on inquiry based learning and assessment in CPD programs.

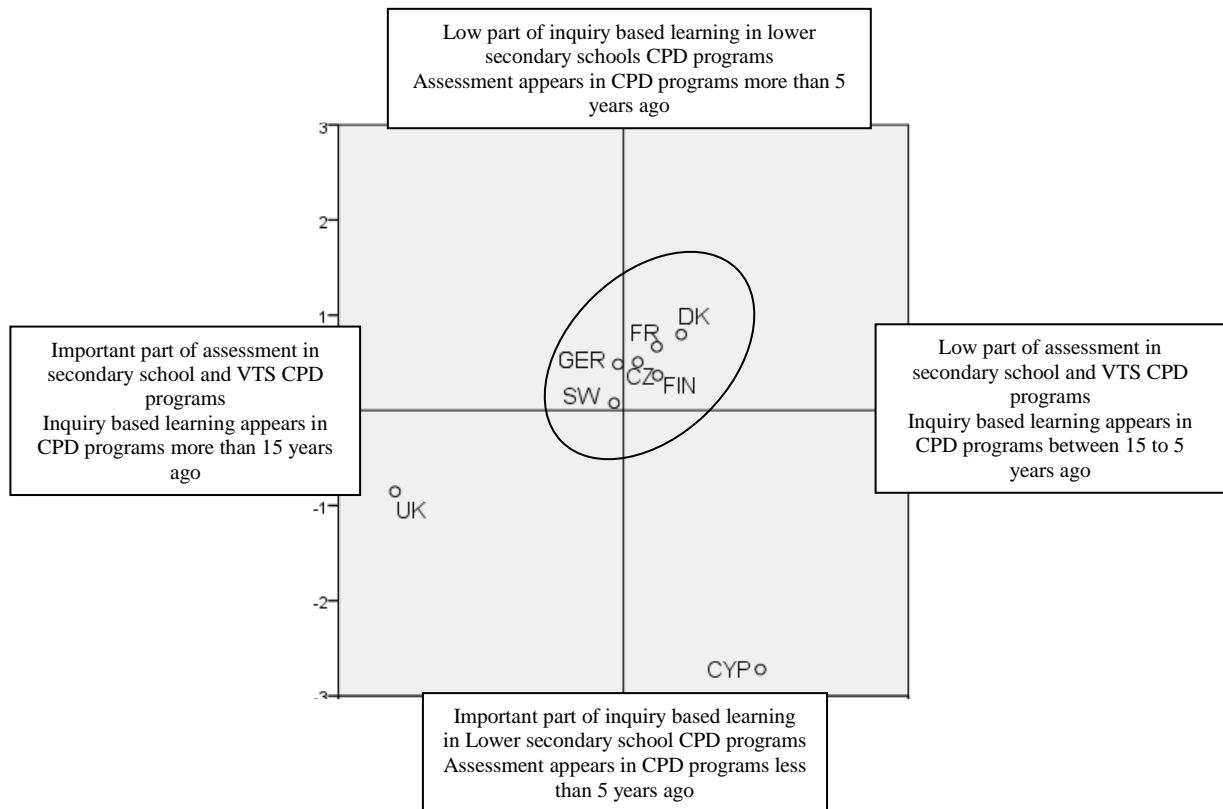


Figure 13: Correspondence analysis for part of IBST and SA/FA in CPD

The main group is characterized by a low part of both inquiry based learning and assessment (Formative/summative) in CPD programs and an appearance more than 5 years ago for both of them. The focus on both inquiry based learning and assessment in CPD programs seems more important and older in UK. On the contrary, the topic of assessment appears less than 5 years ago in CYP and have a low part in CPD program even though inquiry based learning is more developed in CPD programs.

4.3.3. Teacher population ratio age

For this variable we have chosen to present the results in a table, for the countries for which we have data.

Average age of teachers				
country	PE	LS	US	VTS
CYP	37	47	47	47
CZ	45	45	47	47
DK	45	45	48	48
FR	41	43	43	45
UK	30	35	35	

Table 5: Average age of teachers

4.3.4. Characterization of the partners countries regarding teacher education and professional development

Appearance of IBST	Less than 5 years	5 -15	More than 15
TE	CYP CZ FR	DK GER FIN SW UK	
CPD (secondary)	CYP	DK CZ FIN FR	GER SW UK

Appearance of SA/FA	Less than 5 years	5 -15	More than 15
TE		CYP CZ FR	DK GER FIN SW UK
CPD (secondary)	CYP UK	DK FIN GER SW	CZ FR

IBST and FA are not important subjects in TE in all countries. A similar weakness occurs in CPD programs except for CYP and in a minor way for UK.

IBST and FA are quite new subjects for CYP.

The teacher population is quite experienced since the mean age is more than 40 in all countries except for UK and for primary teachers of CYP.

4.3.5. Implications for ASSIST-ME project

IBST and FA are not part of teacher culture in any countries. Nevertheless, regarding in-service teachers, except for CYP, these two subjects are part of some CPD programs since 5 years at least.

Thus, except for CYP, the members need to reflect with NSP about two questions:

How to renew the CPD programs towards IBST and FA/SA in order to emphasize the interest of the combination of these two approaches? The teacher population is quite experienced and this entails that CPD programs need to be innovative.

Is it necessary to enhance the part of IBST and FA/SA in CPD programs?

4.4. Science education

We could presume that when the competence model is explicit the coordination between FA/SA is more effective, when the science departments are coordinated or integrated, students can more easily create meaning, and when IBE is explicitly mentioned in STM steering texts for teachers, the IB uptake is more effective.

Dimensions	Variable
4- Science education	Role of competence model competence model explicit or implicit specific competencies related to IBSTME competencies related to Formative Assessment
	Importance of science and math subject in the curriculum STM: separate or integrated subjects amount of time allocated STM connection with other subjects
	Importance of IBSTME IBSTME mentioned in STM curriculum IBSTME mentioned in STM textbook IBSTME resources for teachers part of inquiry based methods in science teaching part of practical work in science teaching

Table 6: variables for the dimension Science education

4.4.1. Competence model

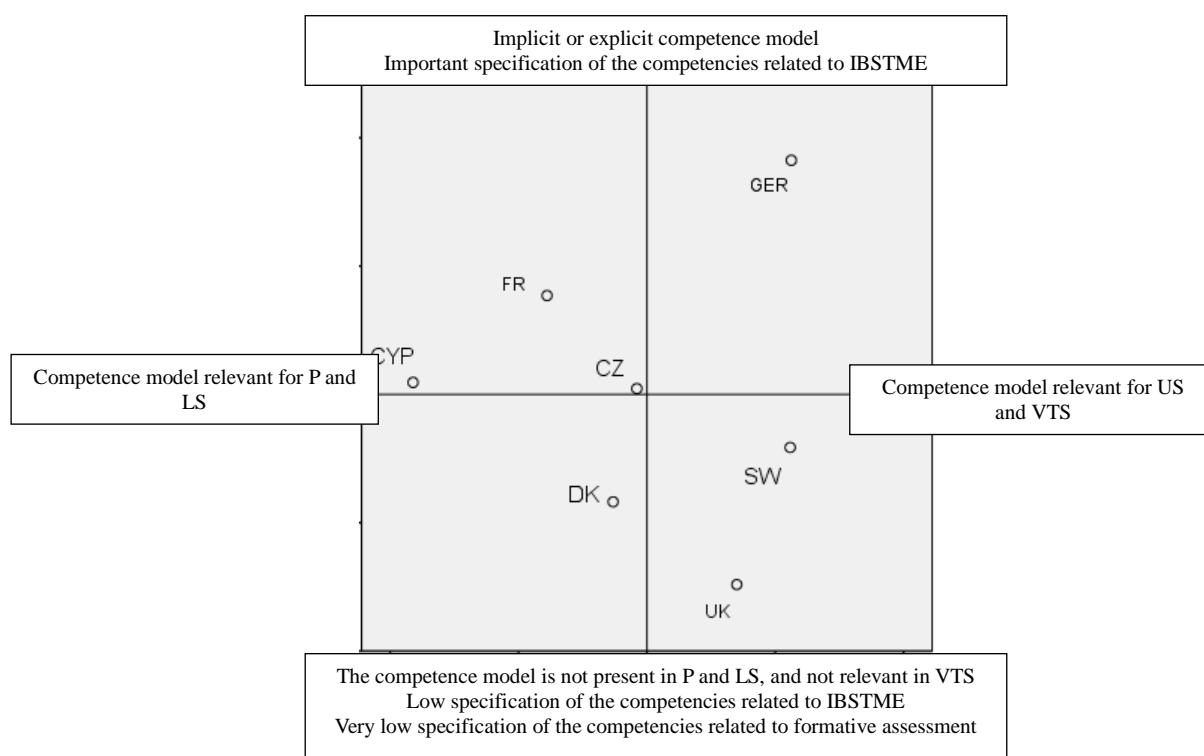


Figure 14: Correspondence analysis for competence model

The analysis of the answers related to the competence model in sciences show that some countries have a greater development in term of competence model definition for upper secondary or VTS (GER, SW and UK) level while other are more focused on primary and lower secondary competence model (CYP, FR, DK). The other distinction between national school systems is the fact that in some systems (UK, DK and SW) there is no or very low specification of a competence model in every dimension, while in other systems a competence model (explicit or implicit) exist and the competencies related to IBSTME are clearly defined (DK, CYP, FR and GER). Through it central position, CZ has a situation characterized by an explicit competence model for all level and an important specification of the competencies related to IBSTME.

4.4.2. Integrated subjects

We do not have data for UK. Without UK the result of the cluster analysis shows a 2 groups structure (see Annex 2):

- CZ, FIN and DK with low integration of subjects (only couple of disciplines in primary schools and almost no integration in secondary schools)
- CYP, GER, FR and SW with more integration of subjects (all sciences disciplines (physics, chemistry, biology, earth) are integrated in primary schools, with or without

the integration of technology, some couples of disciplines are integrated in secondary schools).

One can notice that mathematics are never integrated with other subjects

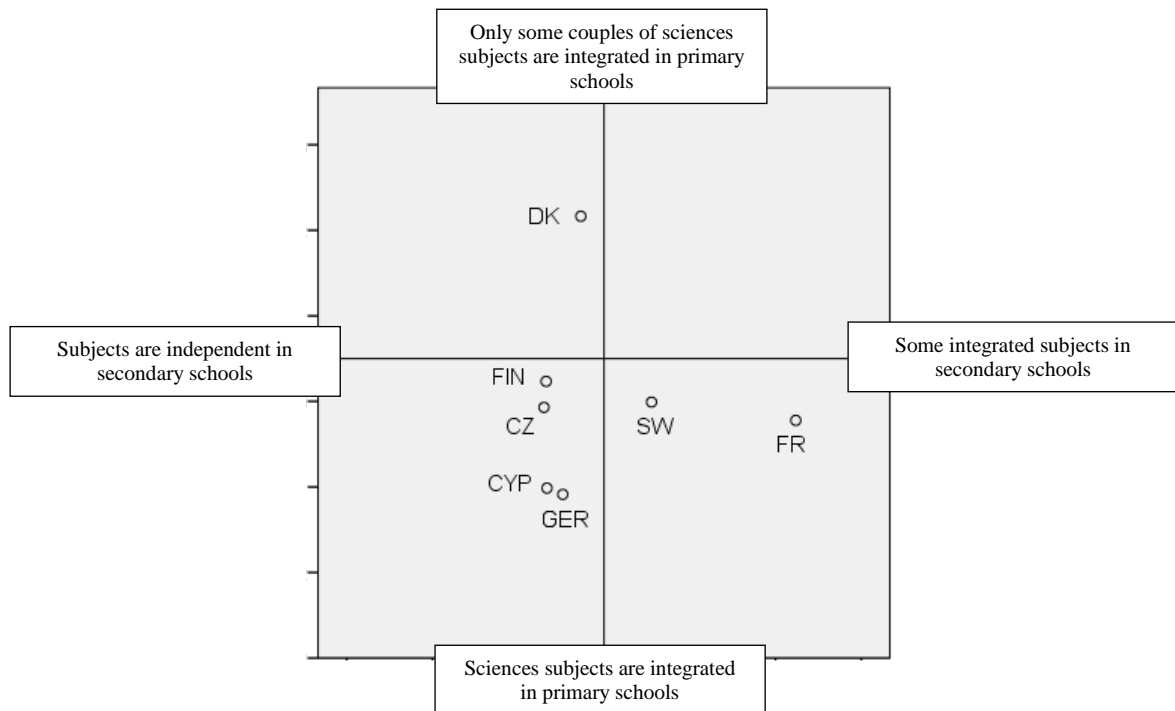


Figure 15: Correspondence analysis for integrated subjects

A multiple correspondence analysis gives more details on the integration of sciences subjects. Two countries are quite different from the others: France shows the more integrated profile with some integrated subjects even in upper secondary schools (physics+chemistry and earth+biology) when DK, on the contrary shows a low integrated profile as soon as primary school

4.4.3. Place of IBE in the curriculum

- For this variable we do not have any data concerning Finland. The result of the cluster analysis (annex 3) shows a three group structure.
- The first group (UK) with few activities mentioned in the curriculum,
- The second group (SW and GER) with some activities mentioned and some others not mentioned,
- And the third group (FR, CZ, DK and CYP) with most of the activities mentioned in the curriculum.

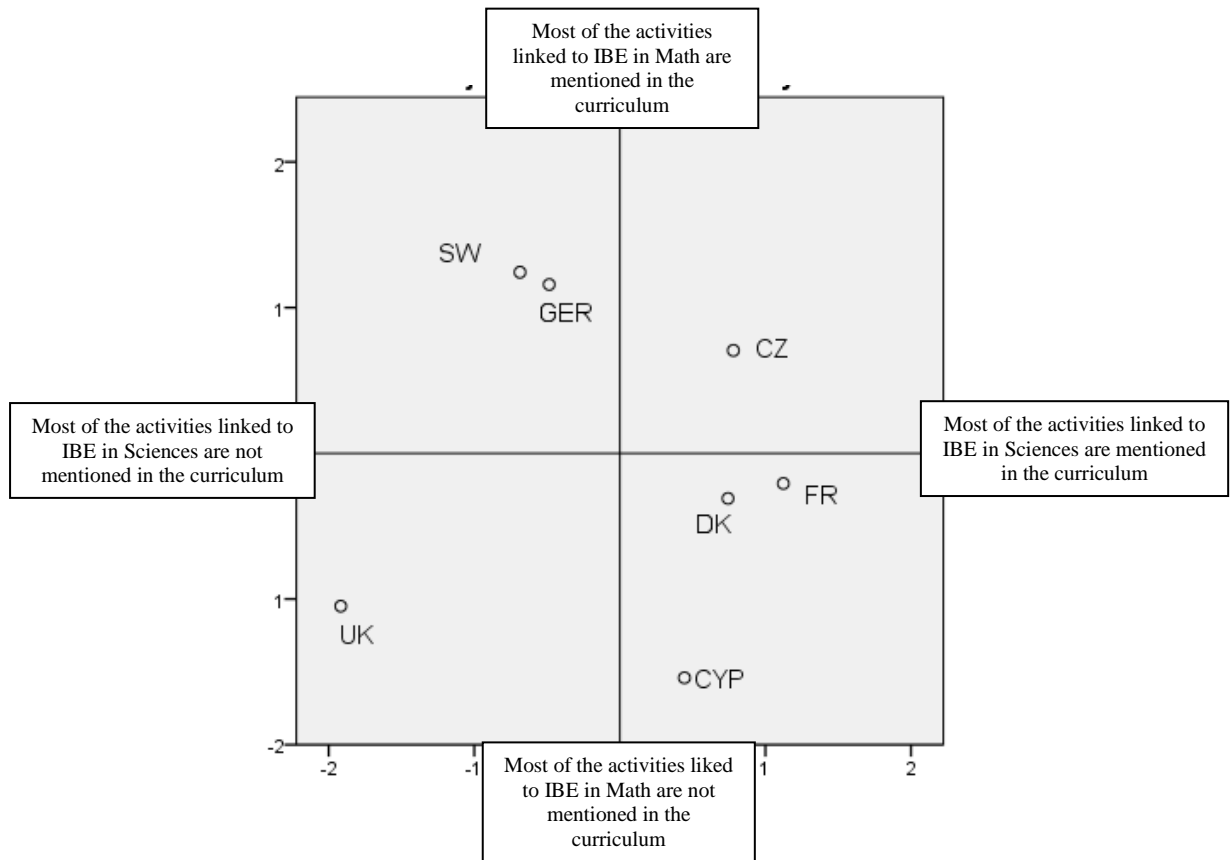


Figure 16: Correspondence analysis for place of IBE in the curriculum

A multiple correspondence analysis gives more details on the presence of explicit references to some activities linked to IBE in the curriculum of math, sciences and technology. The results show that UK is the country with the lowest level of appearance of explicit references to IBE activities in both curriculum of sciences and math. FR, DK, and CYP have numerous references to IBE activities in their sciences curriculum but lower development (even lower in CYP) of IBE activities specific to math in their curriculum. In the contrary, GER and SW have lower development of sciences specific IBE activities and higher development of math specific IBE activities in their curriculum than in the other country. Finally, CZ presents a balance profile with a high presence of both sciences specific and math specific IBE activities in the curriculum.

4.4.1. Characterization of the partners countries regarding science education

In some countries, a competence model is very important for teaching (CYP, CZ, FR, GER). Nevertheless, this competence model hasn't the same importance for all the schools levels: it is more important for primary and lower secondary schools in CYP, CZ, DK and FR than in US; and in contrary, it is more important for Upper and Vocational secondary schools in GER, SW and UK.

This model of competences is strongly related to science education in CZ, CYP, DK and FR,

and to mathematics education in CZ, GER and SW. In UK, this linkage is poor towards the two subjects.

Regarding the integration of subjects, all members have integrated subjects at primary level (excepted for DK) and separated subjects at secondary level (excepted for FR and SW). Mathematics is always a separated subject for all levels and all members.

4.4.2. Implications for ASSIST-ME project

Some members can't rely on any habit or skills in the use of a competence model by teachers (DK, SW and UK). Some can't rely on a strong linkage between competence model and secondary schools (CYP, CZ, DK and FR). Most of members need to emphasize this linkage in science education (GER, SW) and others in mathematics education (CYP, DK, FR).

They need to reflect on these points with the NSP.

UK and CZ are on two specific positions: in UK the competence model isn't very developed, thus the linkage with science and mathematics education is very poor. In CZ, the situation is opposite but as in other countries the teachers aren't very trained to use this model (see section 4.3).

The project has to design specific tools for primary teachers since science is an integrated subject at this level. At this level as for secondary schools mathematics is a specific subject.

4.5. Form of student assessment

1/As assumed in the ASSIST-ME project, when teachers are involved in the whole assessment process (at each stage from the design to the correction) they are more aware of the necessity to monitor all their students learning processes.

2/ knowing the effective teachers' practices of assessment will provide information on the implementation of FA in the classroom.

Dimensions	Variable
5- Form of student assessment	Day-to-day assessment designing, performing and correcting day-to-day students' assessment students' progress communication students involvement in assessment of their own (and others') performance dedicated meetings for helping students and parents to make sense of the assessment information consequences of evaluation on students' career
	Summative assessment designing, performing and correcting SA teachers involvement in SA design consequences of evaluation on students' career
	Students' career and grade retention grade retention allowance grade retention limitation grade retention frequency coping with students who encounter difficulties

Table 8: variables for the dimension form of student assessment

4.5.1. Day to day assessment

For these variables, we have chosen to present the data in the form of tables.

Do the programs require student day-to-day assessment?

	Sciences	Math	Technology
CYP	important requirement	important requirement	low requirement
CZ	important requirement	important requirement	important requirement
DK			
FIN			
FR	important requirement	important requirement	important requirement
GER	low requirement	low requirement	not relevant
SW	not relevant	not relevant	not relevant
UK	low requirement	low requirement	low requirement

Table 9: Programms' requirement for day-to-day assessment.

Who is in charge of designing day-to-day assessment?

	P	LS	US	VTS
CYP	teachers	teachers	teachers	teachers
CZ	teachers	teachers	teachers	teachers
DK	teachers	teachers	teachers	teachers
FIN	teachers	teachers	teachers	teachers
FR	teachers	teachers	teachers	teachers
GER				
SW				
UK				

Table 10 : Person in charge of designing day-to-day assessment.

Do resources for teachers exist in order to support the uptake of day-to-day assessment?

	P	LS	US	VTS
CYP	many resources	many resources	many resources	many resources
CZ	no resources	no resources	no resources	no resources
DK	many resources	many resources	no resources	no resources
FIN				
FR	no resources	no resources	no resources	no resources
GER	no resources	no resources	no resources	no resources
SW	not relevant	not relevant	not relevant	not relevant
UK				

Table 11: Ressources to support the uptake of day-to-day assessment.

4.5.2. Summative assessment

For this variable we do not have data for DK. Without DK the result of the cluster analysis (see annex 2) shows a three group structure.

- A first group comprising UK and FR
- A second group comprising GER
- And a last group comprising CZ, CYP and SW.

A multiple correspondence analysis gives more details on summative evaluation practices. The first dimension shows a distinction for GER from all the other schooling systems, and specifically from those using student allocations to another pathway as a consequence of summative evaluation (CZ, CYP, SW and UK). The German system is the only one where there is low requirement on student summative assessment in sciences, no consequences of summative evaluation on students' career inside the schooling system, where teacher education departments have a role to play in the design of student's summative assessment at all levels. The second dimension oppose system where authorities have a role in the design of student summative assessment like Fin and SW and where summative evaluation can lead in primary or lower secondary schools to student allocation to a permanent group featured with respect to his/her strengths and weaknesses, like in FIN, SW or UK, to the other systems.

This analysis should be considered with caution as the answers of the questionnaire and the feedback from the Germany team concerning the question of the consequences of students'

summative evaluation on students' career are not consistent. In the feedback, the team says that this evaluation has a great impact on students' career whereas in the questionnaire the answer was: "no impact".

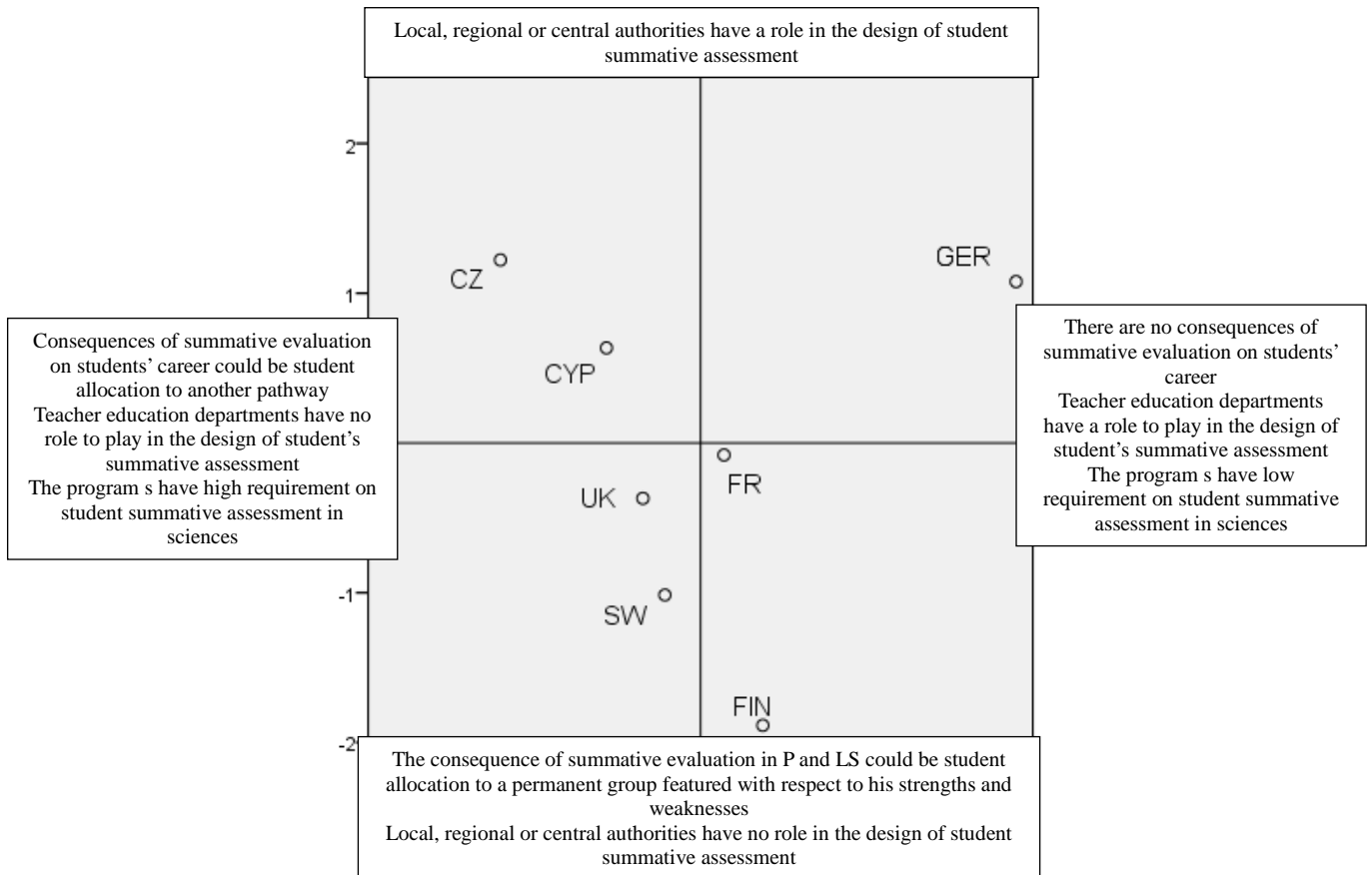


Figure 17: Correspondence analysis for summative assessment

4.5.1. Characterization of the partners countries regarding science education

Day-to-day assessment

Day-to-day assessment	Low	High
Requirement	GER SW UK	CZ CYP FR
Resources	FR GER SW	CYP DK

Only one member (CYP) has both a high requirement and a lot of resources regarding day-to-day assessment. The other members have either a high level of requirement and

very poor resources (FR) or a low requirement and thus very poor resources (GER and SW)

Summative assessment

For most members, regarding summative assessment, they have a high level of requirement. The consequences of this assessment for students are allocation to another pathway. There is poor implication of teacher education departments in designing this assessment. Nevertheless there is distinction between two groups regarding the teacher responsibility in designing summative assessment: in the first one (CYP, CZ and GER) local, regional or central authorities play a role in designing this assessment, whereas these authorities do not play any role in the second one (FIN, FR, SW and UK).

4.5.2. Implications for ASSIST-ME project

Day-to-day assessment

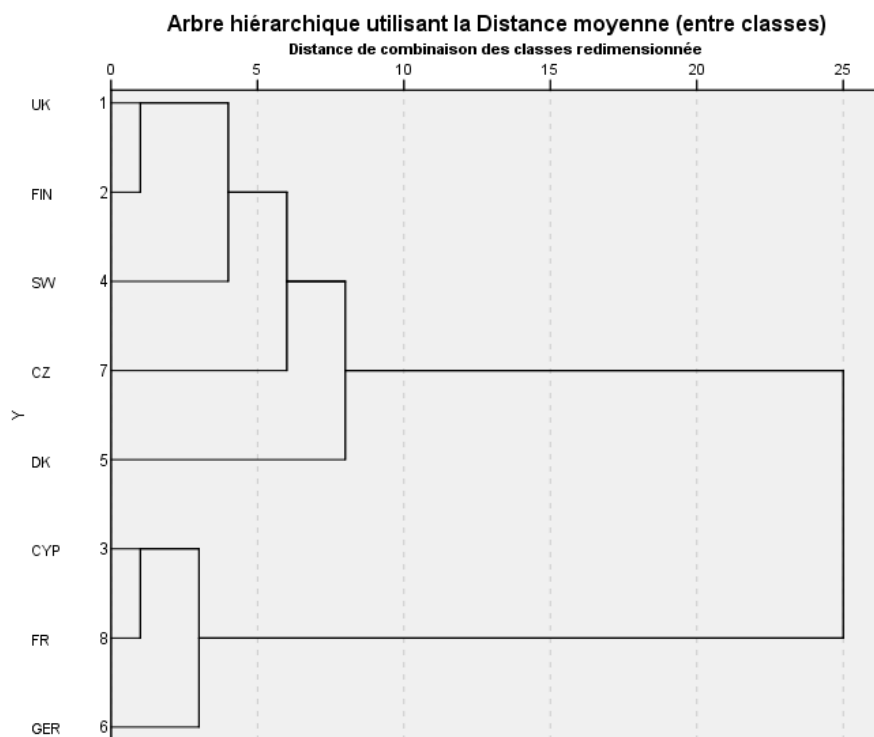
In the countries where resources already exist (CYP and DK) the project has to be careful about the alignment of these resources and the formative assessment methods that will be produced. In the other countries teachers are not used to rely on this kind of resources. The project has to foresee how to facilitate the up-take of the resources by teachers.

Summative assessment

Summative assessment is a crucial matter in all countries. In some countries teachers have a role in the design of summative assessment (FIN, FR, SW and UK) thus the resources that will be produced by the project might be useful for them. In the other countries where the local authorities have a role in the design of summative assessment, exchanges with each NSP are required in order to connect the ASSIST-ME methods with the national rules.

Annex 1: Cluster analysis

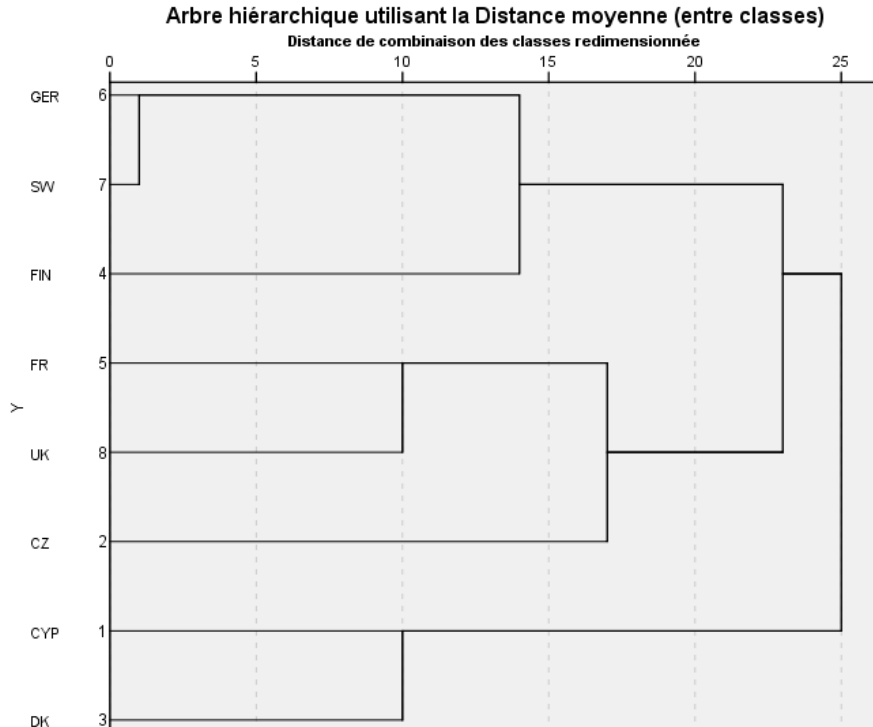
1. Curriculum and textbooks



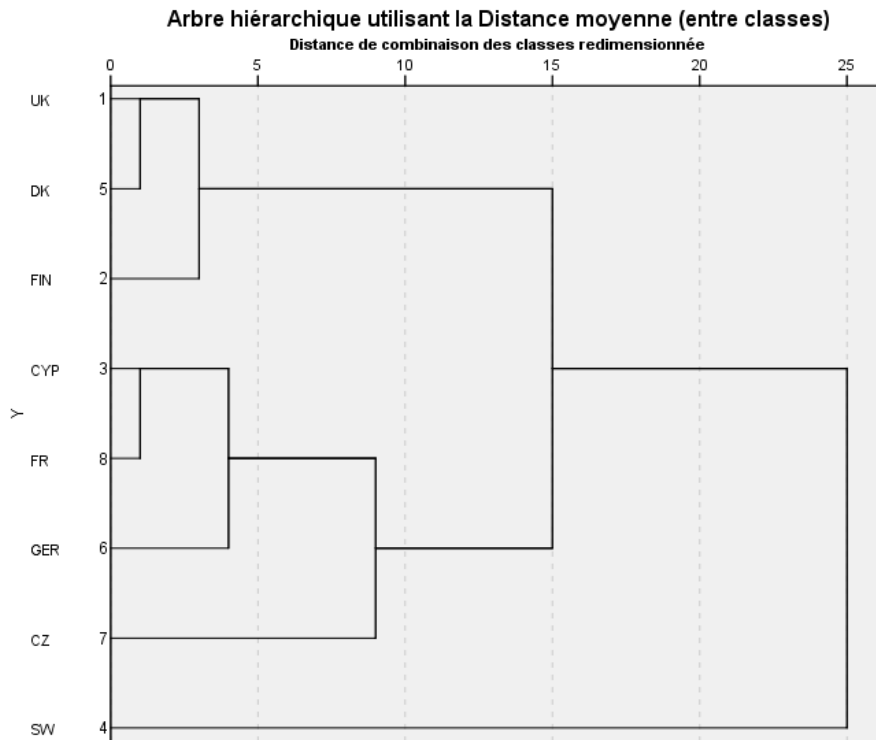
2. Funding and expenditures



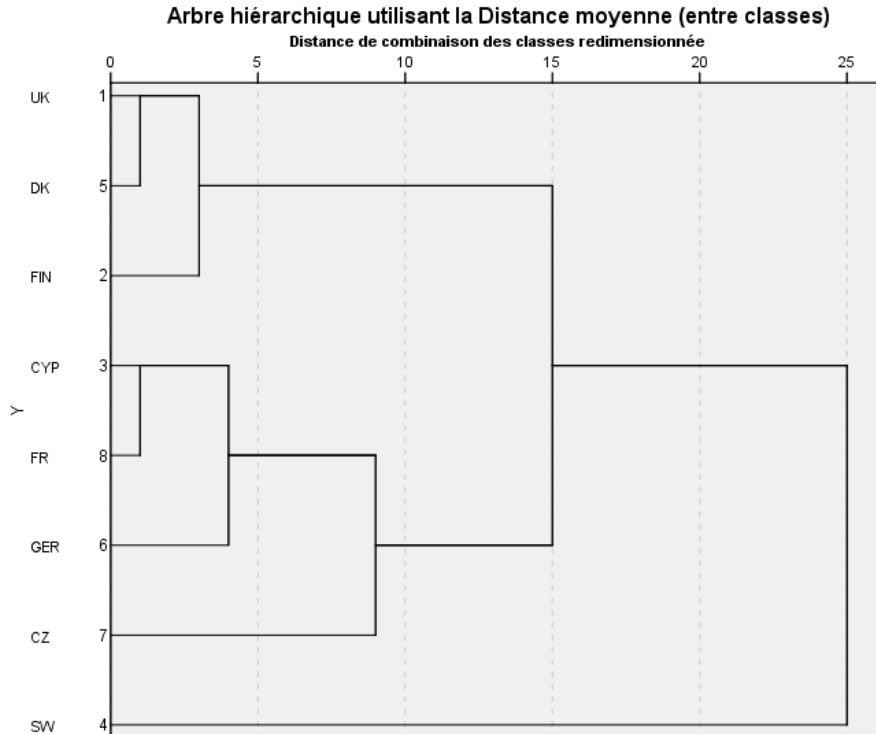
3. Student monitoring



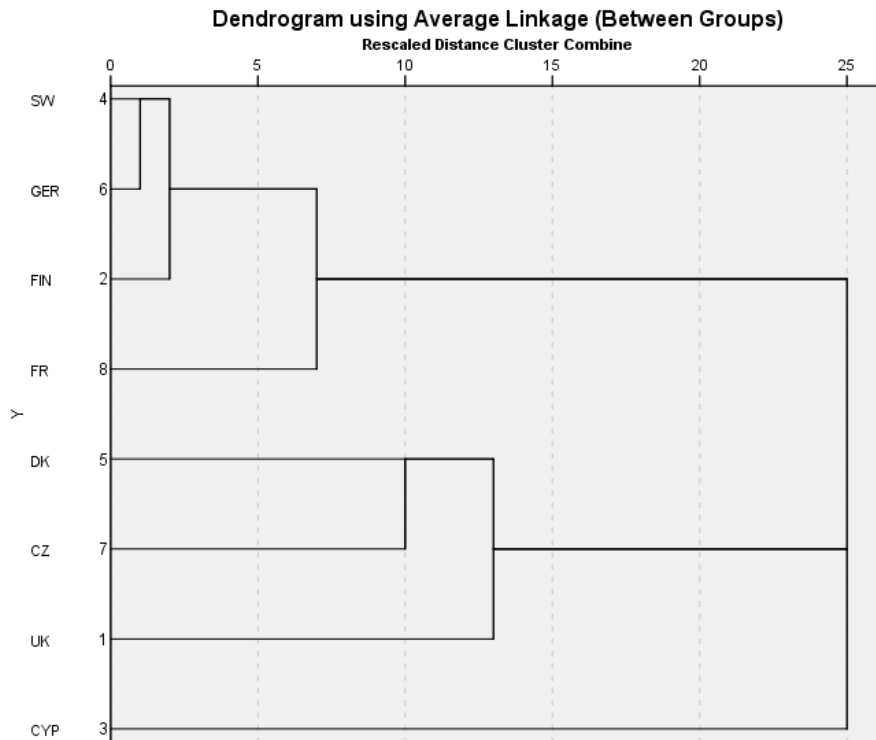
4. Teacher collaboration



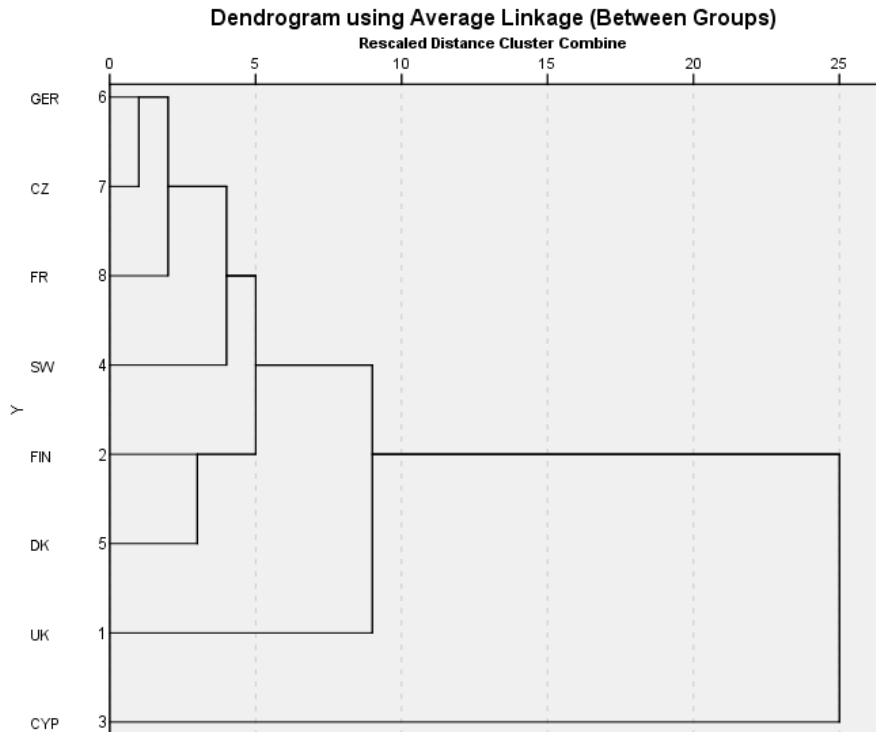
5. Teacher management



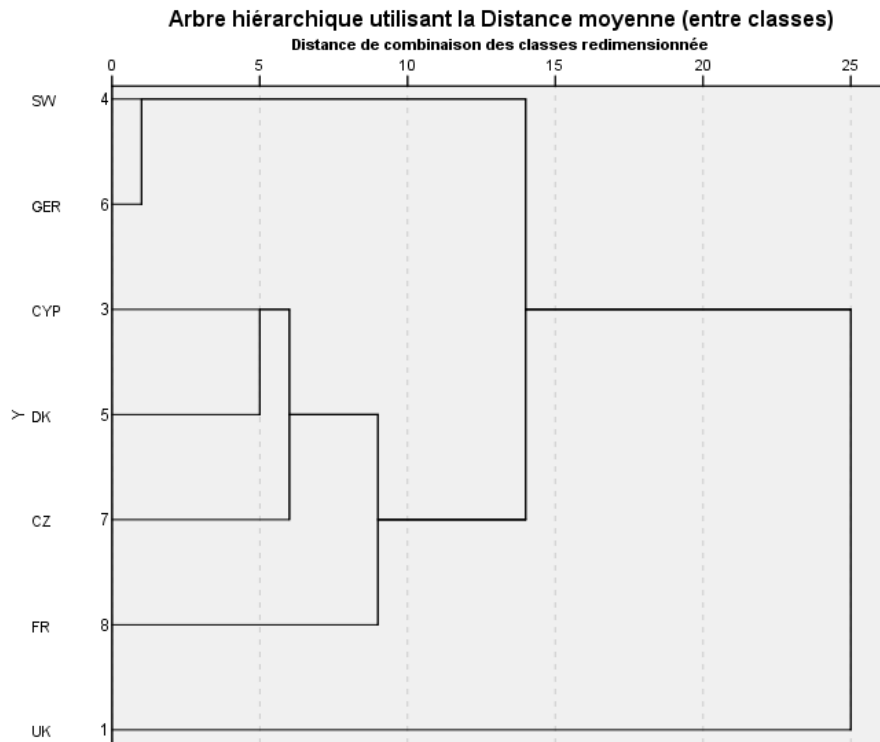
6. IBST and FA in initial training



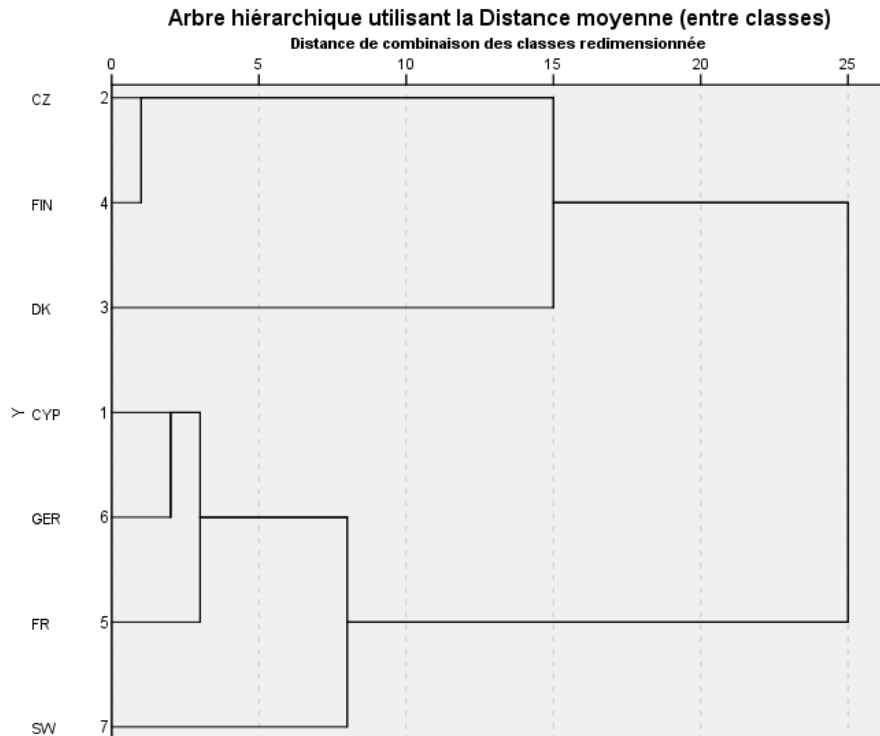
7. Part of IBST and FA/SA in CPD



8. Place of IBE in the curriculum



9. Integrated subjects



10. Summative assessment



Annex 2: First version of the questionnaire presented at the kick-off conference Jan 2013

	Criteria	Source from which the question was drawn	Questions / System
Centralization of educational system	Curriculum	OECD	Who is in charge of the curriculum? To what extent schools are allowed to adapt the curriculum?
	Textbooks	OECD	Who is in charge of textbook and learningware choices?
	Funding		Who is in charge of funding the schools (material, textbooks, documentation)
	Teacher management	OECD	Who is in charge of the teachers' hiring?
	Teacher status	Eurydice	Are they civil servants? For how long teachers are hired?
	Teachers' evaluation and consequences	PISA OECD	Who is in charge of teacher evaluation? What are the consequences of this evaluation on teacher professional development?
Structure of educational system	Streaming	Eurydice	At what age students have to choose a career (general, technological, vocational)?
	Positive action		Do Educational Zone exist?
	Public/Private	Eurydice	Ratio public/private schools

Teacher education and professional development	Education and training	Eurydice S-TEAM	What is the education level of teachers (Primary / secondary teachers)? What is the model of initial teacher education (concurrent / consecutive)? What is the part of IBST in science teacher education? What is the part of FA/SA in science teacher education?
	CPD programmes	S-TEAM	Is in-service education mandatory for all teachers? What is the part of IBST in CPD programmes? What is the part of FA/SA in CPD programmes?
	Attractiveness of teacher profession	OECD	Ratio average wage teacher/general
	Nature of teacher population	OECD	Ratio age, experience length per degree
School organisation	Collaboration		Does a dedicated structure support collaboration between teachers?
	Leadership		Is the system collective-leadership oriented? Is there a formal role for school leaders in continuous improvement of instruction?
Form of students' assessment	Day-to-day		Who are in charge of day-to-day students' assessment designing, performing and correction?
			How students' achievement is communicated to them or their family (marks, booklet, portfolio)
			What are the consequences of this evaluation on students' career?
	Certification		Who is in charge of summative students' assessment designing, performing and correction?

	Students' career and grade retention	Eurydice	Is grade retention allowed? Is it frequently practiced? What are the ways to cope with students who encounter difficulties?
Role of competence model	Explicit/ Implicit		Competences related to IBST
			Competences related to Formative Assessment (self-assessment)
Importance of science subjects in the curriculum	Integration	S-TEAM OECD	Is science taught through separate subjects / integrated department?
	Dedicated time	OECD	Amount of time allocated to science in primary/secondary schools
Importance of IB STM E	Curriculum and teacher resources		Is IBST mentioned in STM curriculum? Is IBST mentioned in STM textbook? Do teacher resources exist towards IBSTME?
	Dedicated time		What is the part of IBST in science teaching (Differentiating primary/secondary and vocational/general schools.)
	Practical work		What is the part of practical work in science teaching?

Annex 3: Second version of the questionnaire submitted to the partners in May 2013

1. System organisation and management

1.1. Centralization of educational system

1.1.1. Curriculum

Criteria	References	Relevance /4 The order of the data is: UCPH, IPN, UCY, FHNW, KCL, JYU, JU
Who has legal authority to approve changes or new curricula?	Primas WP2, p.24 OECD, 2012, p. 503	4 4 3 4 4 4 4
Who has been appointed to create new curricula or make changes?		
Who is in charge of textbook and learningware choices?	OECD, 2012, p. 503	4 3 4 4 4 4 4
How independent can schools be in the implementation of the programmes of study, in general, and in relation to mathematics, science and technology in particular?	Primas WP2, p. 24 OECD, 2012, p. 503	4
How independent can teachers be in the implementation of the programmes of study, in general, and in relation to to mathematics, science and technology in particular?		- 4 4 4 3 4 4

1.1.2. Funding and resources management

Criteria	References	Relevance /4
Who is in charge of funding the schools (material, textbooks, software, learningware, documentation)	OECD, 2012 D6	4 1 4 4 2 4 4
Who is in charge of the expenditures (material, textbooks, software, learningware, documentation)?	OECD, 2012 D6	4 1 4 4 2 4 3
Who is in charge of the teaching time dedicated to each topic?	OECD, 2012 D1.3 p 432	- 3 4 4 3 4 4
Who is in charge of the size of the classes?	OECD, 2012 D2 p 440	2 3 4 4 3 4 3
Is school funding based on students' success?		4
What level of financial autonomy do schools have?		4
Are funding and resources for examinations centralized or a part of the schools' budget?		4

1.1.3. Teaching profession

Criteria	References	Relevance /4
What is the average teacher wage compared to the average wage of the population with the same level of education (Ratio of salary to earnings for full-time, full-year workers with tertiary education aged 25-64)?	OECD, 2012 table D3.1	3
How attractive is the teaching profession? (if you have some evidences, please give them)		3
Who is in charge of the teachers' hiring?	OECD, 2012, p. 505	2 3 4 3 2 4 4
Are teachers civil servants?		3 3 4 1 2 2 3
For how long teachers are hired?		3 4 4 1 2 3 3
Who is in charge of teacher evaluation?	OECD, 2012, p. 505	4 2 4 2 4 1 4
What are the consequences of teacher evaluation in terms of teacher professional development?	OECD, 2012 D5.5 et D3.3a	3 2 4 4 ? 1 4

1.2. Structure of Educational system

Criteria	References	Relevance /4
At what age are students normally expected to choose a career track (academic, technological, vocational)?		2 2 3 4 3 4 3
How many students per class? (please 1-give the average number of students per class at each level, 2-give the min and max number of students per class if there is a legal norm)	OECD, 2012 D2	4 3 2 4 3 3 4
What is the ratio public/private schools?		2 3 3 1 3 4 3
Who is in charge of monitoring school performance?		3 3 3 3 4 2 4
What types of criteria are used for monitoring school performance?		
Is there any local targeting of resources (e.g. focusing on low income population, immigrants...)?		3 - 4 3 4 2 3

2. Schools organisation and management

2.1. Teacher collaboration

Criteria	References	Relevance /4
Is there a dedicated in-school structure that supports collaboration among teachers?		4 4 3 4 4 4 3
Is there dedicated time for teachers to collaborate with each other?		
Does the school structure allow for teachers to collaborate in smaller groups based on affinities?		4
To what extent do teachers collaborate in smaller affinity groups?		4
Do teachers have regular meetings in which they analyze and discuss evidence of student learning and engagement?		4

2.2. Leadership

Criteria	References	Relevance /4
Do teachers have formal roles in the decision-making process regarding local school initiatives?		4 4 4 3 4 2 4
Do teachers have regional or national organisations that have formal roles in the decision-making process regarding local school initiatives?		4
Is there a regional or national organisation of students or parents that can influence school initiatives?		4
Do students, parents, and community have formal ways to provide input regarding the optimal functioning of the school?		4 3 4 2 4 2 3
Is there a formal role for school leaders ³ in continuous improvement of instruction?		4 3 4 4 4 3 3
Do school leaders have a role to play in teachers' on-going evaluation of their pedagogical strengths and weaknesses?		4 3 4 4 4 2 3
Do school leaders have a role in teachers' professional development?		4 3 4 4 4 3 3

2.3. Student performances monitoring

Criteria	References	Relevance /4
Do schools collect data that monitors student progress on a continuous basis?		4 4 4 3 4 3 4
Are these data accessible to teachers?		4 3 4 2 4 1 4
Are these data accessible to students?		4
Are these data accessible to parents?		
Is there a compulsory process for teachers to keep a detailed record of student progress for internal use?		3 3 2 3 4 3 4
Does this record offer interpretive information about student difficulties?		
Does this record include recommendations for individual student improvement?		

3 School Leaders = principal, director, headmaster, head teacher or head (OECD,2008 p. 18)

3. Teacher education and professional development

3.1. Education and training (initial and CPD⁴)

Criteria	References	Relevance /4
What is the required education level of teachers?	OECD, 2012 table D5.4	4 2 3 3 4 4 4
What is the actual education level of teachers?		
Who is in charge of pre-service education of teachers at different levels?		
What is the model of initial teacher education (concurrent / consecutive ⁵)?		4 3 4 3 4 4 4
What is the approximate amount of ECTS spent on educational courses/subjects during teacher education (by school level)?		4
What is the part of IBST in science, math and technology teacher initial education? When did it appear in teacher initial education?	INQUIRE, p. 19 ESTABLISH, WP2.1 p.12	4 4 4 3 3 3 4
What is the part of Formative Assessment / Summative Assessment in science, math and technology teacher initial education?	INQUIRE, p. 19	4 4 2 3 4 3 4
When did Formative Assessment / Summative Assessment appear in teacher initial education? Je ne vois pas vraiment le type de réponses possibles		
How is teacher professional development managed in general and in relation to mathematics, science and technology teaching in particular?	Primas WP2, p.24	4 4 4 4 4 3 4
Is in-service education mandatory for all teachers?	OECD, 2012 table D5.4	4 3 4 3 2 4 4
Who is in charge of designing and providing in-service teacher education?		4 4 4 4 3 2 4
Who is in charge of evaluating these teacher preparation programmes?		
What is the part of IBSTME in CPD programmes?	INQUIRE, p. 19 ESTABLISH, WP2.1 p.12 Mind the GAP 6.1	4 4 4 4 2 2 4
When did IBSTME appear in CPD programmes?		
What is the part of Formative Assessment / Summative Assessment in CPD programmes?	INQUIRE, p. 19	4 4 4 4 4 2 4
When did Formative Assessment / Summative Assessment appear in CPD programmes?		

4 CPD: Continuing Professional Development

5 Concurrent model: Academic subjects are studied alongside educational and professional studies throughout the duration of the course. Consecutive model : The specialized courses in pedagogy and in teacher teaching are accessible after having completed another degree in a discipline taught in school, (Musset, 2010)

3.2. Teacher population characteristics

Criteria	References	Relevance /4
What is the age distribution of teachers in primary and secondary education?	OECD, D5	- 3 2 4 2 1 2
What is the experience length distribution of teachers in primary and secondary education?		

4. Science education

4.1. Role of competence model

Criteria	References	Relevance /4
Is the competence model ⁶ explicit, implicit or not present at all?		- 3 2 4 4 2 4
Does the competence model specify competencies related to IBSTME?		- 3 2 4 2 2 4
Does the competence model specify competencies related to Formative Assessment?		- 3 2 3 4 2 4

4.2. Importance of science and math subject in the curriculum

Criteria	References	Relevance /4
Is science, math and technology taught through separate or integrated subjects?	ESTABLISH, WP2.1 p.6	- 2 3 4 3 4 4
What is the amount of time allocated to science math and technology teaching?	ESTABLISH, WP2.1 p.6 OCDE, 2012 D1	- 2 3 3 3 4 4
Are science, math and technology subjects are commonly taught in connection with other subjects		

4.3. Importance of IBSTME

Criteria	References	Relevance /4
Is IBSTME mentioned in STM curriculum?		- 4 4 4 3 4 4
Is IBSTME mentioned in STM textbook or other teaching resources?		- 4 4 3 3 4 4
Do IBSTME resources for teacher exist?		4 4 4 4 3 2 4
What is the part of inquiry based methods in science teaching?		- 3 4 4 4 3 4
What is the part of practical work in science teaching?		3 3 4 3 4 3 4

⁶ 'competence model' is understood from ASSIST-ME project definition

5. Form of student assessment

5.1. Day-to-day assessment

Criteria	References	Relevance /4
Do the programs require student day-to-day assessment?		
Who is in charge of designing, performing and correcting day-to-day students' assessment?	INQUIRE, p. 15	- 3 4 3 4 3 4
Do resources and guidelines exist for designing, performing and correcting day-to-day assessment in STM subjects?		
How is students' progress communicated to them (marks, booklet, and portfolio)?		4 3 4 3 4 4 4
How common is it that students are involved in assessment of their own (and others') performance assessment?		
How is students' achievement communicated to their family (marks, booklet, and portfolio)?		1 3 4 3 4 4 4
Are there dedicated meetings for helping students and parents to make sense of the assessment information and decide strategies for improving their learning?		
What are the consequences of this evaluation on students' career inside the primary and secondary schooling system?		1 3 3 3 2 3 4

5.2. Summative assessment

Criteria	References	Relevance /4
Do the programs require student summative assessment?		
Who is in charge of designing, performing and correcting students' summative assessment?		4 3 4 3 4 2 4
Are teachers involved in designing students' summative assessment?	Primas WP2, p.24	- 3 4 3 4 3 4
Do regional or national resources and guidelines exist for designing, performing and correcting summative assessment in STM subjects?		
What are the consequences of this evaluation on students' career?		- 3 4 3 4 4 4

5.3. Students' career and grade retention⁷

Criteria	References	Relevance /4
Is grade retention allowed?		- 2 4 2 – 3 4
Is grade retention limited (e.g. restrictions exist on the practice of grade retention)?		
Is grade retention frequently practiced?		- 2 4 3 – 2 3
What are the ways to cope with students who encounter difficulties?		- 3 4 4 – 3 4

⁷ Grade retention: Countries vary in the way they help individual pupils who experience problems during the school year. Depending on the legislation in force, pupils are usually offered additional support and activities to help them catch up with their peers. However, if they still fail to meet the set objectives by the end of the school year, they may have to repeat it – this process is known as grade retention or grade repetition. (Eurydice, 2012 p. 161).