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CURRICULUM ALIGNMENT BETWEEN THE IB DP AND NATIONAL SYSTEMS: SWITZERLAND

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Executive Summary

With IB programmes available across the world in diverse educational landscapes, alignment with national educational standards is important. This project aims to provide an empirical analysis of the alignment between IB standards with the Gymnasien in two cantons in Switzerland. More specifically, the report examines (a) the ways in which the IB DP written curriculum align with national standards in selected regions in Switzerland with regard to content, cognitive demand, and philosophical underpinnings, and (b) how the intended non-scholastic attributes (if any) of international mindedness, civic-mindedness, citizenship, engagement, and motivation compare among IB DP and Swiss curriculum documentation.

The report focuses on the Diploma Programme for students in the 16 to 19 age range in IB schools which corresponds to Years 10-13 in Switzerland (years 1-4 of the Swiss Gymnasium). The regions which have been selected for the study are Geneva and Zurich, the former located in the French speaking part and the latter in the German speaking part of the country. These regions are linguistically and culturally different and internationally important with many IB schools in the area. The study compares and contrasts mathematics, spanish, geography, history as well as biology. This design covers four of the six curriculum areas in the IB schools. The analysis compares content, cognitive demand and philosophical underpinnings considering also regional and national political contexts.

There are several key findings: First, unlike in the social sciences and humanities (notably history and Spanish), there is a high-level of alignment between the IB DP curriculum and the curriculum of both cantons in the natural sciences (biology and mathematics). Second, there is little variation in the natural sciences between the two cantons which may have to do with the fact that social science subjects such as history are more exposed to reflecting political ideologies and identities of the canton. There is very limited alignment between the IB DP Spanish language curriculum and both Swiss cantonal curricula, which focus more strongly on the technical learning process than on the intercultural competences. Fourth, curricula in Switzerland emerge to a greater extent from local and national roots compared to the more international and global approach in IB DP schools. This is evident in several subjects, e.g. in geography Swiss and Alpine geography is taught and in history European history and national ideologies are part of the curriculum.

1. Project Goals

This project addresses the following goals: (a) identifying standards that represent the content, cognitive demand and philosophical underpinnings in the curricula of IB schools and Gymnasien[1] (university-preparing grammar schools) in Switzerland considering also regional and national political contexts; (b) analysing the alignment between those standards to validate that the IB Programme is at a level consistent with standards of the final four years in the Gymnasium in Switzerland.

1.1 Project Rationale

The International Baccalaureate (IB) Diploma Programme has a reputation of being challenging and rich in content allowing students to graduate in an international educational environment. With IB programmes available across the world in diverse educational landscapes, alignment with national educational standards is an important factor. This project aims to provide an empirical analysis of the alignment between IB standards with the Gymnasien in two regions in Switzerland (cantons). Given the importance of academic content, cognitive demand and philosophical underpinnings in education, such an analysis is valuable as a means to help the IB Programme to compare and evaluate the DP curricula against the backdrop of Swiss national educational policies and practices.

The need for alignment became fundamental in the context of education. The concept of alignment can be described as the degree to which the different elements of an education system interact functionally and effectively to achieve successful student learning. The elements of an education system are, for instance: standards, curricula, assessments, and instructions (Ananda, 2003; Resnick, Rothman, Slattery, and Vranek, 2003; Webb, 1997). Alignment studies usually analyze the extent to which standards and assessment address the same content (Webb, 1997; Webb, 1999). By introducing his work on the enacted curriculum, Porter added the curriculum as an additional component of alignment research (Porter, 2002, 2005). Although a variation of slightly different criteria for alignment of standards and assessment is suggested by different researchers, there is general agreement

[1] The Gymansium (plural: Gymasien) is the German word for high school. The completion of the Gymnasium, called Matura in Switzerland, enables students to attend higher education.

on the most fundamental requirements for alignment. These basic stipulations are content match and depth match (LaMarca, 2001, Ananda, 2003). Content match describes the extent to which test content corresponds to targeted standards. Depth match examines whether test items reflect the cognitive complexity of the knowledge and skills defined in the standards. Alignment studies are a useful source of information and can fulfill a number of different purposes: (a) identifying gaps and possible shortcomings, (b) inform whether restructuring of the existing assessment or accountability system is advisable, (c) comparing own standards to others, (d) providing information for the development of new assessment items, (e) analyzing content validity (Ananda, 2003). Accountability plays an increasingly important role in education and drew the attention of education policymakers and researchers to the relevance of alignment. Thus, concepts of alignment have become multi-dimensional and advanced to support the education systems and maintain high quality standards. Mostly applied to curricula analysis within a country, alignment research is particularly informative in international comparisons as it provides insights into the learning preferences of different educational systems. Little is known about the comparability of IB curricula to national curricula. Obtaining such insights is important as the final years of secondary schooling prepare students to enter university courses. This study therefore examines (a) the ways in which the IB DP written curriculum align with national standards in selected regions in Switzerland with regard to content, cognitive demand, and philosophical underpinnings, and (b) how the intended non-scholastic attributes (if any) of international mindedness, civic-mindedness, citizenship, engagement, and motivation compare among IB DP and Swiss curriculum documentation.

Several curriculum alignment studies have been carried out to date (e.g. Byrd 2007, Conley 2009). For example, Conley (2009) compared the extent to which the IB standards align with the Knowledge and Skills for University Success (KSUS), which describe what university staff expect in entry-level students, college-ready standards in the United States. He found that the IB standards are highly aligned with the KSUS standards indicating that students who learn the IB DP curriculum in high school enter college with the type of knowledge and skills not only expected by university staff but also with skills known to promote academic success in entry-level courses. In science, biology and mathematics there was complete alignment whereas some discrepancies were observed in English and the languages. Many of the

individual IB standards are at a level more advanced than entry-level college courses. In addition, Byrd (2007) compared the Advanced Placement Programme (AP), which started in the 1950s when staff from elite US prep schools joined college professors, and the IB DP Programme. The AP was designed as a college placement incentive and is today an important factor in the college admissions process. Nearly 60% of US high schools participate in the AP programme. Byrd reviewed history, biology, English literature/language and mathematics in terms of content, clarity and rigour. She found that both the AP and IB DP curricula were much better than nearly all of the US state standards and exams. Consistency of course quality around the globe was found to be important for the IB DP programme. However, the review report found that teacher guides for courses are richly detailed, sometimes to a fault. The lengthy documents in some subject areas were found somewhat unhelpful leaving teachers little scope to decide what matters most. While quality checks were found to be much better in the IB DP programme, the AP (unlike IB DP) programme made courses available to any school with teachers willing to undertake them.

1.2 The Swiss Educational System

In Switzerland all levels of education lie with the authority of the governments of the 26 cantons. The cantons and local municipalities finance more than 80% of public expenditure on education. Most students in Switzerland attend a state school for their compulsory education, which is free of charge. Only 5% of the students are enrolled in a private school. Compulsory education in state schools is co-ordinated by the cantons, whereas the local municipalities run the schools (Wolter et al. 2014).

In all cantons free pre-school education (Kindergarten in the German speaking part and école enfantine in the French speaking part of the country) is provided of either one or two years. In most of the cantons the attendance of pre-school is mandatory. The German speaking cantons are an exception within the Swiss educational system as they offer a choice between two models: either a pre-school or a first learning cycle (which is called Grundstufe or Basisstufe: a combination between pre-school and the first one or two years of primary school). Including pre-school or an alternative model, compulsory education starts as early as age four or five and takes eleven years to completion (Wolter et al. 2014). Primary school starts at age six or seven and covers grades 3 to 8. All students are taught in a

basic set of subjects. Lower secondary education lasts additional three years and covers grades 9 to 11. The subjects covered differ from canton to canton and vary between the entire spectrum of disciplines in some cantons and a selection of subjects in performance-based groups in others.

Language education is special due to the cultural and linguistic variety in the country. The language in class can be German, French, Italian or Romansh, depending on the language region. In general language learning is considered very important in Switzerland. All students learn at least two languages in addition to their mother tongue as part of their compulsory education. These entail one of the other official languages of Switzerland and English.

In the lower secondary level pupils receive instruction either in all or in some subjects in performance-based groups. 90 % of young people in Switzerland complete upper secondary education at the age of 18 or 19. This enables them to start working, to transfer to a college of higher vocational training or to pursue a university degree (for which a matura/baccalaureate is required) (Wolter et al. 2014).

Inter-cantonal and national legislation regulate post-compulsory education (upper secondary level and tertiary level). The cantons and the federal government have separate responsibilities for post-compulsory education (general education schools, veterinary medicine education, universities) and thus bear responsibility for these levels of education together. The cantons are responsible for the organisation of the schools. The federal authorities are in charge of the two federal universities, the Swiss Federal Institutes of Technology.

By contrast, the IB DP programme was founded in 1968 to facilitate the international mobility of students preparing for university by providing schools with a curriculum and diploma recognised by universities around the world. It is a two-year programme for high school juniors and seniors, aged 16-19, offered in 126 countries. Recently, a middle-years and primary years programme was also introduced. IB DP students must choose one subject from each of five groups (1 to 5), ensuring breadth of knowledge and understanding in their best language, additional language(s), the social sciences, the experimental sciences and

mathematics. Student may choose either an arts subject from group 6, or a second subject from groups 1 to 5. Students take written examinations at the end of the programme, which are marked by external IB examiners. Students also complete assessment tasks in the school, which are either initially marked by teachers and then moderated by external moderators or sent directly to external examiners. There are three core courses of the Diploma Programme: (1) a 4,000 word research essay; (2) an interdisciplinary theory of knowledge course; and (3) creativity, action, service (CAS).Students write a 4,000 word research essay, complete an interdisciplinary theory of knowledge course on top of the coursework required for their subject choices. The three strands of CAS enhance students' personal and interpersonal development through experiential learning and enable journeys of self-discovery (see http://www.ibo.org/diploma).

1.3 Methodology

There are different methodologies for investigating alignment (Bloom, Madaus, Hastings 1981; Tyler 1949; Webb 1999). As this field of research is currently still emerging, alignment studies in the past were often confronted with the criticism of being too subjective and even to a certain degree arbitrary. The research field developed greatly in recent years and meanwhile applies more advanced, in-depth methods of alignment between standards, assessments, and instruction. The process became increasingly refined, asserting that assessments also include the depth and breadth of content standards for a given grade level. The current assessment process usually entails both a systematic review of the standards and a systematic review of assessment items and tasks. Hence, methodologically sound alignment studies evaluate the content match between each item and standard and additionally provide a qualitative analysis of alignment. There are several established methodologies for systematically evaluating and documenting the alignment of educational standards, the most frequently used alignment models are the Webb Model, the Surveys of Enacted Curriculum Model, and the Achieve Model (La Marca, Redfield and, Winter 2000).

This project uses a mixed method approach drawing mainly on documentary analysis, content analysis (Faas 2011) and the Surveys of Enacted Curriculum Model, which was developed, by Andrew Porter and John Smithson (Porter 2002; Porter 2005; Porter, Smithson, Blank and Zeidner 2007). As the focus of this project lies in the international

comparison of curricula, this methodological framework provides the most instructive approach for our purposes. We use documentary analysis, in which content and structure is analyzed by using a system for encoding. The data is categorized according to content topics and cognitive demand (CCSSO 2002). Cognitive demand is described using categories that are characteristic of each subject area. The cognitive demand in mathematics, for instance, may contain the following categories: memorize facts/definitions/formula, perform procedure, communicate understanding of concept, and solve problem/make connections. This categorization produces a matrix that enables a comparison of the mainstream of content and cognitive demand in the curricula of both countries and the IB curriculum (Porter et al. 2007). The encoded data can be quantified and systematically compared to the alignment of the documents. Content analysis is applied to the underlying principles of educational belief which are described in each of the curricula. The ideas go back to the American philosopher and educator John Dewey, who believed that the learning process of a growing mind is shaped by real-life experiences. Dewey argued that 'the real process of education should be the process of learning to think through the application of real problems' (Dworkin 1959: 20). Qualitative content analysis will primarily be used to address the philosophical underpinnings of the curricula, with quantification of the findings when feasible. Curriculum documents will be read and objectively and systematically reviewed. This process is described as 'data reduction and sense-making (...) to identify core consistencies and meanings' (Patton 2002: 453).

We focus on the Diploma Programme for students in the 16 to 19 age range in IB schools which corresponds to Years 10-13 in Switzerland (years 1-4 of the Swiss Gymnasium). The design includes the areas of Geneva and Zurich because these are linguistically and culturally different and internationally important with many IB schools in the area. Students in both cantons attend the Maturitätsschule/Gymnasium after 9 years of compulsory schooling. The final 3-4 years of secondary education lead to the Matura which is required to get access to university. Hence, the study concentrates on this final level of education which provides the qualification to enter university.

The study compares and contrasts the following subject curricula: mathematics (mathematics higher level in the IB schools), a modern foreign language (Spanish),

geography, history as well as biology. This design covers four of the six curriculum areas in the IB schools. Mainstream Gymnasien do not have a separate literature and language subject/curriculum and several of the arts subjects in IB such as theatre, film, and dance are also not taught which makes a comparison not feasible in these areas. An overview of the documents analysed for this project is included in Appendix 1.

The analysis compares content, cognitive demand and philosophical underpinnings taking into consideration also regional and national political contexts. The content analysis also takes account of the different socio-ethnic compositions of IB and mainstream schools in the two countries and likely impacts on curriculum design and development. The content analysis compares and contrasts learning units and topics between IB and mainstream curricula. With regard to cognitive demands, the study looks at expectations of student thinking including categories such as problem-solving and memorizing formula in mathematics or synthesising and understanding topics in social science subjects.

Following the notion of Grounded Theory (Glaser and Strauss 1999), our approach started with the collection of curriculum data aiming to develop categories from this data which capture the underlying educational objectives of each of the subjects in the different school types. This approach allows for structured comparison between the different dimensions of analysis. In a first step, the central aspects of the curriculum data were marked with codes. In order to organise the data, related codes were then grouped into umbrella concepts describing the main aspects of each group of codes. From these concepts, categories were formed which are presented in the tables of the report.

The quantitative content analysis of geography, history, biology, mathematics and Spanish curricula refers to the presence of a set of optional or pre-assigned topics in the curriculum. To this end, we will count which units and sub-units across the identified age groups in the five subject areas refer to specific topics such as identity, interculturalism, and Europe with a view of uncovering the level of alignment between IB subject curricula and curricula in two selected regions in Switzerland: Geneva and Zurich. The qualitative content analysis will focus on the discourses employed in the curriculum. For example, attention will be given as to the extent to which ‘Europe’ was constructed in political, economic, geographical,

historical, or socio-cultural terms, and the ways in which these discourses combine European and multicultural issues (see Faas 2011). As can be seen in Appendix 1, the IB DP curricula are far more comprehensive and complex than any of the subject standards issued in the curricula of the two Swiss cantons.

2. Content Analysis of Curricula in Switzerland and IB DP Schools

2.1 Biology

The Biology curricula of IB DP schools and Swiss cantonal schools show a number of similarities (see Table 1). In both school types the curricula concentrate on genetics, physiology and cells. In Switzerland these topics are taught in relation with the human body. Additionally, the IB DP curriculum applies a general view of the subject, and topics such as 'chemistry of life' and 'plant science' are also included.

Table 1: Comparison between IB DP, Zurich and Geneva Biology curricula

Content	IB DP	Zurich (ZH)	Geneva (GE)
Focus	Human biology General biology Plant biology	Human biology	General biology
Options (available areas of concentration)	Options SL, Options SL and HL, Options HL	None	None
Topics	**Core:** 1. Cells 2. Genetics 3. Ecology and evolution 4. Plant science 5. Statistical analysis 6. The chemistry of life 7. Human health and physiology 8. Nucleic acids and proteins 9. Cell respiration and photosynthesis	**Preassigned:** 1. Genetics 2. Environmental issues 3. Evolution 4. Human Nutrition 5. Physiology	**Preassigned:** 1. Cells 2. Genetics 3. Ecology 4. Evolution 5. Physiology 6. Immunology

The IB DP curriculum provides the most variation offering general biology, human and plant biology, whereas Geneva only focuses on general biology and Zurich on human biology. The DP curriculum for biology presents three options including several sub-

topics for students. The topics in Switzerland are all pre-assigned[2] leaving no options for students to specialize in an area. The IB DP curricula cover a broader spectrum including different aspects of human biology such as nutrition and health, neurobiology and behavior and human physiology. Students can define their area of concentration according to their interests and preferences choosing between one these topics and sub-topics.

The biology curriculum of IB DP schools and the cantonal schools in Geneva are structured in a very similar way showing alignment in five of the six topics taught in Geneva. Biodiversity is the only topic, which is not included in the IB DP curriculum. There is also alignment between IB DP schools and Gymnasien in Zurich. Two topics, physiology and genetics, are included in both core curricula, whereas human nutrition can be chosen as an option in the IB DP schools. The two topics, which are taught in Zurich but not included in the IB DP curriculum, are sensory organs and molecular genetics.

2.2 Mathematics

The mathematics curricula in the Gymnasien in both Swiss cantons show a number of similarities to the IB DP curriculum, but also some smaller differences.

[2] The pre-assigned topics in Switzerland correspond to the IB core topics.

Table 2: Comparison between IB DP, Zurich and Geneva Mathematics curricula

Content	IB DP	Zurich (ZH)	Geneva (GE)
Focus	- Algebra, - Functions and equations, - Circular functions and trigonometry, - Vectors, - Statistics and probability, - Calculus	- Algebra - Geometry - Vectors - Functions and equations - Probability and statistics - Differential and integral calculus	- Algebra, - Geometry - Functions and equations - Vectors, - Statistics and probability, - Calculus
Options (available areas of concentration)	**Options:** 1. Statistics and probability 2. Sets 3. Relations and groups 4. Calculus 5. Discrete mathematics	None	None
Topics	**Core:** 1. Functions and equations 2. Statistics and probability 3. Calculus 4. Circular functions and trigonometry 5. Vectors 6. Algebra	**Preassigned:** 1. Functions and equations 2. Statistics and probability 3. Calculus 4. Vectors 5. Geometry	**Preassigned:** 1. Functions and quations 2. Statistics and probability 3. Calculus 4. Vectors 5. Algebra 6. Geometry

All schools teach functions and equations, vectors and additional units of statistics and probability. The IB schools offer students the choice to select from a variety of sub-topics, which is not possible in the Swiss schools. In Geneva the curriculum shows a specific variation as history of mathematics and its interaction with other sciences is one of the teaching units. In general the mathematics curricula of IB DP schools and Swiss cantonal schools demonstrate a high level alignment with 5 identical core topics between Zurich and IB DP schools and 5 identical core topics between Geneva and IB DP schools. In contrast to the Swiss curricula, Geometry is not covered in the Mathematics HL curriculum. Students should have studied geometry prior to this course as a pre-requisite topic (Math HL guide: 15).

Variations can be found in the additional teaching units and in the optional topics. The IB DP schools again provide the most flexibility allowing students to focus on an area of interest and specialising in one of the optional topics.

2.3 History

The IB DP schools offer more diverse options whereas the Swiss schools focus mainly on European history, the world wars and political ideologies. World history and perspectives other than national and European are not a central part of the Swiss curriculum, whereas these teaching units can even be studied in depth in the IB DP schools (Route 2 and HL options).

The IB DP curriculum for history offers the most flexibility, both in terms of epochs covered and regarding the choices available for students (see table 3). The curricula in Zurich and Geneva both focus on modern history and address the decades 18th, 19th and 20th century. The topics are all pre-assigned leaving no options for students to select a specific historic period as their area of concentration. The IB DP curricula cover a broader spectrum offering both medieval history (5th to 14th century) and modern history (20th century). Students can define their area of concentration according to their interests and preferences choosing between one these historic periods.

Table 3: Content comparison between IB DP, Zurich and Geneva in history curricula

Content	IB DP	Zurich (ZH)	Geneva (GE)
Epochs covered	C500-661 1130-1302 20th century	19th century 20th century	19th century 20th century
Options (available areas of concentration)	Route 1 HL Option: Aspects of the history of medieval Europe and the Islamic world Route 2 HL Options: Aspects of the history of Africa, the Americas, Asia and Oceania, Europe and the Middle East	None	None
Topics	**Route 1:** 1. The origins and rise of Islam c500–661 2. The kingdom of Sicily 1130–1302 3. Dynasties and rulers 4. Society and economy 5. Wars and warfare 6. Intellectual, cultural and artistic developments 7. Religion and the state HL Option: Aspects of the history of medieval Europe and the Islamic world **Route 2:** 1. International relations 1918–36 2. The Arab–Israeli conflict 1945–79 3. Communism in crisis 1976–89 4. Causes, practices and effects of wars 5. Democratic states—challenges and responses 6. Origins and development of authoritarian and single-party states 7. Nationalist and independence movements in Africa and Asia and post 1945 Central and Eastern European states 8. The Cold War	**Preassigned:** 1. Imperialism 2. World Wars 3. Cold War 3. history of the 20th century 4. Swiss history 5. political theories and ideologies 6. economic and social history 7. industrialisation 8. colonialisation and decolonalisation 9. peace-keeping 10. global developments 11. politics in Switzerland 12. philosophy 12. methods in history	**Preassigned:** 1. Culture and mentality 2. World wars 3. Cold war 4. Culture and mentality 5. social organisation 6. political organisation 7. the birth of modern Switzerland

The topics covered in these three curricula differ widely. Matches can be found between the IB DP history curriculum und the curriculum in Zurich which both address the world wars and the cold war. There are no common topics between the history curricula in IB DP schools and the Gymnasien in Geneva. The content of the history classes within Switzerland is equally diverse with only 2 matching topics in Zurich and Geneva indicating a high degree of educational autonomy in the cantons.

2.4 Geography

In Switzerland, a number of the geography curricula topics were similar to those in the IB DP schools such as competence with cartographic material, diagrams as well as graphs. However, the Swiss schools, in particular in Zurich, focus more on topics related to Switzerland such as Alpine orogeny, but also on national topics with regard to social aspects such as immigration issues, consumption, culture and economy.

The curriculum in Zurich includes areas of geography with a national, regional and global focus, as well as a social and political dimension. Topics such as ecology, population and economic geography, climate and immigration issues are also part of the curriculum, which are not addressed in that much detail in Geneva and the IB DP schools.

In Geneva there is a stronger emphasis on developing a global consciousness in the curricula rather than a national. By contrast, the IB DP schools put somewhat more emphasis on statistical analysis and cartographic and empirical techniques and less focus on the social dimensions of geography and its role in citizenship education. In particular the IB DP schools and schools in Geneva have a number of similarities in their geography curricula, both have a strong focus on methodology and approach the discipline from a global perspective.

Table 4: Comparison between IB DP, Zurich and Geneva Geography curricula

Content	IB DP	Zurich (ZH)	Geneva (GE)
Focus	Methods: statistics, geographic data production and interpretation,	- Ecology - Population geography - Economic geography - Swiss geography	- Methods: statistics, geographic data production and interpretation, - Environment - Population geograhy
Options (available areas of concentration)	(SL/HL and HL options)	None	None
Topics	**Core:** 1. Locate and differentiate elements of the Earth's surface 2. Interpret, analyse and, when appropriate, construct tables, graphs, diagrams, cartographic material and images 3. Undertake statistical calculations to show patterns and summarize information 4. Research, process and interpret data and information 5. Collect and select relevant geographic Information 6. Evaluate sources of geographic information 7. Produce written material	**Preassigned:** 1. Plate tetonics 2. topography 3. geological development history of Switzerland 4. welfare 5. economic cycles, inflation, deflation 6. energy supply in Switzerland 7. climate in tropical regions 8. tropical rainforest and its threats 9. cultures of native populations 10. tourism 11. Method 12. data interpretation 13. Evaluation of geo-graphic information 14. regional geography and ethnology	**Preassigned:** 1. earth in the universe 2. human influence on nature 3. human action on the environment 4. understand the interdisciplinary relevance 5. today's global issues 6. regional geography and ethnology 7. Method 8. Interpretation, analysis and construction of tables, graphs, diagrams and cartographic material 9. Statistics 10.data interpretation 11. Evaluation of geographic information

2.5 Spanish

The IB DP curriculum for Spanish offers flexibility and choice to students whereas the curricula in both Swiss schools are fixed (see table 5). The IB DP curriculum in Spanish is organized alongside topics, the curriculum in Geneva is centered on language skills and the Zurich curriculum is a combination of both.

The two cantonal schools and the IB DP School differ in the foci of their Spanish curricula. While the IB DP School follows a more integral approach in which language learning is integrated in its social and cultural context, the cantonal schools apply a technical learning

approach. Both Swiss schools focus on language acquisition, grammar, pronunciation and orthography but in particular in Geneva, the global and social perspectives are missing.

Table 5: Content comparison between IB DP, Zurich and Geneva in Spanish curricula

Content	IB DP	Zurich (ZH)	Geneva (GE)
Focus	- Literature - Social, cultural and political issues of the Spanish language area	- Literature - Cultural and political issues of the Spanish language area - Language acquisition	- Literature - Language acquisition
Options (available areas of concentration)	**Options:** 1. Cultural diversity 2. Customs and traditions 3. Health 4. Leisure 5. Science and technology	None	None
Topics	**Core:** 1. Communication and media 2. Global issues 3. Social relationships	**Preassigned:** 1. history, literature and culture of the Spanish linguistic area 2. oral expression 3. political and social issues of Spain and Hispanoamerica 4. cultural diversity 5. customs and traditions	**Preassigned:** 1. history, literature and culture of the Spanish linguistic area 2. oral expression 3. written expression 4. political and social issues of Spain and Hispanoamerica 5. written comprehension of different text types

There is also no transfer of Spanish into related fields comparable to the topic 'Communication and media' which is offered in IB DP schools. In the cantonal schools in Geneva the Spanish curriculum focuses on four main pillars of language acquisition: written comprehension, listening comprehension, written expression and oral expression. The content is not structured alongside topics but centered on the language learning targets. Literature, theatre, music, media, discussions and dialogues are used to practice the written and oral language skills, but they are not organized in stringent topics. Thus the cultural and social aspects of the Spanish language area are only loosely integrated in the learning content. The only similarity between IB DP Schools and Gymnasien in Geneva is the reading of Spanish literature.

The curricula in Zurich share content with both other schools and include language acquisition, cultural issues of the Spanish language area and reading of literature. They show similarities to the IB DP schools in their focus on 1) social relationships and historical and cultural events, 2) on global issues and current political events of the Spanish language area and 3) the reading of Spanish literature. They share technical learning units, in particular written and oral expression and the reading of literature, with the schools in Geneva.

3. Analysis of the Cognitive Demand and Philosophical Underpinnings

3.1 Biology

The IB DP biology curriculum promotes a diversity of approaches and explanations and addresses several ways of knowing in science, but also the limitations of data and knowledge.

Table 6: Cognitive demand in Biology curricula in Zurich and Geneva

Cognitive Demand	IB DP	Zurich (ZH)	Geneva (GE)
Methods	- embrace the diversity of approaches and methods in the natural sciences - learn that knowledge is produced in observations and experiments - use models if elements are not observable - learn to produce theories - identify correlations between a factor and a outcome to	- enable students to explore, observe and document states and processes - use instruments of observation and measurement - plan, conduct, demonstrate and assess experiments - develop and evaluate hypotheses - use models - understand easy scientific texts	- learn that knowledge is produced in observations and experiments - use instruments of observation and measurement - plan, conduct, demonstrate and assess experiments - develop and evaluate hypotheses - use models - understand easy scientific texts
Making connections	- understand that data is limited - understand that knowledge is limited	- experience the natural environment - students are encouraged to be curious, to enjoy discovery and be responsible towards nature	- students are encouraged to be curious and be responsible towards nature - understand biology from an epistemological through the perspective of the history of science
Biology and its systemic context		- students are encouraged to understand systemic contexts and symbiotic communities and their interactions	
Knowledge production	- learn that science requires freedom of thought and open-mindedness	- understand the world from a natural scientific perspective	- understand the world from a natural scientific perspective

In contrast to this universal approach, the schools in Zurich discuss these issues in science in the light of specific examples such as nutrition, health, ageing and death. The schools in Geneva emphasize the historical and philosophical background of science as means to

understand the subject. The overall goal in biology is to inspire the joy of discovery but also a sense of responsibility towards nature.

In the IB DP schools the methodological diversity in biology is a central part of the curriculum. Students are introduced to the instruments of science and learn to conduct experiments and observations. They learn that research involves rigour and scrutiny but also open-mindedness. Knowledge production in the sciences differs from other disciplinary areas and thus is an important cognitive learning objective in IB DP schools. The schools in Switzerland also follow a methodological approach putting emphasis to the plurality of emprical methods in the natural sciences. Biology in the IB DP schools promotes the diversity of approaches and explanations and addresses several ways of knowing in science, but also the limitations of data and knowledge. In the IB DP schools the methodological diversity in biology is a central part of the curriculum. Students are introduced to the instruments of science and learn to conduct experiments and observations.

An additional aim of biology in Switzerland is to encourage students to be curious, to enjoy discovery and be responsible towards nature. In Geneva biology is also taught in view of its historical and epistemological roots, whereas in Zurich education in biology aims to equip students with knowledge relevant for their personal lives by addressing topics such as health. In IB DP biology curricula open-mindedness and freedom of thought play an important role. Students are encouraged to embrace diversity and address problems in biology from different perspectives and in an unbiased way.

3.2 Mathematics

In the case of Switzerland similarities can also be found with regard to the cognitive demand in the curricula in both cantonal schools and the IB DP schools. For instance, in all school types the joy and appreciation of mathematics is encouraged, but also problem-solving and the transferability of skills, as well as the precision and universality in which mathematics is communicated.

Table 7: Cognitive demand in Mathematics curricula in Zurich and Geneva

Cognitive Demand	IB DP	Zurich (ZH)	Geneva (GE)
Critical Thinking	- develop logical, critical and creative thinking, and patience and persistence in problem-solving	- develop logical and critical thinking, and problem-solving skills - develop own ideas for mathematical problems and learn to solve them with creativity and persistency	- learn to analyse problems and draw conclusions in a precise and structured way
Methods	- develop an understanding of the principles and nature of mathematics	- develop an understanding of the principles and nature of mathematics - apply geometrical knowledge in mathematical planes and spaces - apply knowledge of algebra - develop the ability to break down problems	- develop an understanding of the principles and nature of mathematics - apply geometrical knowledge in mathematical planes and spaces - learn to solve problems - apply statistical knowledge
Making connections	- enjoy mathematics, and develop an appreciation of the elegance and power of mathematics - employ and refine their powers of abstraction and generalization	- enjoy mathematics, and develop an appreciation of precise thinking - enjoy the aesthetic and elegance of mathematical evidence - understand mathematical problems and interrelations	- understand mathematical problems and interrelations - employ and refine their powers of abstraction and generalization - develop appreciation of precise thinking
Communication	- communicate clearly and confidently in a variety of contexts	- learn precise communication and reasoning - describe problems in a suitable, mathematical format	- learn precise communication and reasoning - describe problems in a suitable, mathematical format
Transferability of universality of mathematics	- apply and transfer skills to alternative situations, to other areas of know-ledge and to future developments - appreciate the moral, social and ethical implications arising from the work of mathematicians - appreciate the international dimension in mathematics through an awareness of the universality of mathematics and its multicultural and historical perspectives - appreciate the contribution of mathematics to other disciplines.	- apply mathematical knowledge to new problems	- apply mathematical knowledge to new problems

Although there is a high level of alignment in terms of content between the IB DP schools and the Swiss schools, the cognitive demand of the curriculum clearly shows different priorities. The IB DP schools emphasize the transferability of mathematics to other areas of knowledge and the universality of mathematics adding to the advancement of other areas and disciplines and being applicable in an international and mulit-cultural context. The Swiss schools see the learning and application of mathematical methods as a central objective in their curricula, but also the precise and logical way of thinking, describing, analysing and communicating which students learn in their mathematical education and apply to unknown problems in mathematics and to different areas of knowledge. Although all schools address these different factors in the cognitive demand of their curricula, it is quite obvious that the IB DP schools and the Swiss schools prioritize differently focusing either on the transferability and universality in IB DP schools or on methods and communication in Swiss schools. In all curricula the enjoyment of mathematics and an appreciation of its elegance and precision is promoted.

The nature of mathematics is seen as an abstract system of ideas and a useful tool in IB DP schools and in Swiss schools. Students' attention is drawn to questions relating theory of knowledge and mathematics in IB DP schools, and they are encouraged to raise such questions themselves. In contrast, the philosophical underpinning in Zurich schools prioritizes the creativity, elegance and subtleness of mathematical thoughts, while students in Geneva are also encouraged to be curious, imaginative and critical with regard to mathematical methods. In IB DP schools the universality of mathematical thoughts is an important aspect introducing students to a creative and transferrable way of thinking and problem solving.

3.3 History

In the case of Switzerland similarities can be found with regard to the cognitive demand in the curricula in both cantonal schools and the IB DP schools. In history, the critical analysis of the past is a priority. Whereas the Swiss curricula address all the topics from an anthropological, cultural, political, economic and social point of view, the IB DP curriculum teaches the methodologies of the subject and the use and nature of historic data to a larger extent. However, the reflection on the past and the students' historical identity is

encouraged in all curricula. Further similarities in cognitive demand can be found with regard to linkages of the present and the past through reflection and histories impact on today's societies as well as the diversity of social studies, both with regard to human attitudes and opinions and in terms of methods, sources and interpretations.

Table 8: Cognitive demand in history curricula in Zurich and Geneva

Cognitive Demand	IB DP	Zurich (ZH)	Geneva (GE)
Critical Thinking	- human experience and behaviour - physical, economic and social environ-ments; - history and development of social and cultural institutions	- differentiate between facts and opinions - appreciate controversial opinions - understand the historical dimension in the present	- understand the diversity and complexity of human reality - develop a critical perspective applying historical knowledge to the present
Methods	- analyse and evaluate theories, concepts and arguments - collect, describe and analyse data - test hypotheses - interpret complex data and source material	- analyse and evaluate theories, concepts and arguments - collect, describe and analyse data - test hypotheses - interpret complex data and source material	- analyse and evaluate theories, concepts and arguments - interpret complex data and source material
Making connections	- understanding of history as a discipline - toleration of un-certainty in content and methods	- understanding of historical events in their context - identify myths in history	- reconstruct the individual and collective memory - understand socio-historic contexts of the past
History of culture and identity	- historical identity through the study of the historical experiences of different cultures.	- develop an under-standing for other cultures	- develop an under-standing for other cultures

The philosophical underpinnings of the history curriculum in IB DP schools explore the interactions between humans and their environment in time, space and place. History is not only seen as the study of the past, but primarily as the process of recording, reconstructing and interpreting the past through the investigation of a variety of sources. It is a discipline that gives people an understanding of themselves and others in relation to the world, both past and present. In order to understand the past, students are encouraged to engage with it both through exposure to primary historical sources and through the work of historians. The Swiss curricula focus more strongly on the aspect of tolerance towards different cultures,

mentalities and value systems that students learn to tolerate and respect in the light of a historical understanding and their own traditions.

3.4 Geography

In geography, critical thinking is fostered and students are introduced to the importance of sustainability and diversity for both the physical and social environment. The differences in cognitive demand between the schools are minor (see Table 9). In line with the focus in the content of the curriculum, the cognitive demand in IB DP schools prioritizes the development and application of methodological skills and critical thinking about geographical concepts and the impact of human actions. Global responsibility is also a central aspect of the IB DP curriculum, teaching students to realize the interdependence between environmental issues and the maintenance of human welfare.

The curricula in Zurich and Geneva pursue a similar approach to the IB curriculum. In Zurich students are encouraged to think about geographical concepts in an inter-disciplinary and cross-functional way appreciating the discipline's interface position between the natural and social sciences. Their focus on methods for critical and informed evaluation of geographical concepts and actions is a less distinct objective of the curriculum in Zurich compared to IB DP schools and Gymnasien in Geneva. Students in Zurich are encouraged to develop a responsible attitude towards the environment, but also open-mindedness towards the world and its cultural diversity. In Geneva the global responsibility is also a key concept of the curriculum, which aims to teach students respect, tolerance, solidarity and global consciousness. The importance of geography for developing the capacity to understand and evaluate contemporary realities and interactions with the ecosystem, as well as economic, political and socio-cultural factors is also highlighted in the curriculum in Geneva.

The philosophical aspects of geography in IB schools highlight the dynamic of the subject that is grounded in the real world and focuses on the interactions between individuals, societies and the physical environment in both time and space. The identification of trends and patterns in these interactions is a key competence of the geography curriculum, but also the human response to change and the associated management strategies. The Swiss philosophical position encourages students to see the contacts to people, cultures and

landscapes as enrichment. Comparisons between the familiar and the new should help them to understand their own environment and enable them to identify local problems.

Table 9: Cognitive demand in Geography curricula in Zurich and Geneva

Cognitive Demand	IB DP	Zurich (ZH)	Geneva (GE)
Critical Thinking	- develop in the student the capacity to identify, to analyse critically and to evaluate theories, concepts and arguments about the nature and activities of the individual and society	- develop ability to observe and evaluate changes in the living environment	- develop the capacity to understand and evaluate contemporary realities and interactions with the ecosystem, as well as economic, political and socio-cultural factors
Methods	- enable the student to collect, describe and analyse data used in studies of society, to test hypotheses, and to interpret complex data and source material	- apply geographical methods and knowledge	- enable the student to collect, describe and analyse data used in studies of society, to test hypotheses, and to interpret complex data and source material
Making connections	- develop an under-standing of the inter-relationships between people, places, spaces and the environment	- understand that norms and attitudes are spatially formative - use geographical knowledge - understand the inter-dependence between humans and nature	- develop an under-standing of the inter-relationships between people, places, spaces and the environment - understand the consequences of human action for the environment
Global responsibility	- develop a concern for human welfare and the quality of the environment, and an understanding of the need for planning and sustainable manage-ment - promote the appreciation of the way in which learning is relevant both to the culture in which the student lives, and the culture of other societies	- develop responsibility towards the living environment - students are encouraged to be open-minded towards the world and other cultures	- develop responsibility towards the living environment - students are encouraged to be open-minded towards the world and other cultures - develop respect, tolerance, solidarity and global consciousness
Interdisciplinarity	- appreciate the relevance of geography in analyzing contemporary issues and challenges, and develop a global perspective of diversity and change.	- combines natural and social sciences - students are encouraged to recognize the larger context of topics - students are encouraged to discuss topics interdisciplinary	- students are encouraged to recognize the larger context of topics - students are encouraged to discuss topics interdisciplinary

In line with the focus in the content of the geography curriculum, the cognitive demand in IB DP schools prioritizes the development and application of methodological skills and critical thinking about geographical concepts and the impact of human actions. Global responsibility is also a central aspect of the IB DP curriculum, teaching students to realize the interdependence between environmental issues and the maintenance of human welfare.

3.5 Spanish

The Spanish IB DP curriculum focuses on the development of intercultural competence. In all schools the benefits of a language for social interaction in different contexts is emphasized alongside the gain of intellectual and linguistic skills.

The differences in cognitive demand between the schools are visible (see Table 10). In line with the focus in the content of the curriculum, the cognitive demand in IB DP Schools prioritizes cultural understanding and the role of language for the personal and intellectual development of the students. The curriculum in Geneva pursues a completely different aim; the development of linguistic and intellectual competences is the main purpose. The cultural dimension is not explicitly included into the cognitive demand of the curriculum; instead critical discourse with Spanish literature and the ability to express thoughts, ideas and arguments is the educational objective. Self-expression is an important objective in schools in Geneva facilitating intercultural exchange and communication.

The cognitive demand pursued in schools in Zurich is a combination of the approaches in Geneva and the IB DP schools. They expect students to develop linguistic competences, but a more profound cultural understanding and open-mindedness is also promoted. Engagement with language, culture and diverse ways of thinking is seen as important processes in the formation of students' identities.

The philosophical underpinning in all types of curricula promotes awareness and a greater respect for other cultures and the reflection on cultural behaviours and values. Language competences enable students to engage with different cultures and in different language areas on both a social and on an intellectual level promoting

communication, exchange and cultural understanding.

Table 10: Cognitive demand in Spanish curricula in Zurich and Geneva

Cognitive Demand	IB DP	Zurich (ZH)	Geneva (GE)
Language acquisition	- enable students to understand and use the language they have studied in a range of contexts and for a variety of purposes	- development of linguistic and intellectual competences - development of useful and situational vocabulary - competences in grammar, written and oral communication - text writing competences	- development of linguistic and intellectual competences - development of useful and situational vocabulary - competences in grammar, written and oral communication - text writing competences - improve pronunciation
Cultural understanding	- encourage, through the study of texts and through social interaction, an awareness and appreciation of the different perspectives of people from other cultures - develop students' awareness of the relationship between the languages and cultures with which they are familiar	- enable student to use language as means to participate in the Spanish speaking world - open-mindedness to-wards other values	
Role of language	- develop students' awareness of the role of language in relation to other areas of knowledge - provide students with a basis for further study, work and leisure through the use of an additional language - provide the opportunity for enjoyment, creativity and intellectual stimulation through knowledge of an additional language	- Engagement with different ways of thinking and its cultural and historical roots enables students to develop their own identities - provide students for further study or higher education through knowledge of an additional language	- enable students to critically discuss different types of texts from the Spanish speaking world - enable students to express their thoughts, ideas and arguments

4. Discussion and Conclusions

In natural scientific disciplines such as mathematics and biology the content of IB curricula and the curricula in the two selected cantons in Switzerland demonstrate a high level of alignment. In contrast, in the humanities and social sciences (particularly History and Spanish), there is a lower level of alignment in terms of content. These findings resemble Conley (2009) who found that, in biology and mathematics there was complete alignment whereas some discrepancies were observed in English and the languages when comparing IB DP programmes and US mainstream schools.

Key differences can be found in the cognitive demand of the curricula – primarily in humanistic subjects – in IB DP and Swiss schools. The local and national roots from which curricula in Switzerland emerged and the more international approach in IB DP schools could be the reason for this diversity. The cultural and political history of a region appears to have an impact on curriculum design and development. For instance, IB DP and the Swiss cantons apply different approaches to include cultural diversity into the curriculum. In Switzerland these approaches are also influenced by the political context of the country. The federal and decentralised structure of compulsory education is a specific feature of the Swiss education system. This decentralised structure is valued in the country as a way to deal with the cultural differences in a multilingual country and its regional school traditions. The notion of a European and national identity and history seems to be stronger in the curricula of the two Swiss cantons than in IB DP curricula. Therefore, languages, the promotion of a national identity and the awareness of national and regional issues and perspectives are a central aspect of education in the humanistic subjects in Switzerland. IB DP curricula have a more global approach in the humanities including also cultural studies of different world regions, the role of culture and the discussion of social issues from a global perspective.

The curricula in IB DP schools and the Swiss Gymnasien also feature different structures. In Switzerland the curricula show a strong regional influence and offer mainly topics and learning objectives relevant to the canton and the language area. The decentralised system is more restricting with regard to topics and perspectives than IB DP curricula and promotes a national focus over a cosmopolitan. In general the availability of options that

allow students to specialize in their area of choice is a benefit of the IB DP curricula and cannot be found in Switzerland. The IB DP curricula offer flexibility to pursue academic interests and require a larger amount of thought and reflection in the selection process. However, it might bear the risk that some of the options are less demanding and comprehensive than others.

5. Recommendations

1. We recommend that IB content is updated and reviewed in a regular revision cycle considering alignment with national and regional topics and updates relevant to the subject.

2. We recommend that the content be regularly scrutinized to guarantee comparability in time and effort required for each of the options offered in IB DP curricula.

3. We recommend IB curriculum experts to consider the different cognitive approaches to determine whether the IB curriculum should be revised adding additional aspects or if the cognitive objectives should deliberately not be altered or expanded.

4. In some cases the IB curricula show strong preferences towards specific aspects of the discipline's cognitive demand and appear less balanced than the curricula in Switzerland - for example, the focus on the cultural understanding of the Spanish-speaking world, the knowledge production in biology and the transferability and universality of mathematics. We recommend evaluating if an emphasis of a few aspects while ignoring others may introduce a bias into the cognitive approach to certain disciplines and if a more balanced approach would be feasible.

5. The IB DP curriculum, especially in the social science subjects, could be reviewed to strengthen the European dimension and therefore ensure students' knowledge (and identity) is in line with mainstream schools. Arguably, the IB DP curriculum can accommodate various local needs and the European dimension could be viewed to be one of these.

6. The social dimensions of geography and its role in citizenship education and identity formation could be strengthened in the IB DP schools. Despite the inclusion of a topic on population and disparities of wealth, there is an overemphasis on methods in the IB geography curriculum compared with the German state curricula.

6. Appendix

Table of Syllabi documents analysed – IB DP and Switzerland

Age/Cycle	Document Title	Pages	Author/Date
16-19/Diploma programme	Mathematics HL guide: First examinations 2014	85	IB, 2012
16-19/Diploma programme	History guide: First examinations 2010	98	IB, 2008
16-19/Diploma programme	Geography guide: First examinations 2011	82	IB, 2009
16-19/Diploma programme	Biology: First examinations 2009	136	IB, 2007
16-19/Diploma programme	Language B guide (Spanish): First examinations 2013	79	IB, 2011
Subtotal	**5 Documents**	**480**	
16-19/Oberstufe	Lehrplan der Kantonsschule Oberlikon	127	Bildungsrat, 1999
16-19/Oberstufe	Plan d'etudes: Collège de Genève	66	Collège de Genève, 2010
Subtotal	**2 Documents**	**193**	
Total	**7 Documents**	**673**	

IB: International Baccalaureate Organization

7. References

Ananda, S. (2003) "Rethinking issues of alignment under 'No Child Left Behind'", San Francisco: WestEd. Retrieved from: < http://www.wested.org/online_pubs/kn-03-01.pdf> Rev. July 2, 2013.

Bloom, B.S., Madaus, G.F., & Hastings, J.T. (1981) *Evaluation to Improve Learning*, New York: McGraw-Hill.

Byrd, S. (2007) Advanced Placement and International Baccalaureate: Do they deserve gold star status? Washington: Thomas B Fordham Institute.

Council of Chief State School Officers (CCSSO) (2002) Models for Alignment Analysis and Assistance to States, retrieved on 17 September 2014 from: https://secure.wceruw.org/seconline/Reference/AlignmentModelsforStateAssist02.pdf

Conley, D.T. (2009) International Baccalaureate Standards Development and Alignment Project, Eugene: Educational Policy Improvement Center.

Dworkin, M. (1959) *Dewey on Education: Selections*, New York: Teachers College Press.

Faas, D. (2011) "The Nation, Europe, and Migration: A comparison of geography, history, and citizenship education curricula in Greece, Germany, and England", *Journal of Curriculum Studies*, 43:4, p. 471-492.

Glaser, B. and Strauss, A. (1999) *The discovery of Grounded Theory: strategies for qualitative research,* Chicago: Aldine Pub.

Impara, J.C. (2001) "Alignment: One element of an assessment's instructional unity", Paper presented at the 2001 annual meeting of the National Council on Measurement in Education, Seattle, WA.

International Baccalaureate Organization (2007) Diploma Programme Biology Guide: First Examinations 2009, Cardiff: IBO.

International Baccalaureate Organization (2008) Diploma Programme History Guide: First Examinations 2010, Cardiff: IBO.

International Baccalaureate Organization (2009) Diploma Programme Geography Guide: First Examinations 2011, Cardiff: IBO.

International Baccalaureate Organization (2011) Diploma Programme Language B Guide: First Examinations 2013, Cardiff: IBO.

International Baccalaureate Organization (2012) Diploma Programme Mathematics HL Guide: First Examinations 2014, Cardiff: IBO.

La Conférence des Directeurs du Collège de Genève (2007) Plan d'études. Retrieved from: http://ge.ch/formation/sites/formation/files/fichiers/images/documents/programmes-college-geneve.pdf

La Marca, P.M., Redfield, D. and Winter, P.C. (2000) *State standards and state assessment systems: A guide to alignment*, Washington, DC: Council of Chief State School Officers.

Porter, A.C. (2002) "Measuring the content of instruction: Uses in research and practice. Educational Researcher"*, Educational Researcher*, 31:7, p. 3–14.

Porter, A.C. (2005) "Curriculum Assessment", in: J.L. Green, G. Camilli, & P.B. Elmore (Eds.), *Complementary Methods for Research in Education*, Washington, DC: American Educational Research Association.

Porter, A.C., Smithson, J., Blank, R. and Zeidner, T. (2007) "Alignment as a teacher variable", *Applied Measurement in Education,* 20:1, p. 25-51.

Resnick, L.B., Rothman R., Slattery, J.B., and Vranek, J.L. (2003) "Benchmarking and alignment of standards and testing", *Educational Assessment*, 9: 1 & 2, p. 1–27.

Schweizerische Konferenz der kantonalen Erziehungsdirektoren (2014) *Lehrpläne.* Retrieved from: http://www.edk.ch/dyn/18094.php

Tyler, R.W. (1949) *Basic principles of curriculum and instruction*, Chicago, IL: University of Chicago.

Webb, N.L. (1997) "Determining alignment of expectations and assessments in mathematics and science education. NISE Brief 1(2). Retrieved from: <http://facstaff.wcer.wisc.edu/normw/1997alignmentbrief.htm> Rev. July 10, 2013

Webb, N.L. (1999) *Alignment of science and mathematics standards and assessments in four states*, Washington, DC: Council of Chief State School Officers.

Wolter, S.C., Cattaneo, M.A., Denzler, A. (2014) "Swiss Education Report 2014", SKBF/CSRE Swiss Coordination Centre for Research in Education, Retrieved from: http://skbf-csre.ch/fileadmin/files/pdf/bildungsmonitoring/Swiss_Education_Report_2014.pdf

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