DP Country Alignment Studies: Alignment of the Spanish Bachillerato (SB)

Submitted by Ecctis to the IB

August 2023

Ecctis

Acronyms

AA	mathematics: analysis and approaches
AHL	additional higher level
AI	mathematics: applications and interpretation
AO	Assessment Objective
ATL	approaches to teaching and learning
BBMD	Business and Business Model Design
BGE	biology, geology and environmental sciences
CAS	Creativity, activity, service
CP	Career-related Programme
DP	Diploma Programme
EVAU / EBAU	Evaluation for University Access
FB	French Baccalaureate
HL	higher level
IB	International Baccalaureate
IBO	International Baccalaureate Organisation
MYP	Middle Years Programme
PYP	Primary Years Programme
RfP	Request for Proposal
RQ	Research Question
SB	Spanish Bachillerato
SC	specific competence
SDGs	Sustainable Development Goals
SL	standard level
STEM	Science, technology, engineering and mathematics
TOK	theory of knowledge
WIAIBE	What is an IB education?

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1. Executive Summary

Project Aims and Context

The International Baccalaureate (IB) Organization is a not-for-profit educational foundation offering four programmes across the world. One of them – the Diploma Programme (DP) – is a two-year upper secondary programme, primarily intended to prepare students for university matriculation and higher education.

Following previous studies focused on the education systems of Australia, Canada, the USA, Singapore, South Korea, and Finland,[1] Ecctis has been commissioned by the IB to deliver a series of critical and in-depth alignment studies to assess the level of alignment between the DP and comparison points within the upper secondary education systems of France and Spain.[2] More specifically, the studies aim to identify areas of similarity and difference between the DP and these educational systems by comparing philosophical underpinnings, structure, requirements, assessment methods, learning pathways, content, and specifically to determine how the DP compares to the selected benchmarks in terms of intended student learning outcomes at subject level. The studies include, for all countries, a focus on DP mathematics and DP sciences (i.e. physics, chemistry and biology), with an additional focus on DP philosophy and DP Theory of knowledge (TOK) for France, and DP economics and DP business management for Spain.

This report aims to specifically evaluate alignment between the DP and the upper-secondary programme of education in Spain. The comparison qualification in question is the Spanish Bachillerato (SB).

Research Questions and Methods

All comparative studies in this series have been framed by responses to Research Questions (RQs), both at programme and subject levels. For this study, these RQs were the following:

RQ1: To what degree does the DP curriculum align with the Spanish upper secondary curriculum? In what way are the curricula similar and in what way are they different in demand and difficulty? To what degree are the curricula compatible?

RQ2: To what degree do the curricula align with regards to their:
2.1: Philosophical underpinnings
- Objectives
- Principles
- Values.

2.2: Structure
- Learning areas
- Subject offerings

[1] The full reports can be accessed at: www.ibo.org/research/curriculum-research/dp-studies/dp-country-alignment-studies-2023/

[2] The series of studies responds to the following Request for Proposals (RFP), issued by the IB: *The International Baccalaureate Diploma Programme: Alignment with Upper Secondary Education System in France and Spain.*

- Degree of specialization
- Time allocation.

2.3: Requirements
- Programme entry requirements
- Time requirements (i.e. programme duration, teaching hours, study hours)
- Certificate requirements (i.e. credits, passing and failing conditions, compensation options).

2.4: Assessment
- Nature of assessment (i.e. number, type, duration, question types, availability of marks)
- Assessment model (i.e. relative weighting of assessments to overall grades).

2.5: Student learning pathways
- Degree of specialization
- Options in subject (area) choice (i.e. compulsory subjects, electives).

RQ3: To what degree do the subjects align with regards to:

3.1: Content
- Topics (i.e. scope of content area, breadth, depth)
- Learning activities (i.e. difficulty, demand).

3.2: Expected learning outcomes
- Knowledge
- Competences (i.e. subject-specific, 21st century competences).

To answer the above RQs, Ecctis developed and applied a bespoke methodology.

At programme-level, this involved the comparative analysis of key components of the DP and the SB, including: philosophical underpinnings, structure, requirements and associated outcomes, student learning pathways, and assessment methods (where possible). At subject-level, it involved the comparative analysis of key components of the DP and the SB subjects, including: learning outcomes, content, and demand.

Where appropriate, Ecctis complemented its standard comparative methodology with a comprehensive mapping method, extracting themes from the DP to evaluate their presence in the comparison point(s). Additionally, to assess demand at subject level, Ecctis designed and deployed an expert panel approach, scoring each individual subject against a common set of demand criteria.[3]

Key Findings

Programme-level

The philosophical underpinnings constitute the most significant point of similarity between the two programmes. In all other respects, there are some notable differences, though with points of clear alignment with regard to how students would be likely to experience the programmes in practice.

- **Philosophical underpinnings**: the DP and SB programmes share very similar philosophical underpinnings. The main difference between both programmes lies in

[3] Each individual subject was scored for: cognitive skills evidenced in the learning outcomes (based on the Revised Bloom's Taxonomy), depth of knowledge (adapted from Webb's Depth of Knowledge levels), volume of work (a tri-factor score considering breadth, depth and allocated timeframe), and outstanding areas of subject demand (stretch areas).

the SB's specific focus on the development of students' entrepreneurial and digital competences, which are not as explicitly emphasised in the DP. That said, students or teachers moving between the two qualifications would find a high level of consistency between the philosophical underpinnings of both programmes.

- **Programme structure**: there are various similarities between the two programmes' structures, with both taking a baccalaureate-style approach to encourage breadth of study, and both allowing students to specialise in particular subjects. There are also some notable differences between the programmes; for example, the SB offers four different modalities (i.e. streams) of study, whilst the DP is not split into different specialised streams. Additionally, SB subjects span one single year and students may choose to study different subjects in their first and second years, whilst DP subjects are studied over two years. Moreover, contrary to the DP, the SB does not require the completion of additional components – such as the DP's TOK, CAS and the extended essay – to pass the qualification.

- **Entry requirements**: both the DP and the SB present a somewhat flexible approach to entry requirements at the start of their programmes. The IB encourages students and teachers to consult subject guides around expected prior learning but does not provide fixed entry requirements. While for the SB there is a requirement to have completed have completed primary and the compulsory stage of secondary education, students with various qualifications and backgrounds are allowed to enrol.[4] Notably, to take some specific subjects in their second year, SB students must have successfully completed certain subjects in their first year. The DP does not stipulate a similar type of entry requirement for its subjects; instead, it states that, to study *some* subjects at HL, some prior study in the specific subject area is advisable.

- **Student learning pathways**: both programmes provide some level of optionality in relation to subjects studied and both require students to study subjects from a wide range of subject groupings. The approach to combining subject-specialisation with breadth is, therefore, somewhat similar. The main difference between the student learning pathways is that, depending on their choice of modality, students in the SB can choose to follow a pathway that exposes them to fewer subject areas than those experienced by DP students.[5] The two programmes also differ in the minimum total number of hours allocated to specialty subjects. Whilst DP students typically dedicate a combined total of 720h to the study of subjects at HL,[6] SB students only dedicate a minimum of 525h to all their modality subjects (combined).

- **Assessment methods:** due to the decentralised nature of the Spanish education system, it is challenging to meaningfully compare the assessment methods of the DP to those of the SB, as the latter varies from region to region. Nonetheless, some general trends can be noted. For instance, both the DP and the SB often feature both

[4] Students with any of the following qualifications are allowed to enrol in the SB: the Compulsory Secondary Education certificate; any vocational training qualifications; any plastic arts and design diplomas; or any diplomas in sports education.
[5] For example, students in the SB's Humanities and Social Sciences modality may complete their SB without taking any mathematics or sciences subjects, which is not possible for DP students to do.
[6] This can go up to 960h if students choose to study four subjects HL, instead of three.

internal, school-designed assessment and externally-set, end-of-subject examinations, with both typically awarding more weighting to externally-set assessment overall. In both programmes, too, internal assessments can assume different forms, varying across subjects. There are also some similarities between the subject-specific assessment objectives of the DP and the subject-specific competencies and evaluation criteria in the SB, with both programmes assessing similar skills. That said, the overall approach to assessment differs between the two programmes – while the SB allows regional educational authorities to make decisions about certain elements of subject selection and the specific weighting awarded to each assessment type, the DP follows a more homogenised approach, with both assessment types and weighting being set centrally.

Subject-level

In this study, Ecctis carried out subject-level comparative analysis between the DP and SB in mathematics, physics, chemistry, biology, economics, and business management focusing on the following DP standard level (SL) and higher level (HL) subjects and comparison subjects:

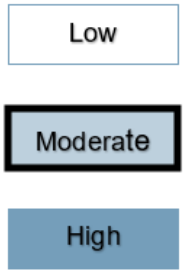
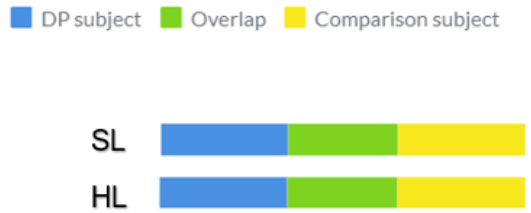
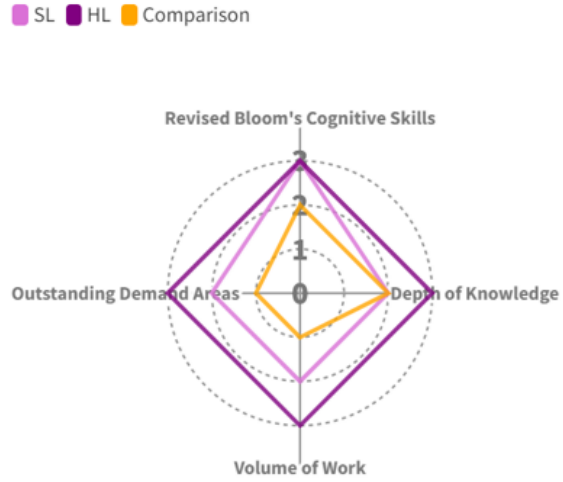
Table: Subject areas for comparison of the DP and the SB curricula

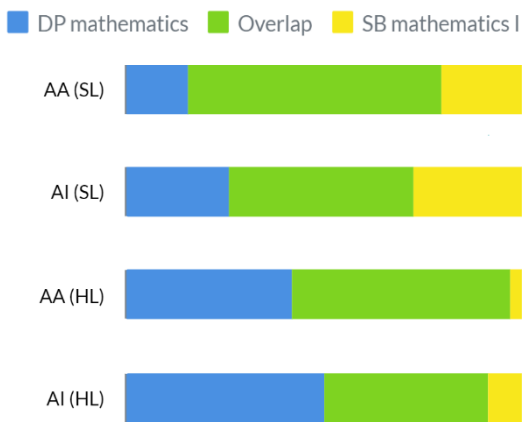
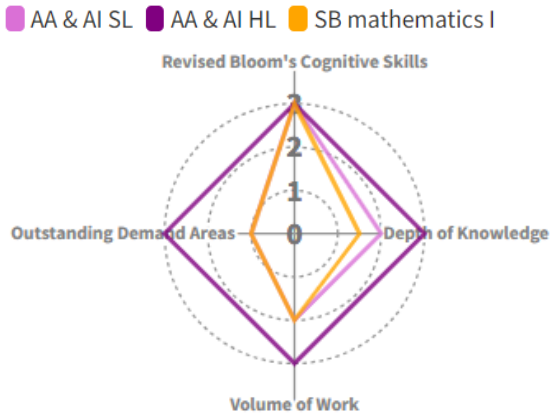
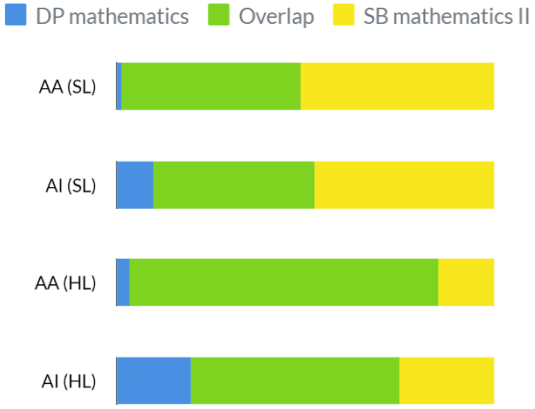
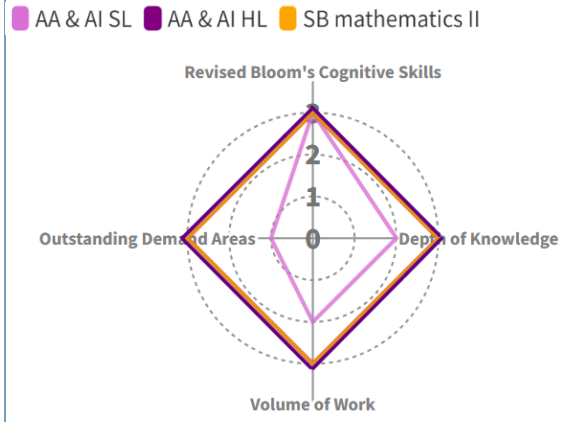
DP subjects (area)	**SB subjects**
MATHEMATICS	*SCIENCE AND TECHNOLOGY*
mathematics: analysis and approaches (AA) SL and HL	mathematics I and II
mathematics: applications and interpretation (AI) SL and HL	
SCIENCES	*SCIENCE AND TECHNOLOGY*
physics SL and HL	physics and chemistry physics
chemistry SL and HL	physics and chemistry chemistry
biology SL and HL	biology, geology, and environmental sciences biology
INDIVIDUALS AND SOCIETIES	*HUMANITIES AND SOCIAL SCIENCES*
economics SL and HL	economics
business management SL and HL	business and business model design

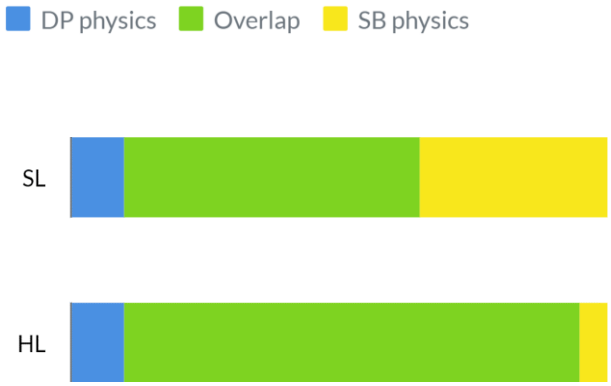
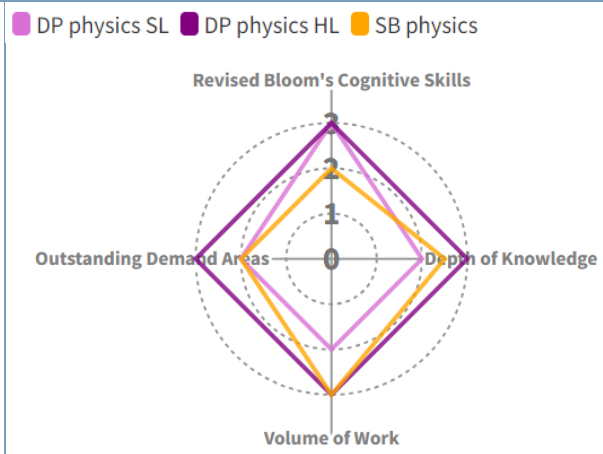
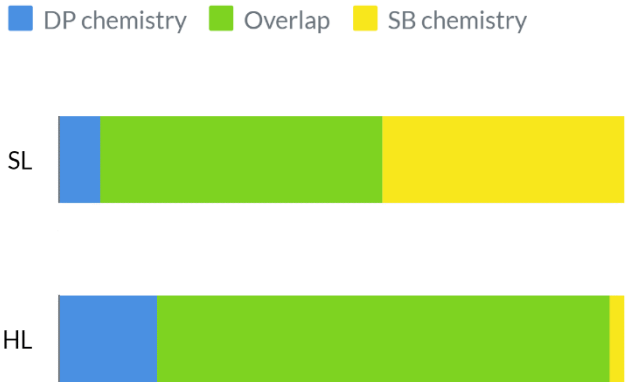
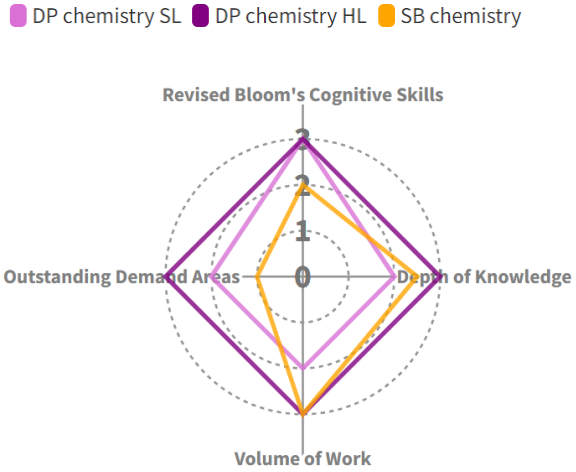
The findings from the subject-level analysis are summarised in the tables below:

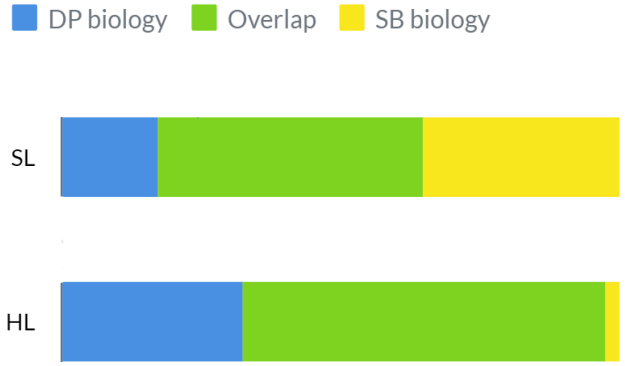
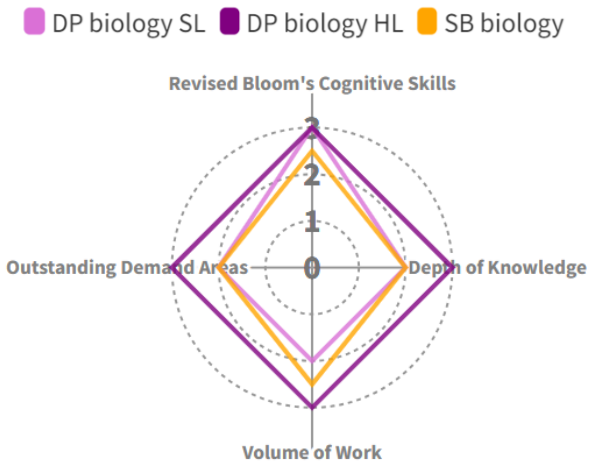
Figures: Visual representation of alignment between DP subjects and comparison subjects

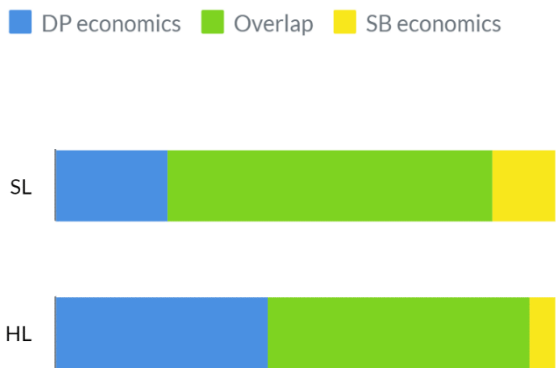
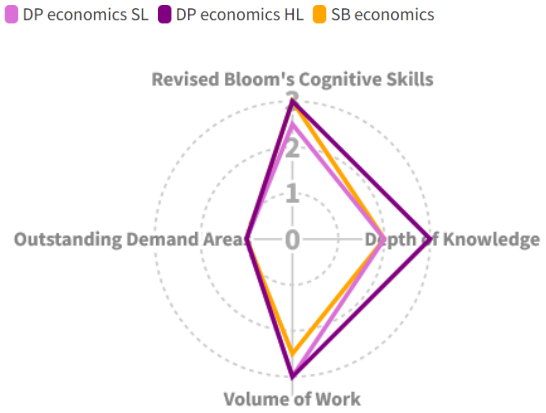
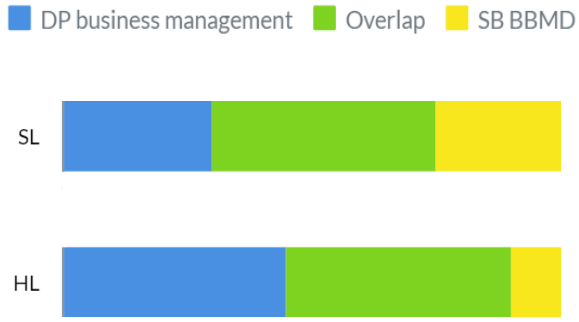
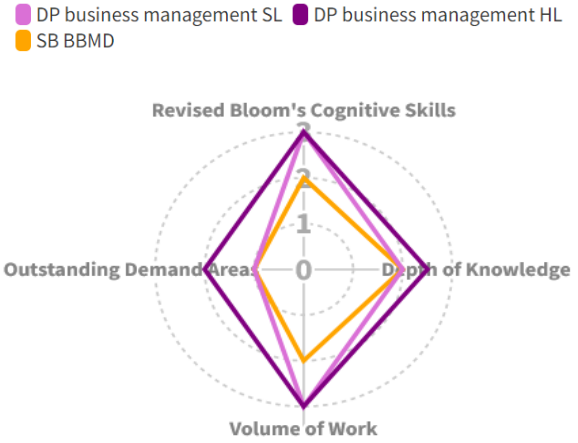
Key:

Subject name	Learning outcomes alignment	Content alignment	Demand alignment
Displays the name of the comparison subject	 This represents the learning outcome alignment between the DP subject and the comparison subject. A black border is placed around the selected judgement – 'Moderate' in this example.	 These bars represent the content alignment between the DP subject and the comparison. There is one bar showing alignment with SL content and another for HL content (inclusive of SL content). The **green** section of the bar represents the overlap of content between the subjects. The **blue** section represents content which was in the DP subject only. The **yellow** section represents content which was in the comparison subject only. Therefore, if, say, the blue section was longer than the yellow, this can be interpreted as the DP subject having more content unique to itself than the comparison did. A large green bar would indicate that a substantial proportion of content is common to both the DP and comparison subject.	 This radar diagram displays the demand judgement scores for the comparison subject(s) and the DP subject – both SL and HL.

Subject name	Learning outcomes alignment	Content alignment	Demand alignment
mathematics I	Low Moderate **High**		
mathematics II	Low Moderate **High**		

Subject name	Learning outcomes alignment	Content alignment	Demand alignment
physics	Low Moderate **High**		
chemistry	Low Moderate **High**		

Subject name	Learning outcomes alignment	Content alignment	Demand alignment
biology	Low Moderate High		

Subject name	Learning outcomes alignment	Content alignment	Demand alignment
economics	Low Moderate **High**		
business and business model design	Low Moderate **High**		

Key highlights of the subject-level analysis are summarised below.

Mathematics

- **Learning outcomes alignment**: the level of alignment between the learning outcomes of both DP mathematics subjects, at both SL and HL, and those of the SB mathematics subjects is high, as all DP learning outcome themes are present in the SB curricula.

- **Content alignment**: SB mathematics I is well aligned with DP AA SL content, as they share a considerable number of subtopics and are of similar breadth and depth. SB mathematics I has moderate alignment with DP AI SL, as it shares some, but slightly fewer, subtopics with this subject. SB mathematics II (which requires prior study of mathematics I) is strongly aligned with DP AA HL, as it shares a considerable amount of content and has similar breadth and depth. SB mathematics II has moderate, rather than strong, alignment with DP AI HL, as each subject features several areas which are not covered by the other.

- **Demand alignment**: the demand level of SB mathematics I and SB mathematics II strongly aligns with the demand of DP SL and HL mathematics subjects, respectively. Indeed, SB mathematics I scores the same as, or very similarly to, the DP's SL mathematics subjects for Bloom's cognitive skills, depth of knowledge, volume of work, and outstanding demand areas. Likewise, SB mathematics II scores the same as DP HL for all demand categories.

Physics, chemistry, and biology

All DP science subjects – physics, chemistry and biology – have been individually analysed and compared against the designated comparison subject. However, as they share a number of similarities – including very similar learning outcomes, assessment objectives and assessment requirements – the findings for all subjects were similar and are, thus, collectively presented below.

Economics

- **Learning outcomes alignment**: the level of alignment between the learning outcomes for the DP and SB economics subjects is high. Indeed, all the DP economics' learning outcome themes are evidenced in SB economics, with the latter featuring no significant additional themes.

- **Content alignment**: SB economics has a good level of alignment with DP SL economics, as they share a significant number of subtopics and have comparable breadth and depth. There is less alignment between SB economics and DP HL economics, as the latter covers content in more depth.

- **Demand alignment**: there is a high level of alignment in demand between DP economics SL and SB economics. Indeed, both score very similarly with regards to Bloom's cognitive skills, depth of knowledge, volume of work and outstanding demand

areas. SB economics is less aligned with DP HL, as it scores lower for depth of knowledge.

Business Management

- **Learning outcomes alignment**: the level of alignment between the learning outcomes for the DP business management and SB business and business model design (BBMD) subjects is high. Indeed, all the DP business's learning outcome themes are evidenced in SB BBMD, with the latter featuring only one significant additional theme.

- **Content alignment**: there is a moderate level of content alignment between DP SL business management and SB BBMD, as they share some subtopics and are similar in content size. However, SB BBMD and DP HL have limited content alignment due to the latter covering additional content areas and a significant number of subtopics in more depth.

- **Demand alignment**: SB BBMD has some alignment with DP SL, as it scores the same for depth of knowledge and outstanding demand areas, though less for Bloom's cognitive skills and volume of work. DP HL economics surpasses SB BBMD in all demand categories.

Summary

The programme-level features of the DP and SB are moderately aligned. The two programmes observe similar philosophical underpinnings and some similarities in programme structure, though differ somewhat with regards to student learning pathways, entry requirements, and assessment methods. At subject-level, alignment between the SB and DP varies across subjects. For SB mathematics, there is high alignment with the DP, as SB mathematics II aligns strongly with DP HL, particularly AA. For SB science subjects, these were all considered to be moderately-highly aligned with their respective DP subjects, with SB physics and chemistry demonstrating particularly high content alignment with the DP. As for economics and business, the respective DP and SB subjects are moderately aligned. In both subjects, the SB demonstrates good alignment with the DP SL courses, particularly in economics, but have less alignment with DP HL courses.

2. Introduction

2.1 Context and Scope

The International Baccalaureate (IB) Organization is a not-for-profit educational foundation offering four programmes across the world, including the Primary Years Programme (PYP), Middle Years Programme (MYP), Diploma Programme (DP) and the Career-related Programme (CP). The DP – the IB's two-year upper secondary Diploma Programme – is conceived as a preparatory programme for university matriculation and higher education, aimed at developing students with 'excellent breadth and depth of knowledge' who 'flourish physically, intellectually, emotionally and ethically'.[7]

Following previous studies focused on the education systems of Australia, Canada, the USA, Singapore, South Korea, and Finland,[8] Ecctis has been commissioned by the IB to deliver a series of critical and in-depth alignment studies to assess the level of alignment between the DP and comparison points within the upper secondary education systems of France and Spain.[9] More specifically, the studies aim to identify areas of similarity and difference between the DP and these educational systems by comparing philosophical underpinnings, structure, requirements, assessment methods, learning pathways, content, and specifically to determine how the DP compares to the selected benchmarks in terms of intended student learning outcomes at subject level. The studies include, for all countries, a focus on DP mathematics and DP sciences (i.e. physics, chemistry and biology), with an additional focus on DP philosophy and DP Theory of knowledge for France, and DP economics and DP business management for Spain.

Ultimately, this series of comparative studies aims to inform the IB's development of tools and resources for IB teachers, helping them navigate between the IB and the local curriculum in the target countries where needed. In doing so, it also contributes to further supporting fair recognition of the DP by institutions, employers, and other key stakeholders, supporting progression and mobility for DP graduates.

This report constitutes one of the project's deliverables and aims to specifically answer the research questions pertaining to how the DP aligns with the Spanish upper-secondary programme of education.

2.2 Research Questions

All comparative studies in this series have been framed by responses to Research Questions (RQs), both at programme level and subject level. For this study specifically, the RQs are as follows:

[7] International Baccalaureate. (2022). *Diploma Programme*. https://www.ibo.org/programmes/diploma-programme/
[8] The full reports can be accessed at: www.ibo.org/research/curriculum-research/dp-studies/dp-country-alignment-studies-2023/
[9] The series of studies responds to the following Request for Proposals (RFP), issued by the IB: *The International Baccalaureate Diploma Programme: Alignment with Upper Secondary Education System in France and Spain.*

Spain Research Questions

Table 1: Spain research questions

RQ1: To what degree does the DP curriculum align with the Spanish upper secondary curriculum? In what way are the curricula similar and in what way are they different in demand and difficulty? To what degree are the curricula compatible?

RQ2: To what degree do the curricula align with regards to their:

2.1: Philosophical underpinnings
- Objectives
- Principles
- Values.

2.2: Structure
- Learning areas
- Subject offerings
- Degree of specialization
- Time allocation.

2.3: Requirements
- Programme entry requirements
- Time requirements (i.e. programme duration, teaching hours, study hours)
- Certificate requirements (i.e. credits, passing and failing conditions, compensation options).

2.4: Assessment
- Nature of assessment (i.e. number, type, duration, question types, availability of marks)
- Assessment model (i.e. relative weighting of assessments to overall grades).

2.5: Student learning pathways
- Degree of specialization
- Options in subject (area) choice (i.e. compulsory subjects, electives).

RQ3: To what degree do the subjects[10] align with regards to:

3.1: Content
- Topics (i.e. scope of content area, breadth, depth)
- Learning activities (i.e. difficulty, demand).

3.2: Expected learning outcomes
- Knowledge
- Competences (i.e. subject-specific, 21st century competences).

With regards to subjects to be compared in the subject-level comparative analysis, the following table indicates the agreed scope:

Table 2: Subjects/courses for comparison of the DP and the SB (per DP subject group)

DP subjects	SB subjects
MATHEMATICS	
mathematics: analysis and approaches SL and HL	Mathematics I Mathematics II
mathematics: applications and interpretation SL and HL	
SCIENCES	
physics SL and HL	physics and chemistry physics
chemistry SL and HL	physics and chemistry chemistry

[10] With regards to subjects within scope, see Table 2.

biology SL and HL	biology, geology and environmental sciences biology
INDIVIDUALS AND SOCIETIES	
economics SL and HL	economics
business management SL and HL	business and business model design (BBMD)

All DP curricula has been considered at both standard level (SL) and higher level (HL).

2.3 Report Structure

In responding to the above RQs, this report included the following sections:

- 3. Methodology: this section provides a brief overview of the methodology applied in this study. This includes details of how the document selection and identification of comparison points for the study took place; a definition of 'alignment'; an outline of the methodology used for comparisons at both programme and subject levels; and an outline of the methodology used to assess demand.

- 4. Programme-Level Alignment: this section presents the synthesised analysis from the programme-level comparisons between the DP and the Spanish upper secondary curriculum. In doing so, it includes brief programme overviews for both qualifications, followed by the comparative analysis on their philosophical underpinnings, structure, requirements and associated outcomes, student learning pathways and the general nature of assessment practices.

- 5. Subject-Level Alignment: this section presents the synthesised analysis from the subject-level comparisons between DP and Spanish upper secondary curriculum subjects. For each comparison subject, this includes the comparative analysis on their learning outcomes, content, and demand.

- 6. Key Findings: this section outlines the key findings from both the programme- and subject-level comparisons undertaken in this study. In doing so, it provides a top-level conclusion on alignment at both programme and subject levels, and a succinct summary of key similarities and key differences.

- 7. Bibliography: this section references all sources cited in the study, including the documents used for both programme- and subject-level curriculum analyses.

3. Methodology

3.1 Document Selection and Identification of Comparison Points

To undertake these comparative analyses, the following core documentation was reviewed (supplemented by additional documentation – detailed in the Bibliography – where relevant and available):

IB Documentation

- What is an IB education? (WIAIBE)
- WIAIBE Support Material
- DP: From Principles into Practice
- Programme Standards and Practices
- DP subject guides:
    - mathematics: analysis and approaches
    - mathematics: applications and interpretation
    - physic
    - chemistry
    - biology
    - economics
    - business management.

SB Documentation

- Government of Spain, Ministry of Education, Vocational Training and Sports (website), including information about Key Competences of the SB,[11] as well as the specific competences (SCs), evaluation criteria and content covered in each of the following subjects:
    - mathematics I
    - mathematics II
    - biology, geology and environmental sciences
    - biology
    - physics and chemistry
    - physics
    - chemistry
    - economics
    - business and business model design.
- Where possible, due to the less detailed nature of the SB curriculum, this was complemented by a review of publicly available official textbooks. References to these can be found in the Bibliography section of this report.

[11] Government of Spain, Ministry of Education, Vocational Training and Sports. (2022) Royal Decree 243/2022. https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521; https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/competencias-clave.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp

Philosophical Underpinnings Comparison

For the programme-level comparisons between the philosophical underpinnings of each programme, Ecctis used the following elements of the curriculum documentation:

Table 3: Philosophical underpinnings for comparison of the DP and the SB

Documentation containing philosophical underpinnings	
DP	**SB**
'What is an IB Education', particularly the following sections: ○ IB learner profile ○ International-mindedness ○ Approaches to teaching and approaches to learning (ATL).[12]	Ministry of Education, Vocational Training and Sports' website, particularly the section on: ○ Key competences.[13]

For the IB, the document 'What is an IB Education?' provides detailed information about the IB's educational philosophy. For the SB, the Spanish Ministry of Education, Vocational Training and Sports website also lays out its educational philosophy and goals in detail, so these sections were used to compare the philosophical underpinnings of the two programmes.

For more information on the mapping process, see the Measuring Alignment section below.

Learning Outcomes Comparison

For the Learning Outcomes comparisons, as neither of the two qualifications explicitly defines 'learning outcomes' in their curriculum documentation, Ecctis used the following categories of the curriculum documentation for comparison:

Table 4: Learning outcomes for comparison of the DP and the SB

DP subject (group)	Categories utilised as learning outcomes
MATHEMATICS	
mathematics: analysis and approaches	DP mathematics subject group – aims and assessment objectives
mathematics: applications and interpretation	
SCIENCES	
physics	DP sciences subject group – aims and assessment objectives
chemistry	
biology	
INDIVIDUALS AND SOCIETIES	
economics	Individuals and societies subject group & economics aims and assessment objectives
business management	Individuals and societies subject group & business management aims and assessment objectives
SB subjects	**Documentation and Sections**
SCIENCES AND TECHNOLOGY MODALITY	
mathematics I	Specific competences and evaluation criteria for mathematics I
mathematics II	Specific competences and evaluation criteria for mathematics II

[12] International Baccalaureate. (2017). *What is an IB Education?*

[13] Government of Spain, Ministry of Education, Vocational Training and Sports. (2022) Royal Decree 243/2022. https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521; https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/competencias-clave.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp

physics and chemistry	Specific competences and evaluation criteria for physics and chemistry
physics	Specific competences and evaluation criteria for physics
chemistry	Specific competences and evaluation criteria for chemistry
biology, geology, and environmental sciences	Specific competences and evaluation criteria for biology, geology, and environmental sciences
biology	Specific competences and evaluation criteria for biology
HUMANITIES AND SOCIAL SCIENCES MODALITY	
economics	Specific competences and evaluation criteria for economics
business and business model design (BBMD)	Specific competences and evaluation criteria for BBMD

Although not labelled as learning outcomes per se, the above categories were chosen as they were deemed to provide the most complete picture of the skills and knowledge that students should obtain upon completion of each subject.

For more information on the mapping process, see the Measuring Alignment section below.

3.2 Measuring Alignment (Similarities and Differences)

Alignment is a key concept for this series of studies. The aim of this study is to ascertain the level of alignment between the DP and the SB. Although Ecctis has sought to represent the alignment findings as straightforwardly as possible in this report, alignment is not a simple concept, so it is important to establish Ecctis' approach in this regard.

Alignment, as a term, is often used in education circles to refer to the *internal* coherence between learning outcomes, assessment methods, teaching practices and other features of teaching and learning. This study does not consider *internal* alignment, but what might appropriately be labelled *external* alignment. Alignment of this type looks at the extent to which a programme (in this case, the DP) aligns with other educational programmes (in this case, the SB). This form of external alignment is particularly key to understand for an organisation like the IB which operates in so many international contexts, often alongside national curricula, where teachers and students may seek to move back and forth between IB and national streams of education.

Within this narrower definition of *external* alignment, the term is still broad and could be viewed from any number of perspectives. In this series of studies, the IB has specifically asked Ecctis to consider alignment from the specific perspectives outlined by the RQs. The RQs thereby define the limits of the type of alignment that will be considered within the reports, namely:

- At the programme level:
    - Alignment of philosophical underpinnings
    - Alignment of structure
    - Alignment of requirements and associated outcomes
    - Alignment of student learning pathways
    - Alignment of approaches to assessment.

- At the subject level (in selected subjects):
    - Alignment of learning outcomes
    - Alignment of content
    - Alignment of demand.

To form a comprehensive picture of alignment, Ecctis' approach has followed multiple repeating steps within each study. For Spain, it sought to analyse the extent to which:

- the SB is similar to the DP.
- The SB is different from the DP.
- the SB lacks features contained within the DP.
- the DP lacks features contained within the SB.

In this respect, **alignment is a measure of the extent to which there are similarities and differences between key selected criteria of two educational programmes**. High alignment indicates significant similarities, with few differences in key areas, whereas low alignment results from many differences in important aspects, with perhaps only few or non-impactful similarities. Alignment judgements in this study took a holistic view of similarities and differences and the likely impact these will have on what skills and knowledge students possess upon completion of a programme of study. As such, the study did not use fixed quantitative criteria to differentiate high from low alignment, but rather utilised the expert panels to produce informed, holistic judgements drawing on an outcomes-focused perspective.

Mapping

To accurately measure the alignment of the DP to the SB, it is necessary to map the similarities and differences across the selected alignment criteria. This necessitates identification of comparable structural features in the DP and in the SB (the comparison programme) so that a mapping process can be undertaken.

Mapping, in this case, refers to detailed analysis of a feature of an education programme (generally as represented within that programme's documentation). Specifically, mapping applies the same analytical method to two separate sets of data (for example, the learning outcomes of two different curricula), enabling similarities and differences between those two data sets to be understood through the different results of applying the same mapping method to both. Another important feature of mapping is that there is a paper trail of the analysis, as the approach is methodical, testable, and repeatable.

For more information on how mapping has been applied in this study, see sections 3.2.1 and 3.2.2.

3.2.1 Method: Programme-Level Comparison

Each aspect of the programme-level comparison is achieved through slightly different approaches to mapping and assessing alignment, the results of which inform the overall alignment evaluation. Each method is described in the appropriate subsection below.

Philosophical Underpinnings

In the DP, the ATL, the learner profile, and the framework of international-mindedness were used to represent the philosophical underpinnings, while the 'Key Competences'[14] section was used for the SB.

In order to carry out the comparative analysis, six themes were extracted from the DP's philosophical underpinnings:

Table 5: Philosophical underpinning themes

Philosophical underpinning themes
• International outlook, diversity, and intercultural understanding • Grounded in real world contexts • Principled and community-oriented • Independence/self-management, critical inquiry, and reasoning • Communicative and collaborative competence • Conceptual thought and understanding.

This list of themes was mapped against both the DP's philosophical underpinnings and the philosophical underpinnings of the SB to identify what aspects of the DP's philosophical underpinnings are shared with the SB and what aspects are unique to either the SB's philosophical underpinnings or the DP's. The detail of this mapping was carried out in the mapping spreadsheets, while a visual summary and written explication of the findings can be found in the Philosophical Underpinnings section below (see section 4.2).

Structure

Comparing the structures of the DP and a national programme does not require a mapping process. Instead, subject offerings, how duration interacts with subjects/progression, and the general structure of the qualification (including exit points) have been represented with visuals for each programme. These curriculum structure diagrams use block colours and simple box and arrow graphics to demonstrate structure and progression.

Curriculum structure diagrams have been placed next to each other in this report to show the similarities and differences at a glance. The visual presentation is followed by a short write-up of the key similarities and differences, to maintain analytical focus on the alignment of the two programmes.

Requirements and Associated Outcomes

The requirements and associated outcomes of each programme are, like the structure, also simple, core features which do not require a mapping process in order to be compared. Comparisons and contrasts are drawn between the different requirements (e.g. entry requirements, pass/fail requirements) linked to both programmes and the associated outcomes of both.

[14] Government of Spain, Ministry of Education, Vocational Training and Sports. (2022) *Royal Decree 243/2022.* https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521#dd; https://educagob.educacionyfp.gob.es/ca/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/competencias-clave.html

Student Learning Pathways

By ‘student learning pathways’, we refer to the learning route that each student can take through a programme – with focus on scope for subject-specific specialisation. As with the comparative analysis of structure, diagrams resembling flow charts have been used to visually demonstrate the core and optional subject choices, providing an example to indicate how students follow different potential learning pathways in both programmes. A short textual write-up has been included after the diagrams to highlight and discuss the key similarities and differences – maintaining analytical focus on the issue of alignment.

Assessment Methods

Although detailed comparative analysis of assessment is not a main component of the analysis of alignment, Ecctis has briefly considered the high-level assessment features within the programmes being compared.

A simple table has been used, followed by a short textual description of the key similarities and differences. The types/numbers of assessment used in the programme are a source of comparison, and the subjects analysed in the subject-level alignment analysis in each report have been used as examples to consider assessment in more detail (i.e. question types and marking approaches, where this information is available).

3.2.2 Method: Subject-Level Comparison

As previously described, a number of subjects has been selected by the IB for a closer look at alignment at the subject level. This includes a closer look at the learning outcomes for each subject, the subject content, and the demand level. Each approach is outlined below.

Learning Outcomes

To analyse the alignment of learning outcomes at the subject level, the process began by extracting six to eight themes from the DP’s subject-level learning outcomes for each subject being analysed, encompassing both skills and knowledge areas. This thematic code was then mapped onto the learning outcomes of the DP subject and the comparison subject from the SB.

The top-level results of the mapping process are represented with a table per subject area. Following the tables, a written commentary is provided regarding the presence of DP knowledge areas and skills (represented by themes) in the SB and any knowledge areas and skills found in the SB but not in DP.

Content

To compare the content of the DP subject and the comparison SB subject, both are first presented next to each other in the document in a simple tabular format. Additionally, content mapping took place through a simple process of establishing whether each content subtopic covered by the DP subject in question has ‘clear alignment’ with any content in the SB comparison subject. The mapping spreadsheets demonstrate the full logic of all judgements.

A commentary is provided on DP subject content not found to have alignment points in the SB subject and on SB subject content topics not found to have alignment points in the DP subject.

Demand

Comparing the demand of subject curricula is perhaps the most complex mapping and alignment analysis of the study. Ecctis' approach views demand from multiple perspectives to capture its relationship to skills as well as to the detail and scope of content.

To allow for a comprehensive assessment of the level of demand of the DP selected subjects against the respective comparison points, Ecctis has created a Demand Profile for each subject in the study. Each Demand Profile comprises four criteria designed to judge complexity, depth, breadth, workload levels and potential for intellectual stretch. These criteria have been applied uniformly across all subjects in the study, using an expert panel-approach (as outlined below).

Demand Profile – Subject-level Judgement

The Demand Profile is comprised of four scores (each between zero and three) based on specific criteria. Each score within each category has a specific definition which is listed in Appendix A. A panel of subject, teaching, and curriculum design experts analysed each subject curriculum and arrived at a consensus on which score descriptor in each category best matched with the curriculum in question. The categories which comprise the Demand Profile are as follows:

- **Revised Bloom's Cognitive Skills** score (0-3): this is an overall score of course demand, based entirely on a review of learning outcomes. Levels have been defined based on increasing emphasis of higher order cognitive skills taken from Bloom's Revised Taxonomy.[15]

- **Depth of Knowledge** (adapted from Webb's) score (0-3): this is an overall score evaluating the depth of knowledge or complexity of knowledge and skills required by curriculum standards and expectations. The score is focused on subject content and learning outcomes, complemented by assessment where relevant/possible. Levels have been defined based on the level of detail studied per topic, as well as the levels of thinking described in Webb's depth of knowledge framework.[16]

- **Volume of Work** score (0-3): this is a trifactor score, considering:
  a. breadth of content – i.e. the number of topics and subtopics covered
  b. depth of content – i.e. the extent to which the topics and subtopics are focused upon, amplified and explored.[17]
  c. specified timeframe – i.e. the time allocated for studying the subject.

  The three factors – breadth, depth, and time – were all considered in defining the levels.

- **Outstanding Areas of Subject Demand** score (0-3): this score reflects the number of content areas viewed as more challenging and/or conducive to intellectual stretching

[15] Krathwohl, D. (2002). A Revision of *Bloom's taxonomy: An Overview.* Theory Into Practice, Vol 41(4). Available from: www.tandfonline.com/doi/abs/10.1207/s15430421tip4104_2?journalCode=htip20
[16] Webb, N. L. (2002). *Depth-of-knowledge levels for four content areas*. Microsoft Word - Webb DOK all content.doc (pbworks.com)
[17] Note: 'depth of content' primarily describes what is on the curriculum (i.e. the level of detail comprised in each topic), whereas 'depth of knowledge' describes what the students need to be able to do (i.e. how complex and extensive the thinking processes involved are).

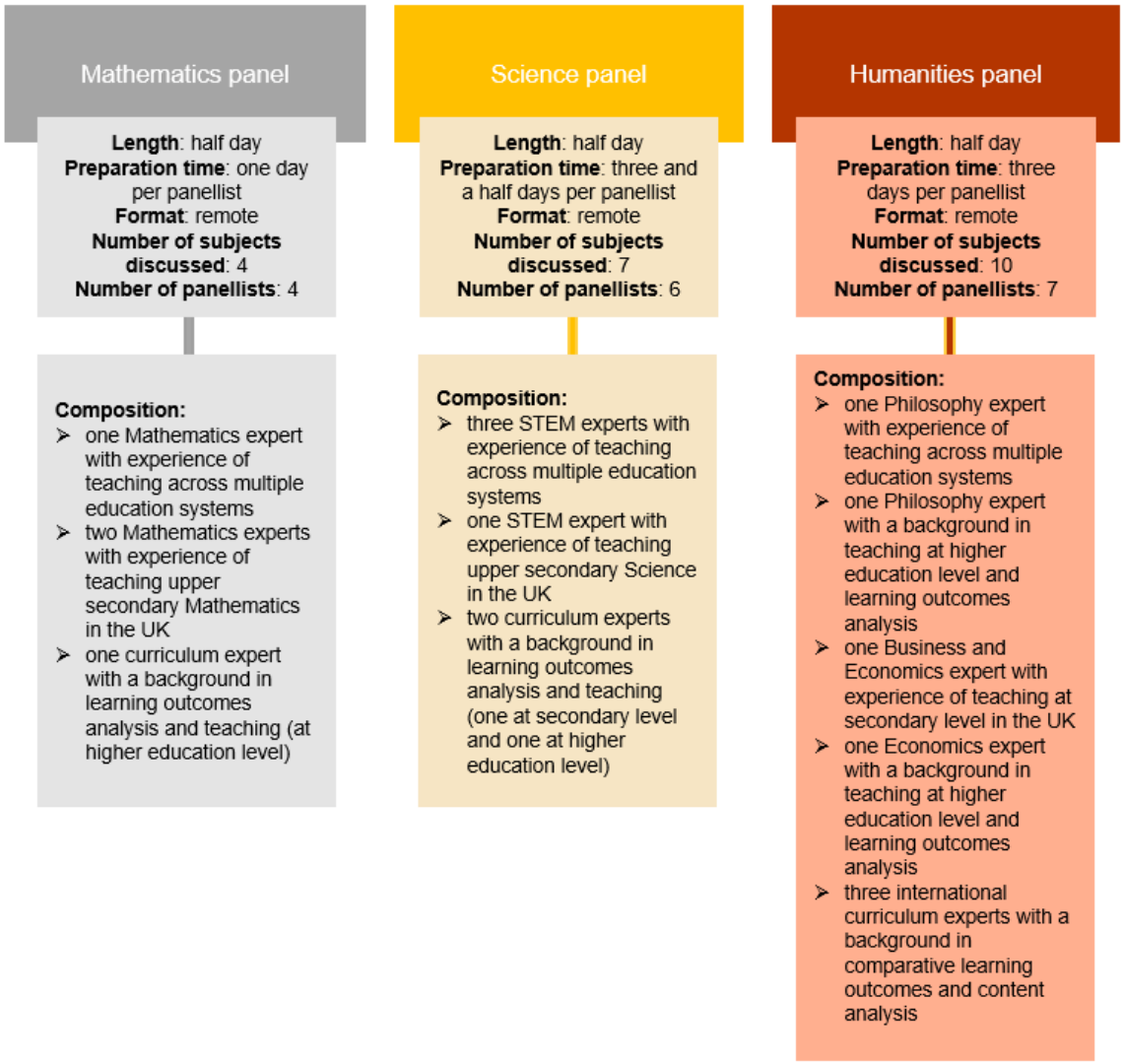
of students. Levels have been defined on a scale of increasing number of 'stretch areas'.

Demand Panel: Expert Judgement Procedure

Demand analysis and judgements against the above criteria rested with a panel of experts comprised of both curriculum and teaching experts – i.e. international education researchers experienced in comparative secondary curriculum evaluation – and subject experts – i.e. researchers and consultants with a subject specialism in the relevant subject areas. For both expert types, teaching experience, understanding of appropriate national/international teaching contexts, and experience of curriculum and learning outcomes comparisons were prioritised.[18]

For the panels discussing the demand level of the DP subjects and respective comparison subjects in the French Baccalauréat (FB) and Spanish Bachillerato (SB) reports, the composition of each panel was as follows:

Figure 1: Demand panels details



[18] To minimise potential biases and subjectivity, Ecctis' recruitment procedure excluded candidates with experience of teaching any of the comparison qualifications in this study.

All panellists were provided with the relevant extracts from the appropriate qualifications' specifications,[19] including (where available):

- Learning outcomes and aims of the qualification
- Assessment structure
- Information about guided learning hours or curriculum time
- Assessment objectives
- Content.

The experts were also provided with a document containing:

- An introduction to the comparative analysis task
- Descriptions of the demand taxonomies
- The demands instrument (used to record findings).

Panellists conducted between one and four days of panel preparation, reviewing the appropriate curriculum documentation in detail and scoring each subject against the demand criteria provided (the template utilised for this has been included in Appendix C). Following this preparation, participants then took part in their respective panels, which were all hosted remotely on Microsoft Teams. All panels lasted for half a day.

All judgements resulted in scores from 0-3 for each demand criterion mentioned above, with each score for each criterion being pulled into each course's demand profile. The panel approach was used to debate the findings and scores reached by each member of the panel and arrive at an evidence-based consensus on every demand score for every subject.[20]

Visually, each demand profile is represented by radar diagrams to facilitate demand comparison between subjects.

NB: all demand scores produced should be interpreted as approximate judgements given the varying degrees of documentation and detail available for each curriculum, as well as likely variation on how the curricula are implemented in practice.

[19] The documents were shared both in their original languages and in English.
[20] Note: each score was debated by the panel until a unanimous agreement was reached.

4. Programme-Level Alignment

This section focuses on answering RQ2 and the sub-questions associated with it, namely:

Table 6: Research question 2

RQ2: To what degree do the curricula align with regards to their: 2.1: Philosophical underpinnings • Objectives • Principles • Values? 2.2: Structure • Learning areas • Subject offerings • Degree of specialization • Time allocation? 2.3: Requirements • Programme entry requirements • Time requirements (i.e. programme duration, teaching hours, study hours) • Certificate requirements (i.e. credits, passing and failing conditions, compensation options)? 2.4: Assessment • Nature of assessment (i.e. number, type, duration, question types, availability of marks) • Assessment model (i.e. relative weighting of assessments to overall grades)? 2.5: Student learning pathways • Degree of specialization • Options in subject (area) choice (i.e. compulsory subjects, electives)?

It starts by offering top-level overviews of both the DP and the Bachillerato, followed by presenting the results from the programme-level comparative analysis for each core aspect outlined above.

4.1 Programme Overviews

4.1.1 The International Baccalaureate Diploma Programme

The Diploma Programme (DP) was established in 1968 as a two-year pre-university programme for 16–19-year-old students.[21]

Students who aim to achieve the Diploma award must generally select one subject from each of the six subject groups:

- Studies in language and literature
- Language acquisition
- Individuals and societies
- Sciences
- Mathematics
- The arts.[22]

[21] DP *From Principles into Practice* (2015), p. 5.
[22] International Baccalaureate. (2023). *DP curriculum*. https://ibo.org/programmes/diploma-programme/curriculum/

Students who do not wish to take a subject from the arts subject group may opt to study an additional Sciences, Individuals and societies, or languages course instead.

All subjects are studied concurrently over the two-year duration of the programme and most subjects can be taken at either HL or SL. In terms of teaching hours, the DP's documentation recommends 150 teaching hours for individual subjects at SL and 240 teaching hours are at HL.[23]

In addition to the six subjects taken from these groups, DP students will also need to complete three further curriculum components. Theory of knowledge (TOK) allows students to reflect on the nature of knowledge by considering their subjects from a broader perspective.[24] The extended essay is a self-directed piece of research which results in a 4000-word essay.[25] Creativity, activity, service (CAS) is not formally assessed but requires that students undertake a creative endeavour, take part in something physically active, and participate in a voluntary or unpaid activity.[26] Together, these three components comprise the DP 'core'.

To achieve the IB Diploma, a student must take at least three HL subjects.[27] The maximum number of subjects that can be taken at higher level is four. HL subjects are intended to prepare learners for the discipline specialisation of higher education, whilst the SL subjects balance this by broadening the range of subjects studied.[28]

The DP curriculum framework is based on a concentric circle model (see below), whereby the learner profile is positioned at the centre to represent its relevance to all aspects of the programme. The next circle comprises the core requirements of TOK, The extended essay, and CAS. The six subject groups are then encircled by international-mindedness and the programme title – indicating that everything students study is unified by the underpinning philosophy of encouraging thinking from a perspective that embraces other points of view outside one's own frame of reference.

[23] Ibid.
[24] International Baccalaureate. (2021). *Theory of knowledge*. https://www.ibo.org/programmes/diploma-programme/curriculum/theory-of-knowledge/
[25] International Baccalaureate. (2023). *Extended Essay.* https://www.ibo.org/programmes/diploma-programme/curriculum/dp-core/extended-essay/
[26] International Baccalaureate. (2022). *CAS projects.* https://www.ibo.org/es/programmes/diploma-programme/curriculum/dp-core/creativity-activity-and-service/cas-projects/
[27] International Baccalaureate. (2023). *DP curriculum*.
[28] International Baccalaureate. (2015). *Diploma Programme: From principles into practice*. p. 6.

Figure 2: IB Diploma Programme curriculum model[29]

Both internal and external assessment methods are used in the DP. In most subjects, students take written examinations at the end of the programme that are marked by external IB examiners. Internally assessed tasks normally comprise between 20-30% of the total mark in each subject.[30]

Question types used in DP assessment vary from subject to subject. Essays, structured problems, short-response questions, data-response questions, case-study questions, and multiple-choice questions are some of the external assessment question types deployed.[31] Coursework forms part of the assessment for areas of the DP such as The extended essay and TOK.[32] This is normally carried out over an extended period under teacher supervision. Where students complete internally assessed tasks, these are marked by teachers and moderated by the IB.[33] Some of the internal assessment methods used include oral work in languages, fieldwork in geography, laboratory work in the sciences, and artistic performances in the arts.[34]

Each DP subject, whether taken at SL or HL, is graded from 1-7 (with 7 representing the highest achievement level).[35] If a student has taken enough subjects at the correct level to be

[29] International Baccalaureate. (2016). *Guide to the International Baccalaureate Diploma Programme*. p. 2.
[30] International Baccalaureate. (2021). *Understanding DP assessment*. https://www.ibo.org/programmes/diploma-programme/assessment-and-exams/understanding-ib-assessment/; International Baccalaureate. (2014). *Diploma Programme: A guide to assessment*. p. 3.
[31] International Baccalaureate. (2021). *Assessment and Exams*. https://www.ibo.org/programmes/diploma-programme/assessment-and-exams/
[32] International Baccalaureate. (2021). *Understanding DP assessment*.
[33] Ibid.
[34] International Baccalaureate. (2021). *Assessment and Exams*.
[35] International Baccalaureate. (2021). *Understanding DP assessment*.

in contention for the Diploma award, a minimum of 24 points is needed to achieve the qualification. A minimum grade of 3 is also needed in at least four subjects to achieve the qualification.[36]

Additionally, 42 total points are available from the combination of the grades for six subjects and a further three points are available to students for successful completion of the core elements of TOK, The extended essay, and CAS. The TOK and extended essay components of the DP are each marked on an A-E scale, where an A grade is the highest award, and an E grade the lowest.[37] Their combined results can contribute up to three additional numerical points to the overall DP score (see Table below). CAS does not constitute a graded part of the DP, although its completion is mandatory to be awarded the Diploma.

HL and SL subjects are assessed against the same grade descriptors;[38] however, HL candidates are expected to demonstrate the various elements of the grade descriptors across a greater range of knowledge, skills, and understanding.

A bilingual Diploma is awarded to students who achieve:

- Grade 3 or higher in two language subjects from the Studies in language and literature group; or,
- Grade 3 or higher in a language subject from the Studies in language and literature group and a grade 3 or higher in a subject from the Individuals and societies group or Sciences group taken in a different language.

Certificates are awarded to students that have taken individual subjects but not enrolled on the full Diploma, or DP candidates who do not achieve the full DP.[39] Prospective candidates can enrol in as many individual subjects as permitted by their school; these are graded with the same 1-7 system used in the full DP.

Table 7: Letter-Grade: numerical score conversion matrix[40]

		Theory of knowledge (TOK)				
	Grade awarded	A	B	C	D	E
The extended essay	A	3	3	2	2	Failing condition
	B	3	2	2	1	
	C	2	2	1	0	
	D	2	1	0	0	
	E	Failing condition				

No formal entrance requirements are stipulated as the IB envisages numerous educational pathways leading to the DP.[41] However, the IB recommends consulting the subject guides prior to enrolment to ensure an adequate understanding of programme expectations.[42]

[36] International Baccalaureate. (2016). *Guide to the International Baccalaureate Diploma Programme*. p. 4.
[37] Ibid.
[38] International Baccalaureate. (2021). *Understanding DP assessment*.
[39] International Baccalaureate. (2016) *Guide to the International Baccalaureate Diploma Programme*. p. 4.
[40] International Baccalaureate. (2018). *Assessment principles and practices: Quality assessments in a digital age*. p. 220.
[41] International Baccalaureate. (2015). *Diploma Programme: From principles into practice*. p. 22.
[42] Ibid.

4.1.2 Bachillerato (SB)

The school system in Spain is overseen by the Ministry of Education, Vocational Training and Sports, but is decentralised into 17 autonomous regions. As such, while the Ministry oversees the core curriculum and assessment, the regions can determine specific procedures (e.g. what to do when a student fails a subject) and dictate some subjects within the overall selection.

Overall, the Spanish system is divided into primary school, compulsory secondary education, and upper secondary education. Primary school, attended by students between six and 12 years old, lasts for six years, with three cycles of two academic years each. Following Primary school, there are two stages of secondary education in Spain: compulsory secondary education (*Educación Secundaria Obligatoria*) and upper secondary education. Compulsory secondary education is mandatory and lasts for four years, being attended by students between the ages of 12 and 16 years old. Upper secondary education – i.e. the *Bachillerato* (SB) – is non-compulsory and lasts for two years, being attended by students between the ages of 16 and 18 years old.[43]

Structure

As mentioned above, the SB spans the two years of Spain's non-compulsory upper secondary education. While, under some specific circumstances, students may be granted permission to complete the SB in three years, the usual structure of the qualification is as follows:

- **First year**: students between 16 and 17 years old
- **Second year**: students between 17 and 18 years old.

The SB is offered through four different streams (i.e. modalities), which students can pick from in line with their specific interests and career plans:

- the Arts modality (includes two pathways);
- the Sciences and Technology modality;
- the Humanities and Social Sciences modality; and
- the General stream.

Students from all modalities study a range of subjects from different categories, including:

- **Common subjects:** these are subjects taken by all students regardless of their stream.
- **Modality subjects:** these are subjects taken by students in the same stream.
- **Elective subjects:** these are optional subjects that students can choose to study.

The full breakdown of the common and modality subjects is outlined in the tables below:

[43] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). Compulsory Secondary Education, https://educagob.educacionyfp.gob.es/ensenanzas/secundaria.html ; Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). Bachiller Certificate, https://educagob.educacionyfp.gob.es/ensenanzas/bachillerato.html

Table 8: Common subjects studied in the first and second year of the SB[44]

Common subjects of the SB	
First year	**Second year**
Physical Education	Spanish History
Philosophy	History of Philosophy
Spanish Language and Literature I and if applicable, regional Language and Literature I	Spanish Language and Literature II and, if applicable, regional Language and Literature II
Foreign Language I	Foreign Language II

Table 9: Modality subjects studied in the first and second year of the SB (shown per modality and pathway).[45]

Modality	Year of study	Subjects
Arts *Visual Arts, Image and Design pathway*	Year 1	Mandatory subject: Artistic Drawing I
		Two subjects to be chosen from: • Audiovisual Culture • Technical Drawing Applied to Plastic Arts and Design I • Artistic Projects • Volume
	Year 2	Mandatory subject: Artistic Drawing II
		Two subjects to be chosen from: • Technical Drawing Applied to Plastic Arts and Design II • Design • Art Fundamentals • Graphic and Plastic Expression Techniques
Arts *Music and Performing Arts pathway*	Year 1	Mandatory subject: Music Analysis I or Performing Arts I
		Two subjects to be chosen from: • Musical Analysis I • Performing Arts I • Choir and Vocal Technique I • Audiovisual Culture • Musical Language and Practice
	Year 2	Mandatory subject: Music Analysis II or Performing Arts II
		Two subjects to be chosen from: • Musical Analysis II • Performing Arts II • Choir and Vocal Technique II • History of Music and Dance • Dramatic Literature
Science and Technology	Year 1	Mandatory subject: Mathematics I
		Two subjects to be chosen from: • Biology, geology and environmental sciences • Technical drawing I • Physics and chemistry • Technology and engineering I
	Year 2	Mandatory subject: Mathematics II or Mathematics Applied to Social Sciences II
		Two subjects to be chosen from: • Biology • Technical drawing II

[44] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). General information of the Bachillerato. Common subjects, https://educagob.educacionyfp.gob.es/ensenanzas/bachillerato/informacion-general/organizacion.html

[45] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). General information of the Bachillerato. Modality subjects, https://educagob.educacionyfp.gob.es/ensenanzas/bachillerato/informacion-general/organizacion.html

Modality	Year of study	Subjects
		• Physics • Geology and environmental sciences • Chemistry • Technology and engineering II
General	Year 1	Mandatory subject: General Mathematics
		Two subjects to be chosen from among all the first-year modality subjects offered at the institution. This offer will compulsorily include the subject of Economics, Entrepreneurship and Business Activity.
	Year 2	Mandatory subject: General Science
		Two subjects to be chosen from among all the second-year modality subjects offered at the institution. This offer will compulsorily include the subject of Cultural and Artistic Movements.
Humanities and Social Sciences	Year 1	Mandatory subject: Latin I or Mathematics applied to social Sciences I
		Two subjects to be chosen from: • Economics • Greek I • Contemporary world history • Latin I • Universal literature • Mathematics applied to social sciences I
	Year 2	Mandatory subject: Latin II or Mathematics applied to social sciences II
		Two subjects to be chosen from: • Business and business model design • Geography • Greek II • History of Art • Latin II • Mathematics applied to social sciences II.

In addition to the common and modality subjects above, students in the SB also study elective subjects. The specific subjects offered are determined by the Spanish regional educational authorities but should include at least one second foreign language.[46] Additionally, schools offering the SB are also required to offer Religion as a subject, though the subject is voluntary for students.

Minimum total teaching hours per subject are the following, regardless of the modality:

- Physical education: 35h
- Philosophy: 70h
- History of philosophy: 70h
- Spanish history: 70h
- Spanish language and literature: 210h
- Foreign language: 210h

[46] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). General information of the Bachillerato. Elective subjects. https://educagob.educacionyfp.gob.es/ensenanzas/bachillerato/informacion-general/organizacion.html

- For each of the six modality subjects: 87.5h.[47]

To progress from the first to the second year of the SB, students are allowed to fail a maximum of two subjects. The educational authorities in some Spanish regions, including Andalucía, Aragón, Asturias, Islas Baleares, Islas Canarias, Cantabria, Castilla León, Castilla-La Mancha, Cataluña, Extremadura, Galicia and País Vasco have signed an agreement that indicates the conditions allowing repetition of the first year of the Bachillerato in cases where students fail three or four subjects of their first year studies. More specifically, students in those regions have the option to:

- Retake the first year of the Bachillerato as a whole by giving up the grades that they have already attained;
- Retake the first year of the SB as a whole by developing their knowledge and skills in specific subjects and improve their grades. In case the new grade is lower, the student can keep the grade achieved in the previous year;
- Only retake the specific subjects that the student has failed.[48]

Notably, passing second year subjects is conditional upon passing the pre-requisite first year subjects. Within the same modality, students may register in the second year of a specific subject without having taken the equivalent first year subject only when the subject teacher deems that the student meets the appropriate requirements to successfully attend and complete the second year subject; in all other cases, the student should retake the first year subject which is regarded as a pending subject.

Students who fail any subjects in their second year of the SB have the option to repeat the whole second year or can register to retake only the specific subject(s) they failed, without needing to retake any subjects they already passed.[49]

Assessment

The assessment methods and assessment criteria for the SB are designed by the Ministry of Education, Vocational Training and Sports in collaboration with the educational authorities of the autonomous communities. The central principles of the assessment in the SB are the following:

- Assessment should be ‘continuous and differentiated’ based on the requirements of the different subjects
- Assessment should be educational in nature
- Assessment should be focusing on improving the teaching and learning processes
- The teacher of each subject decides at the end of the subject if students have achieved the aims and assessment objectives in order to gain the necessary knowledge and skills

[47] Government of Spain, Ministry of Education, Vocational Training and Sports. (2022). *Royal Decree 243/2022, Anexo IV*. https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521#a2-3

[48] Eurydice. (2023). *Spain. 6.6 Assessment in general upper secondary education.* https://eurydice.eacea.ec.europa.eu/national-education-systems/spain/assessment-general-upper-secondary-education

[49] Government of Spain, Ministry of Education, Vocational Training and Sports. (2022). *Royal Decree 243/2022, Anexo IV*, *Article 21*. https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521#a2-3

- Through assessment, the teacher of each subject assesses their own teaching practice
- Teachers can use flexible, differentiated and adapted assessment methods in order to meet the learning needs and interests of students and where needed provide the appropriate educational support to students
- Students can take an extraordinary test of the subjects they did not pass on specific dates determined by the educational authorities and administrations
- In specific autonomous communities which have more than one official language, students can be excused from the assessment of the co-official Language and Literature subjects, according to the regional educational guidelines.[50]

Assessment in the SB typically consists of both continuous assessment set by schools – which can include tests, classroom exercises, homework, and behaviour[51] – and end-of-subject assessments set externally by each regional educational authority.[52]

The results for both continuous tests and end-of-subject examinations are documented in numerical grades from 0 to 10 (10 being the highest), where 5 is the passing grade and any results below 5 are considered a fail. Generally, both the grades from continuous assessment and end-of-subject assessments are taken into account when awarding students' final SB grades, though the specific weighting allocated to each of them varies from region to region. The overall SB grade consists of the mean arithmetic average score obtained across all subjects studied.

University access exam (EVAU / EBAU)

In addition to continuous assessment and end-of-subject tests, students who have studied the SB curriculum and wish to access higher education in Spain are also required to take the 'La Evaluación de Bachillerato para el Acceso a la Universidad' (Evaluation for University Access). This is also known as EVAU or EBAU, depending on the region. Set up by the Ministry of Education, Vocational Training and Sports, the EVAU / EBAU consists of two phases – one mandatory and one voluntary – with different tests taking place in each phase:

- **Mandatory phase:** all candidates are required to take all tests in this phase. The grade for this phase is calculated through averaging the scores in each test. These include: one test on Spanish Language and Literature II, one on history of Spain, one on foreign language II, and one on local language and literature (taken exclusively by students in autonomous regions that mandate it). Additionally, depending on their specific modality, students must also take:
    - Arts: Artistic Drawing II, Music Analysis II, or Performing Arts II;
    - Science and Technology: Mathematics II.
    - Humanities and Social Sciences: either Latin II or Mathematics applied to social sciences II.

[50] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). Characteristics of the evaluation in the Bachillerato. https://educagob.educacionyfp.gob.es/ensenanzas/bachillerato/informacion-general/evaluacion-promocion-y-titulacion.html

[51] Students are assessed and scored on their classroom behaviour.

[52] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). Evaluation results. https://educagob.educacionyfp.gob.es/ensenanzas/bachillerato/informacion-general/evaluacion-promocion-y-titulacion.html

- **Voluntary phase:** this phase is voluntary and aimed at allowing students to improve their university admission grades. Students may choose to be examined on up to four modality subjects (up to three in Cataluña, Islas Baleares and Navarra). In this phase, each individual test is awarded a score (the scores are not averaged out).

Overall, students can access higher education if their overall university access grade is 5 or above, with this grade being made up as follows:

- 60% of the total grade consists of the overall SB grade;
- 40% of the total grade consists of the overall score obtained in the mandatory phase of the EVAU / EBAU exam.[53]

Additionally, each higher education institution can set out specific grade requirements for each modality subject.

NB: DP students are not required to take the EVAU / EBAU in order to access higher education in Spain.[54]

High School Diploma / Título de Bachiller

Students who successfully complete the SB are awarded the *Título de Bachiller.* Typically, this is awarded to students who successfully achieve a grade of 5 or higher in all subjects studied, though some autonomous regions allow some students who meet specific conditions to obtain a certificate even if they fail to achieve a grade of 5 one subject.[55]

Students who have achieved certain technical and vocational awards (e.g. Technical Vocational Award, Technical Award in Music or Dance, or Technical Award in Plastic Arts and Design) may also achieve the *Título de Bachiller* if they successfully pass all common subjects in the SB qualification.[56]

Curriculum Design Principles

In March 2022, the Ministry of Education, Vocational Training and Sports published the Royal Decree 243/2022 which outlines a new curriculum for the SB. According to the Ministry's website, the new curriculum's primary purpose is to provide competence-based education to all students studying in upper secondary education in Spain, aiming to equip them with the necessary knowledge, skills and competences required to become active citizens, exercise

[53] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). Access to university with a Bachillerato. https://educagob.educacionyfp.gob.es/ensenanzas/bachillerato/informacion-general/evaluacion-promocion-y-titulacion.html

[54] Agencia Estatal Boletín Oficial del Estado, 'Real Decreto 412/2014, de 6 de junio, por el que se establece la normativa básica de los procedimientos de admisión a las enseñanzas universitarias oficiales de Grado'. https://www.boe.es/eli/es/rd/2014/06/06/412/con

[55] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). Access to university with a Bachillerato. https://educagob.educacionyfp.gob.es/ensenanzas/bachillerato/informacion-general/evaluacion-promocion-y-titulacion.html

[56] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). Obtaining the Bachillerato from other teachings. https://educagob.educacionyfp.gob.es/ensenanzas/bachillerato/informacion-general/evaluacion-promocion-y-titulacion.html

their human rights and contribute towards the protection of the environment and society, as well as prepare them for further education and the workplace.[57]

More specifically, the SB's new curriculum is organised around specific **goals** and **competences**.

The following table describes the SB's overarching **goals** as outlined in the Ministry's website:

Table 10: SB goals and pedagogical principles[58]

Goals of the SB
The SB aims to prepare students to: • Exercise **democratic citizenship**, from a **global perspective**, and acquire a responsible **civic conscience**, inspired by the values of the Spanish Constitution, as well as by **human rights**, which promotes **co-responsibility** in the construction of a **just and equitable society**. • Consolidate a **personal, affective-sexual and social maturity** that allows them to act **respectfully, responsibly and autonomously** and develop their **critical spirit**. **Anticipate, detect and peacefully resolve personal, family and social conflicts**, as well as possible situations of violence. • Promote effective **equality of rights** and **opportunities** for **women and men**, **analyze and critically assess existing inequalities**, as well as the recognition and teaching of the role of women in history and **promote real equality and non-discrimination based on birth, sex, racial or ethnic origin, disability, age, illness, religion or belief, sexual orientation or gender identity** or any other personal or social condition or circumstance. • Strengthen the habits of **reading, study and discipline**, as necessary conditions for the effective use of learning, and as a means of **personal development**. • Mastering, both in **oral and written expression**, the Spanish language and, where applicable, the **co-official language** of their autonomous community. • **Express themselves fluently and correctly in one or more foreign languages**. • Use **information and communication technologies** with solvency and responsibility. • Know and **critically assess the realities of the contemporary world**, its **historical background** and the **main factors of its evolution**. Participate in **solidarity** in the development and improvement of their social environment. • Access **fundamental scientific and technological knowledge** and master the basic skills of the chosen modality. • Understand the **fundamental elements and procedures of research and scientific methods**. **Know and critically assess the contribution of science and technology in changing living conditions**, as well as **strengthen sensitivity and respect for the environment**. • Strengthen the **entrepreneurial spirit** with attitudes of **creativity, flexibility, initiative, teamwork, self-confidence and a critical sense**. • Develop **artistic and literary sensitivity**, as well as aesthetic criteria, as sources of training and cultural enrichment. • Use **physical education** and **sport** to promote personal and social development. Strengthen the habits of physical-sporting activities to promote physical and mental well-being, as well as a means of personal and social development. • Strengthen **attitudes of respect and prevention** in the field of safe and healthy mobility.

[57] Government of Spain, Ministry of Education, Vocational Training and Sports. (2022) Royal Decree 243/2022. https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521#dd

[58] Government of Spain, Ministry of Education, Vocational Training and Sports. (n.d.) Aims, general principles, pedagogical principles and objectives. https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/fines-principios-objetivos.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp;

Goals of the SB
• Promote a **responsible and committed attitude in the fight against climate change** and in defense of sustainable development.

To ensure the above goals are achieved, the SB outlines eight qualification-level **key competences** that students should develop throughout the qualification.[59] These include:

Table 11: Key competences of the SB[60]

Key competence	Definition
Linguistic competence	**Competence in linguistic communication** includes students' ability to interact orally, in writing, by sign or multimodal in a coherent and appropriate manner in different fields and contexts and for different communicative purposes. It involves consciously mobilizing the set of knowledge, skills, and attitudes that make it possible to understand, interpret, and critically assess oral, written, signed, or multimodal messages, avoiding the risks of manipulation and misinformation, as well as communicating effectively with other people in a cooperative, creative, ethical and respectful manner. **Competence in linguistic communication** constitutes the basis for one's own thinking and for the construction of knowledge in all fields of knowledge. For this reason, its development is linked to explicit reflection on the functioning of the language in the specific discursive genres of each area of knowledge, as well as the uses of orality, writing or signing to think and learn. Finally, it makes it possible to appreciate the aesthetic dimension of language and enjoy literary culture.
Mathematical competence, science and technological competence	**Mathematical literacy and science, technology, and engineering literacy (STEM literacy)** involves understanding the world using scientific methods, mathematical thinking and representation, technology, and engineering methods to transform the environment in committed, responsible and sustainable ways. **Mathematical competence** allows the development and application of mathematical perspective and reasoning in order to solve various problems in different contexts. **Science competence** involves understanding and explaining the natural and social environment, using a body of knowledge and methodologies, including observation and experimentation, in order to ask questions and draw evidence-based conclusions in order to interpret and transform the natural world. and the social context. **Competence in technology and engineering** includes the application of scientific knowledge and methodologies to transform our society according to the needs or desires of people within a framework of safety, responsibility and sustainability.
Digital competence	**Digital competence** implies the safe, healthy, sustainable, critical and responsible use of digital technologies for learning, work and participation in society, as well as interaction with them. **Digital competence** includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), security (including digital wellbeing and cybersecurity related skills), citizenship issues digital, privacy, intellectual property, problem solving, and computational and critical thinking.
Personal, social and learning to	**Personal, social and learning to learn competence** implies the ability to reflect on oneself in order to know oneself, accept oneself and promote constant personal growth; manage time and information effectively; collaborate with others constructively; maintain resilience; and manage lifelong learning.

[59] Government of Spain, Ministry of Education, Vocational Training and Sports. (2022) Royal Decree 243/2022. https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521#dd; https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/competencias-clave.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp

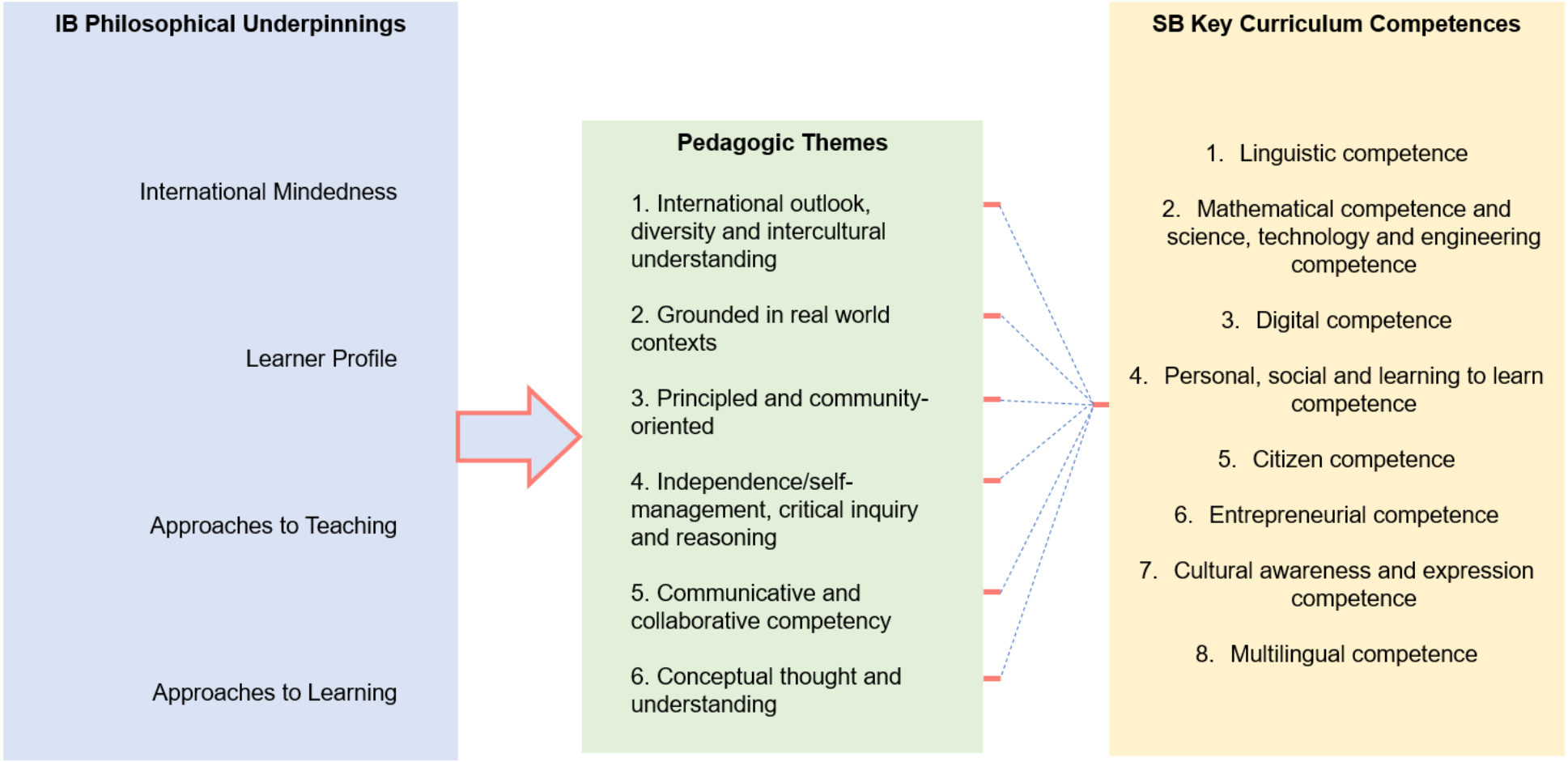
[60] Government of Spain, Ministry of Education, Vocational Training and Sports. (n.d) Key competences. https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/competencias-clave.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp

Key competence	Definition
Learn competence	It also includes the ability to cope with uncertainty and complexity; Adapt to changes; learn to manage metacognitive processes; identify behaviors contrary to coexistence and develop strategies to address them; contribute to their own physical, mental and emotional well-being and that of others, developing skills to take care of themselves and those around them through co-responsibility; be able to lead a future-oriented life; as well as express empathy and address conflicts in an inclusive and supportive context.
Citizen competence	**Civic competence** helps students to exercise responsible citizenship and fully participate in social and civic life, based on an understanding of social, economic, legal and political concepts and structures, as well as knowledge of current events. and active commitment to sustainability and the achievement of global citizenship. It includes civic literacy, the conscious adoption of the values of a democratic culture founded on respect for human rights, critical reflection on the great ethical problems of our time and the development of a sustainable lifestyle in accordance with the Goals. of Sustainable Development proposed in the 2030 Agenda.
Entrepreneurial competence	**Entrepreneurial competence** implies developing a vital approach aimed at acting on opportunities and ideas, using the specific knowledge necessary to generate valuable results for other people. Provides strategies that allow the detection of different needs and opportunities; train thinking to analyze and evaluate the environment, and create and rethink ideas using imagination, creativity, strategic thinking and ethical, critical and constructive reflection within creative and innovation processes; and awaken the willingness to learn, risk and face uncertainty. **Entrepreneurial competence** also implies making decisions based on information and knowledge and collaborating in an agile way with other people, with motivation, empathy and communication and negotiation skills, to put the ideas raised into action through the planning and management of sustainable projects of social, cultural and economic-financial value.
Cultural awareness and expression competence	**Cultural awareness and expression competence** involves understanding and respecting how ideas, opinions, feelings and emotions are creatively expressed and communicated in different cultures and through a wide range of artistic and cultural manifestations. It also implies a commitment to understanding, developing and expressing one's own ideas and the sense of one's place or role in society. It also requires an understanding of one's evolving identity and cultural heritage in a world characterized by diversity, as well as an awareness that art and other cultural manifestations can be a way of looking at the world and shaping it.
Multilingual competence	**Multilingual competence** involves using different languages, oral or signed, appropriately and effectively for learning and communication. This competence involves recognizing and respecting individual linguistic profiles and taking advantage of one's own experiences to develop strategies that allow mediating and making transfers between languages, including classical ones, and, where appropriate, maintaining and acquiring skills in the familiar language or languages and in the official languages. It also integrates historical and intercultural dimensions aimed at knowing, valuing and respecting the linguistic and cultural diversity of society with the aim of promoting democratic coexistence.

As can be seen above, the curriculum particularly emphasises the development of linguistic communication competences, mathematic competences, science, and technology competences. To successfully develop these key competences, teachers are asked to meaningfully incorporate them in the design and implementation of teaching and learning activities.

4.2 Philosophical Underpinnings

Figure 3: Philosophical underpinnings comparative analysis diagram for the DP and SB



The IB learner profile, which is used across all IB programmes including the DP, outlines 10 attributes that all students should strive towards.[61] Linked to these attributes, there are five categories of learning skills that all IB programmes aim to develop as well as six categories of teaching principles. The table in Appendix B presents these qualities of the IB's underpinning philosophies along with the overview used in IB documentation to describe the quality of international-mindedness that also encircles all IB teaching and learning.

The six themes identified within the IB literature have relatively consistent presence across all component parts (learner profile, ATT, ATL and international-mindedness). As a result, these themes present a 'boiled-down' version of the DP's philosophical underpinnings.

To identify the level of alignment in relation to the philosophical underpinnings between the DP and the SB, the project team mapped the philosophical underpinnings of the SB against six themes extracted from the DP's philosophical underpinnings.

Table 12: Philosophical underpinning themes

Philosophical underpinning themes
• International outlook, diversity, and intercultural understanding • Grounded in real world contexts • Principled and community-oriented • Independence/self-management, critical inquiry, and reasoning • Communicative and collaborative competence • Conceptual thought and understanding

When mapping the six DP themes onto the SB key curriculum competences, it is apparent that all DP themes are strongly present in the SB context. All the themes are comprehensively covered across the component parts of the SB key curriculum competences, indicating that the SB curriculum operates on similar philosophical underpinnings to the IB curriculum.

The main differences identified between both programmes is the SB's specific focus on the development of students' entrepreneurial competence, i.e. requiring them to develop and strengthen their entrepreneurial spirit; and the development of students' digital competence, i.e. requiring them to develop knowledge and skills in using digital technologies and learning how to prevent and mitigate risks derived from the inappropriate use of Information and Communication Technologies. These specific elements are not explicitly mentioned in the IB's philosophical underpinning.

Another key difference identified between the two is to do with their very nature. While the IB's philosophical underpinnings are subject-agnostics and broader in nature, as they are meant to be applicable to all subject areas, some of the SB's key curriculum competences are more subject specific. For instance, while the IB's pedagogical themes emphasise the general creation of linkages to real-world contexts (e.g. 'engage with issues and ideas that have local and global significance'[62]) and development of conceptual thought and understanding, the SB focuses on the specific development of mathematical, science, engineering and technological

[61] International Baccalaureate. (2017). *What is an IB education?*
[62] Ibid.

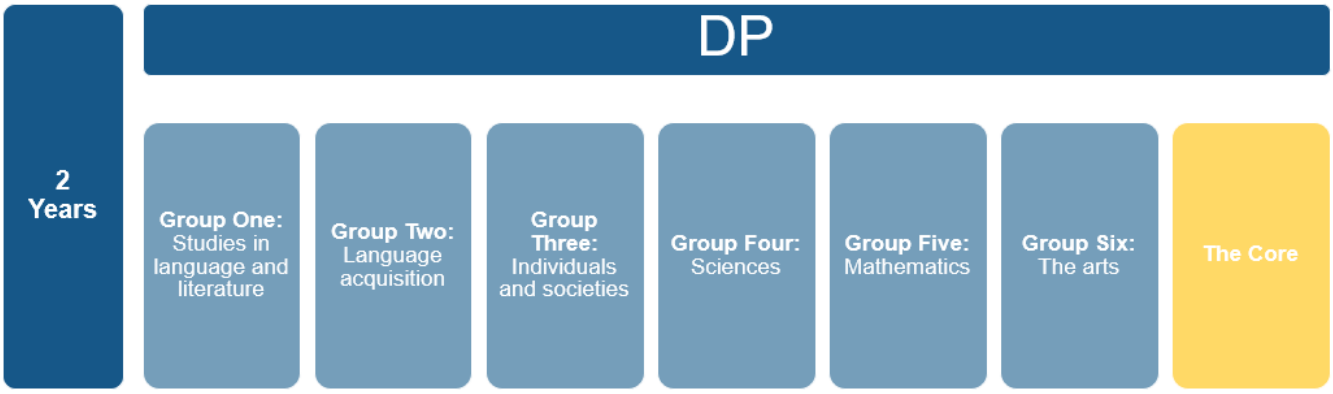
competences, referencing the wider skills of conceptual thought and understanding and real-world linkages within each specific discipline. That said, the SB also includes some key curriculum competences which are broader in nature and have the potential to be covered in multiple subject areas, such as the key curriculum competences of 'Learning to learn', 'Digital competence', 'Entrepreneurial competence', 'Citizen competence' and 'Cultural awareness and expression competence'.

Overall, the philosophical underpinnings of both the DP and the SB share substantial similarities in regard to the key competences they aim to develop.[63]

4.3 Structure

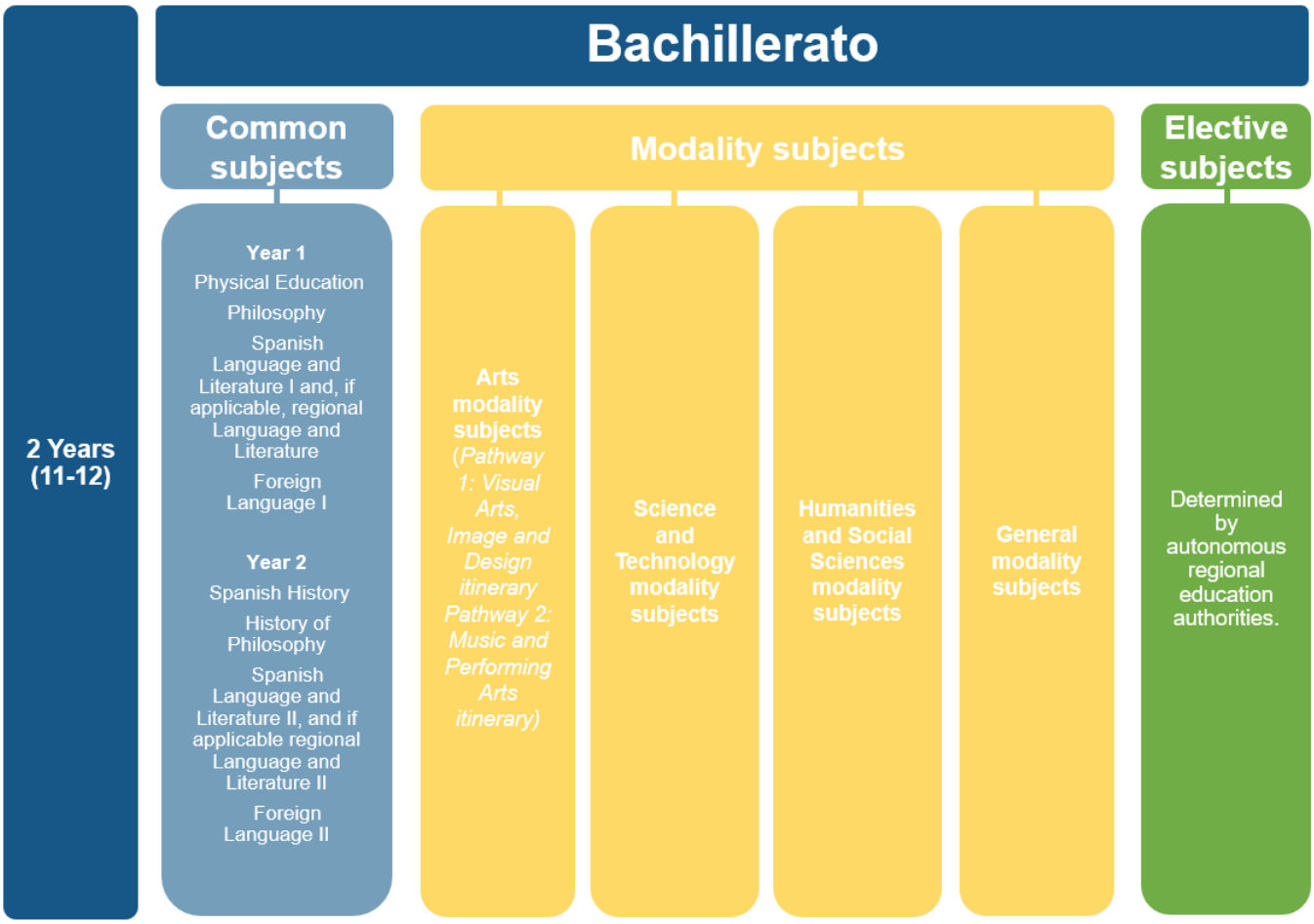
There are six subject groups comprising the DP and students pursuing the Diploma award are normally required to select one subject from each of the six groups.[64] The DP also has three core components which are compulsory and are carried out alongside subjects. The SB also includes both mandatory and optional subjects. More specifically, students in the SB take at least four common subjects both in the first and second year (depending on the specific autonomous region, students may be required to also take a fifth common subject – a regional language – in both years). In addition to common subjects, students also study two modality subjects in the first year and two in the second year; the specific subjects vary depending on the specific modality chosen by the student – i.e. Arts, Sciences and Technology, Humanities and Social Sciences, or General. In addition to common and modality subjects, SB students also study elective subjects determined by the education authority of each autonomous region. The figures below present the subject groups of the DP in comparison with the subjects that cover similar areas of learning in the SB.[65]

Figure 4: Structural overview of the DP



[63] Government of Spain, Ministry of Education, Vocational Training and Sports. (2022) Royal Decree 243/2022. https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521#dd
[64] International Baccalaureate. (2021). *How the Diploma Programme works*. https://www.ibo.org/programmes/diploma-programme/what-is-the-dp/how-the-diploma-programme-works/
[65] Government of Spain, Ministry of Education, Vocational Training and Sports. (2022) Royal Decree 243/2022. https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521#dd

Figure 5: Structural overview of the SB



In terms of similarities in programme structure and subjects taught, both programmes follow a baccalaureate-style approach, prioritising breadth; both organise their subjects into subject groups; and both include various similar-focussed subjects in their programmes of study. Subjects common to both the DP and the SB include languages (including a variety of classical and modern foreign languages), history, science, maths, arts, geography, business studies and management and information technology. Additionally, both programmes also include social, cultural, political, religious, philosophy and humanities subjects.

Regarding differences in structure, the SB offers four different modalities (i.e. streams) of study: the Arts modality (two pathways), the Science and Technology modality, the Humanities and Social Sciences modality, and the General modality. In contrast, the DP is not split into different specialised streams – all students typically study one subject per subject group (although they do have the option to replace their subject from the arts group with another science subject).

Additionally, DP subjects are offered at two levels: SL and HL. A similar division in levels is not offered in the SB, though students do have the option to study various subjects in more or less depth through either choosing to continue to study that specific subject in their second year or choosing not to so. For example, a student wishing to specialise in physics will study physics and chemistry in their first year, and then the standalone physics subject in the second

year; a student wishing to only study the foundation of physics will choose another modality subject in their second year.

Both programmes outline the teaching hours of individual subjects, with the SB mandating a minimum of 35h for physical education, 70h for philosophy, 70h for history of philosophy, 70h for Spanish history, 210h for Spanish language and literature, 210h for a foreign language, and 87.5h for each modality subject.[66] In the case of the DP, while the programme does not mandate minimum teaching hours, the recommended teaching hours per subject are 150h at standard level and 240h at higher level.[67]

One difference between the programmes is the number of subjects that students need to study in order to obtain the respective diploma. In the DP, students must complete six subjects – up to four at higher level – and achieve a minimum pass grade of 3 in all of them. In contrast, SB students take a higher number of subjects in the programmes' two years; they study four common subjects in the first year, four common subjects in the second year, three modality subjects in the first year and three modality subjects in the second year, and some elective subjects (the exact number is set by the respective regional authority). While each SB subject is only one year long, the overall number of subjects experienced by SB per year is still slightly higher, consisting of seven subjects (four common and three modality subjects) plus some electives.

Another notable difference between the two programmes is that the TOK, CAS and The extended essay core components are unique to the DP; the SB does not include any similar courses.

4.4 Requirements and Associated Outcomes

There are no formal entry requirements stipulated for the DP as the IB envisages numerous educational pathways leading to upper secondary education.[68] However, the IB recommends consulting the subject guides prior to enrolment to ensure an adequate understanding of programme expectations.[69] For the SB, students must possess one of the following qualifications in order to enrol in the first year: Compulsory Secondary Education certificate; any vocational training qualifications; any plastic arts and design diplomas; or any diplomas in sports education.[70] Additionally, to take some specific subjects in their second year, students must have successfully completed certain courses in their first year (e.g. to take SB physics in Grade 12, students must have successfully completed SB physics and chemistry in Grade 11). The DP does not stipulate a similar type of entry requirement for its subjects; instead, it simply states that, to study *some* subjects at HL, some prior study in the specific subject area is advisable.

[66] Ministry of Education, Vocational Training and Sports (2022). *Anexo IV*. Available at: https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521#a2-3
[67] International Baccalaureate. (2023). *DP curriculum*.
[68] International Baccalaureate. (2015). *Diploma Programme*: *From principles into practice*. p. 22.
[69] Ibid.
[70] Government of Spain, Ministry of Education, Vocational Training and Sports. (2022) *Royal Decree 243/2022*. https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521#dd

In terms of associated outcomes, both programmes aim to prepare students for higher education and/or employment. According to the DP documentation, although the DP is conceived as a preparatory programme for university matriculation and higher education focusing primarily on rigorous academic study, the programme can also prepare students for employment. Similarly, the documentation of the Spanish Ministry of Education, Vocational Training and Sports outlines that students who possess the SB certificate (*Título de Bachiller*) can access higher education, although they might have to pass specific entrance examinations and meet other requirements set by specific higher education institutions. The SB certificate may also allow students to access other types of education, such as advanced vocational training, advanced artistic education, advanced plastic arts and design professional studies, and advanced vocational education in sports, as well as military education. [71]

Both programmes have a duration of two years and intend for students to work towards a diploma at the end of their period of study.

4.5 Student Learning Pathways

In terms of learning pathways, both programmes include compulsory and optional subjects. See the programme overviews in section 4.1 for further details on subject selection. To understand the levels of optionality and potential specialisation in each programme, it is instructive to look at what individual students could choose in practice. The following diagrams demonstrate the subject options available to an imagined student who knows that they would like to study physics at university after the completion of their upper secondary studies, followed by similar diagrams for a student who would seek to study business at higher education level.

[71] Government of Spain, Ministry of Education, Vocational Training and Sports. (2022) Royal Decree 243/2022. https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521#dd

Figure 6: DP imagined pathway for a student wishing to study physics at university

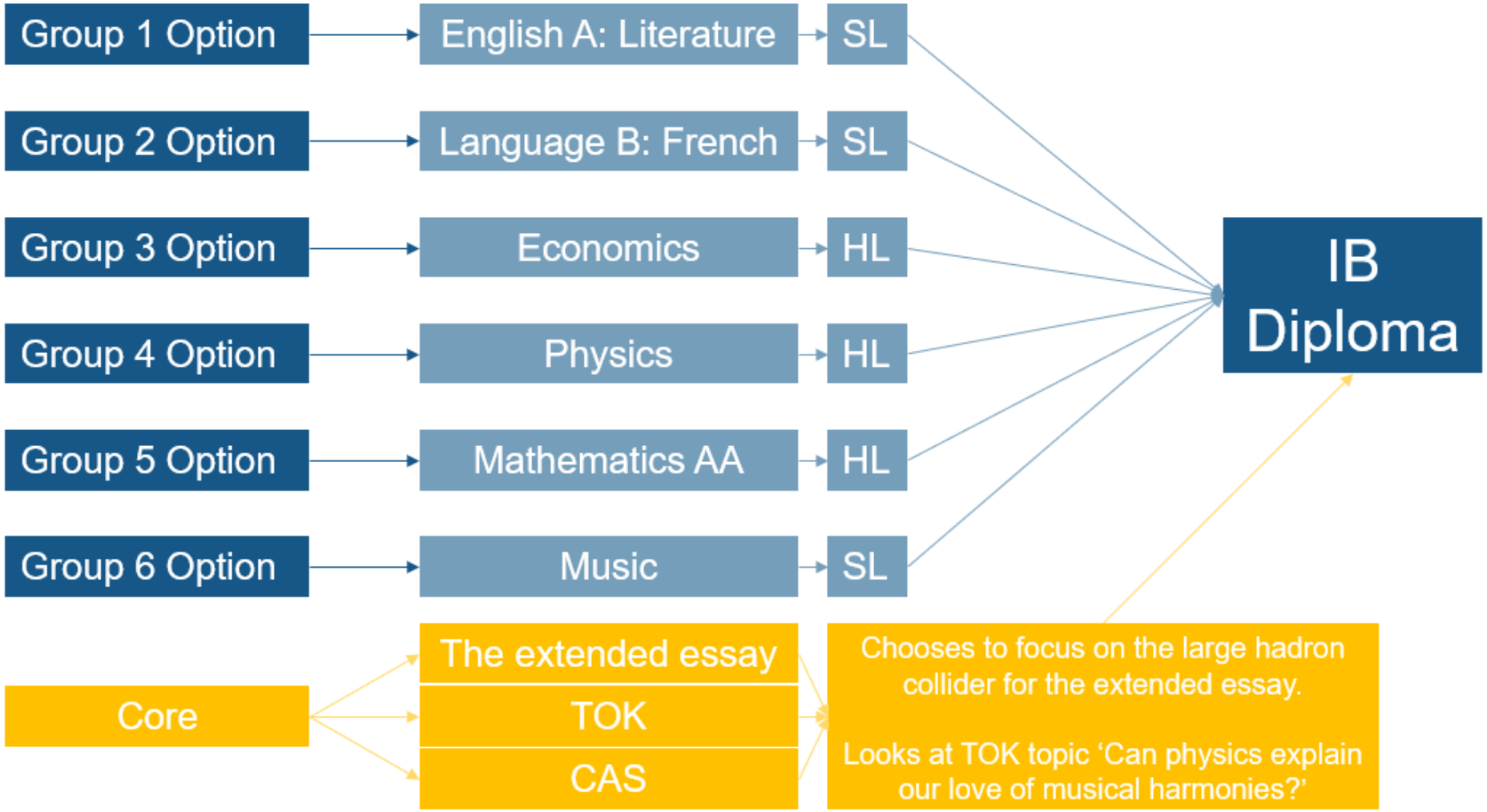


Figure 7: SB imagined pathway for a student wishing to study physics at university

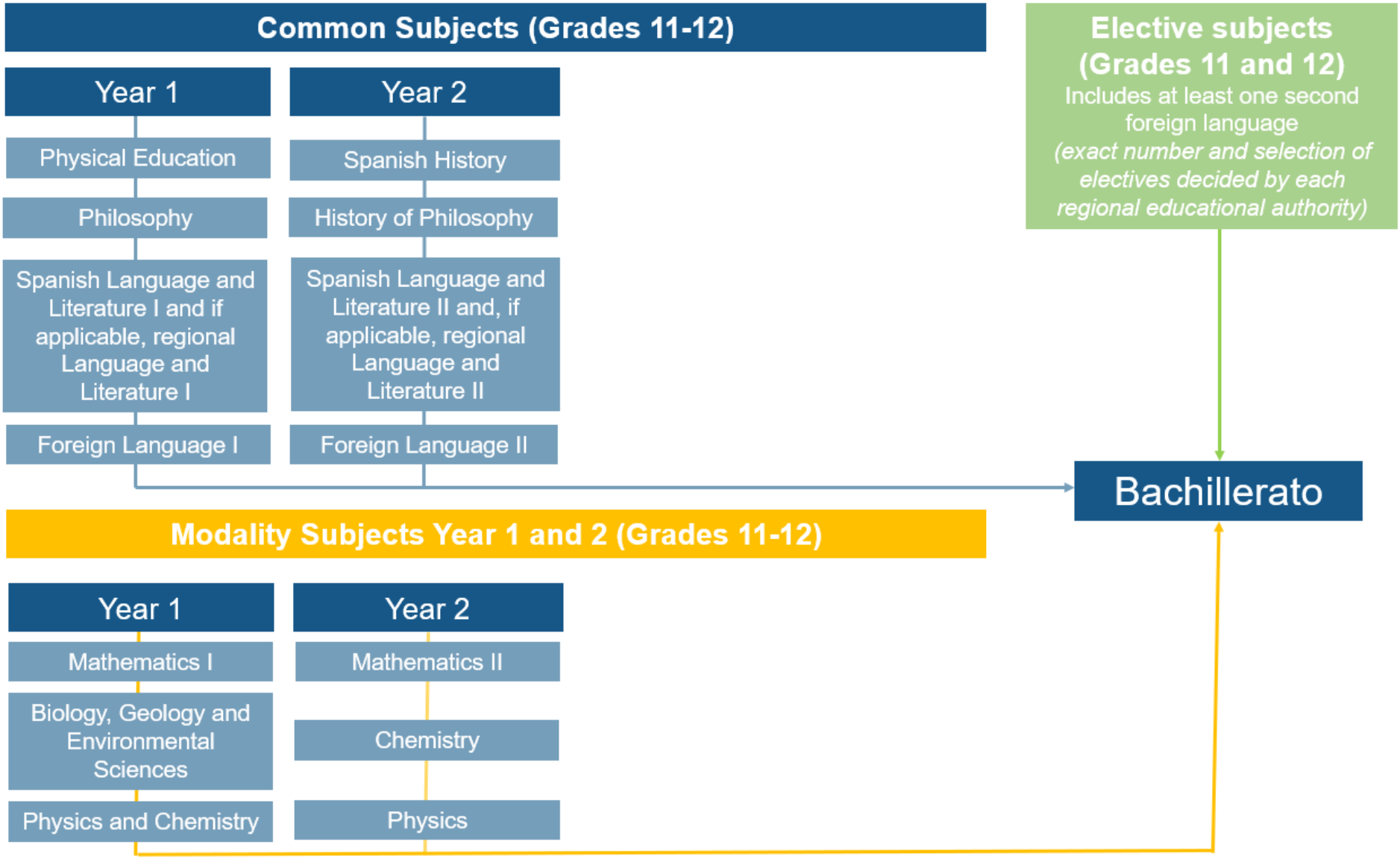


Figure 8: DP imagined pathway for a student wishing to study business studies at university

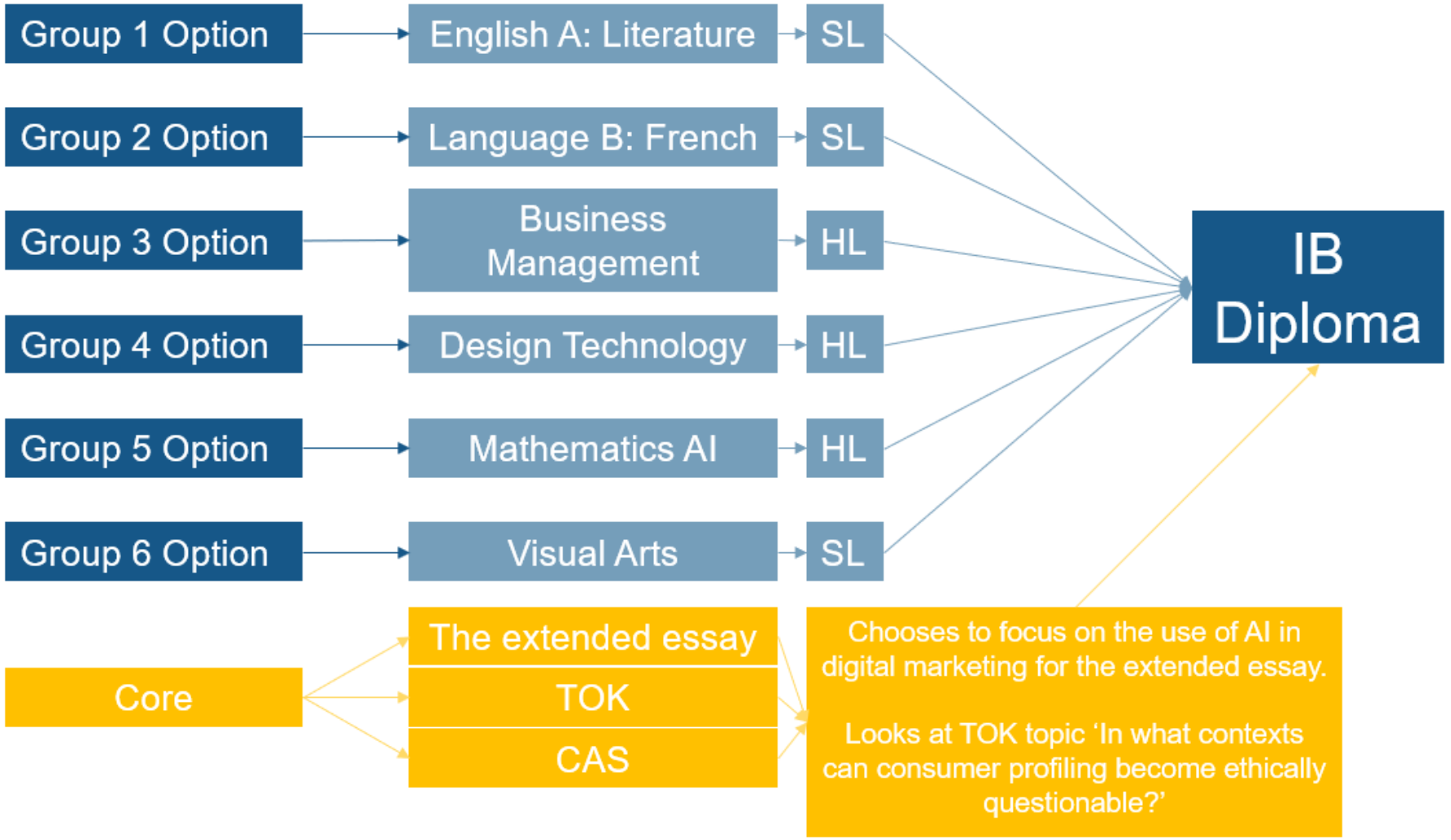
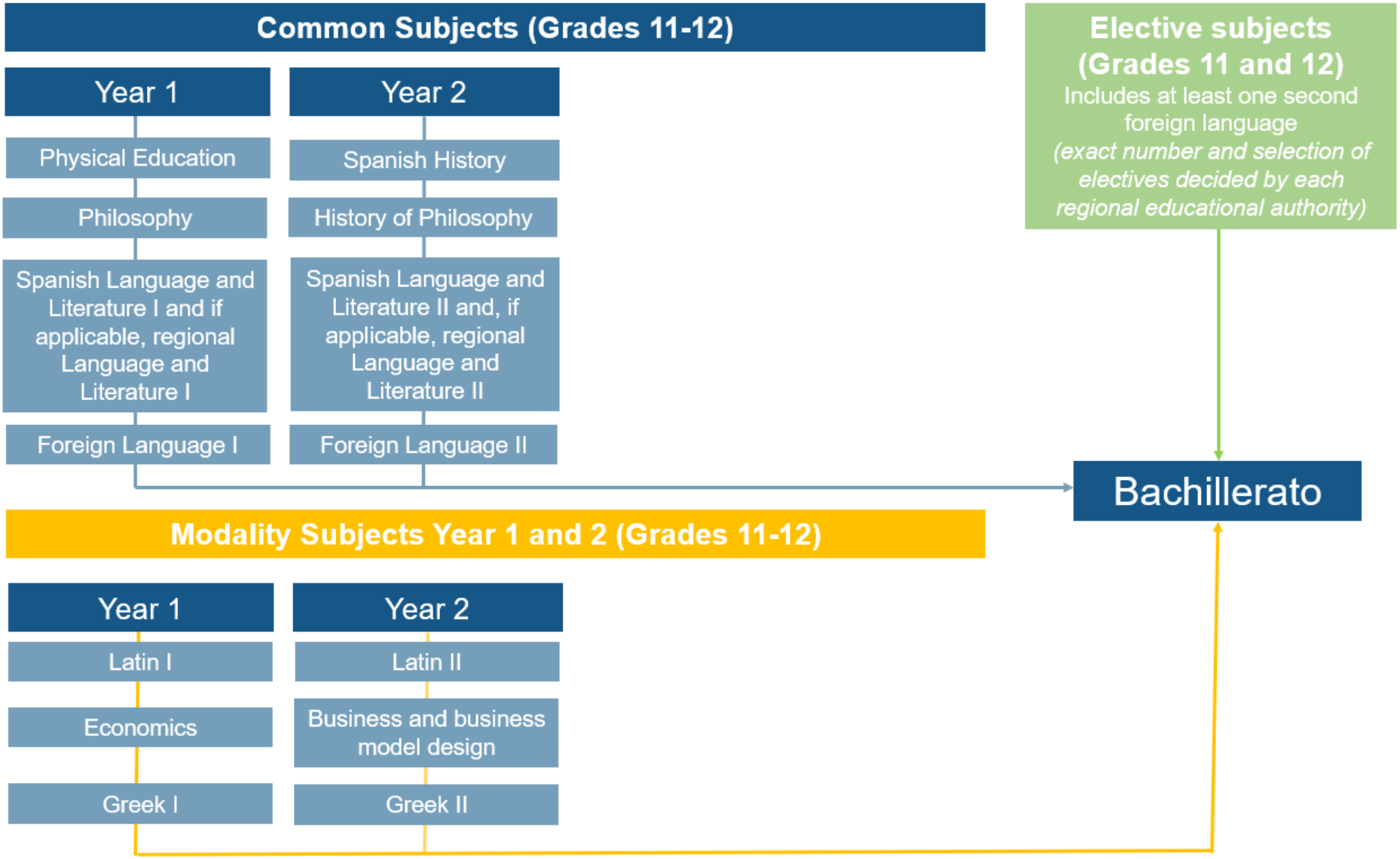


Figure 9: SB imagined pathway for a student wishing to study business studies at university



As can be seen from the diagrams, both SB and DP students can experience significant levels of breadth in their upper secondary studies. Both can study subjects from various subject areas – i.e. languages and literature, sciences, mathematics, and humanities and social sciences. Additionally, students from both programmes are allowed to specialise in certain subject areas – i.e. in the SB, this is achieved through students selecting specific subjects as their modality subjects in the first and second years; in the DP, it is achieved through studying specific subjects at HL. The number of subjects that students are allowed to specialise in is also similar in the two programmes – i.e. SB students select three modality subjects in their first and second years, while DP students study between three and four subjects at HL over the two years.

Nonetheless, there are some notable differences in the pathways students follow in each programme. One key difference is that, depending on their choice of modality, students in the SB can choose to follow a pathway that exposes them to fewer subject areas than those experienced by DP students. For example, a student wishing to study business studies at university would typically choose to follow the Humanities and Social Sciences modality, where they would have the option to go through the full course of the SB without studying any mathematics or science subjects (see figure 9 above). This is in contrast with students in the SB's Sciences and Technology modality (see figure 7 above) and with the DP, where students are required to study both social sciences and languages subjects as well as mathematics and science subjects.

Another difference (already mentioned in 4.3) is that students in the SB take a slightly higher number of subjects overall than students in the DP. DP students are required to study a total of six subjects, typically one from each subject group; though the programme allows students to opt for an additional sciences, individuals and societies or languages subject instead of a subject in the arts group. In contrast, SB students are required to take four common subjects in their first and second years, three specialty subjects in their first and second years, and some elective subjects (exact number and selection is determined by regional education authorities). Adding to this, students in the SB can study combined subjects in their first year before selecting one specialty in their second year. In contrast, combined subjects are not offered in the DP; students select standalone subjects at the start of the programme and study these over the two years.

Moreover, the number of hours dedicated to specialist subjects also differs between the two programmes. Students in the DP will typically study three subjects at HL, though they can also choose to study four at this level. This represents a total of 720h (for three subjects at HL) or 960h (for four subjects at HL) dedicated to the subjects students want to specialise in. In contrast, students in the SB will study three modality subjects per year, with each modality subject being mandated a minimum of only 87.5 teaching hours. This amounts to a total of only 525h dedicated to specialist subjects over the two years – a considerably lower number than in the DP.

Finally, one difference between the DP and the Bachillerato in terms of learning pathways is that DP students who fulfil specific subject grade criteria can be awarded a bilingual Diploma. This option is not available in the SB.

4.6 Assessment Methods

This section looks at the key features of assessment in both programmes by using a simple table followed by a short textual description of the key similarities and differences.

Table 13: Top level assessment comparisons

	DP	Bachillerato
External assessment	✓	✓
Weighting	Varies by subject	Varies per region, though typically a substantial % of overall grade
Mathematics	**SL & HL**: 80%	Varies per region
Sciences	**SL & HL**: 80%	Varies per region
Economics	**SL**: 70% **HL**: 80%	Varies per region
Business	**SL**: 70% **HL**: 80%	Varies per region
Methods	Exam (Typically, two-three exam papers per subject)	End-of-subject exam (Designed by each regional education authority)
Mathematics	**SL**: 2 papers of 90 minutes in duration, worth 40% each. **HL**: 3 papers with durations of 120, 120, and 60 minutes, worth 30%, 30% and 20% respectively. **Question Types**: compulsory short-response and extended response questions, incorporating problem solving in HL paper 3.	See above
Sciences	**SL**: 2 papers worth 36% and 44% of total weighting, with duration of 90 minutes each. **HL**: 2 papers worth 36% and 44% of total weighting, with duration of 120 minutes and 150 minutes, respectively **Question Types**: multiple choice, short and extended response, data-based questions, questions on experimental work.	See above
Economics	**SL:** 2 papers of 75 and 105 minutes in duration, worth 30% and 40%, respectively. **HL:** 3 papers of 75, 105, and 105 minutes, worth 20%, 30% and 30% respectively. **Question Types**: quantitative and qualitative questions.	See above
Business	**SL:** 2 papers of 90 minutes in duration each, worth 35% each. **HL:** 3 papers of 90, 105, and 75 minutes, respectively, worth 25%, 30% and 25% respectively. **Question Types**: structured questions, extended response questions.	See above
Internal assessment	✓ (Often used)	✓ (Used in all subjects)
Weighting	Varies by subject	Varies per region, though typically a relatively lower % of overall grade
Mathematics	**SL & HL**: 20%	Varies per region
Sciences	**SL & HL**: 20%	Varies per region
Economics	**SL**: 30%	Varies per region

	HL: 20%	
Business	**SL**: 30% **HL**: 20%	Varies per region
Methods	Vary by subject but should follow IB guidance.	Varies by subject and region but should be designed around learning outcomes.
Mathematics	**SL & HL**: A 'mathematical exploration' involving a piece of written work for 20 marks.	Combination of approaches designed by schools and teachers.
Sciences	**SL & HL**: A practical, individual investigation with 10 hours duration and 3,000 words of write-up.	Combination of approaches designed by schools and teachers.
Economics	**SL & HL**: Portfolio: portfolio of three commentaries, based on different units of the syllabus (excluding the introductory unit) and on published extracts from the news media.	Combination of approaches designed by schools and teachers.
Business	**SL & HL**: Research project: research project about a real business issue or problem facing a particular organization using a conceptual lens	Combination of approaches designed by schools and teachers.

Given the decentralised nature of the Spanish education system, it is challenging to meaningfully compare the assessments of the DP to those of the SB, as the latter varies from region to region. Nonetheless, some general trends can be extracted from the table above.

For instance, both the DP and the SB often feature both internal, school-designed assessment and externally-set, end-of-subject examinations, with both typically awarding more weighting to externally-set assessment overall (though information on the exact weighting awarded by each regional education authority could not be found). In both programmes, too, internal assessments can assume different forms, varying across subjects, and, in the SB, across autonomous regions and schools also.

There are also some similarities between the subject-specific assessment objectives of the DP and the subject-specific competences and evaluation criteria in the SB. To aid comparison, the tables below present the assessment objectives of each DP subject in this study side-by-side with the specific competences for the SB comparison subjects.

Table 14: Comparison of DP mathematics subjects' assessment objectives and the specific competences of the SB Mathematics I and Mathematics II subjects[72]

DP mathematics assessment objectives (AOs)	SB Mathematics (I and II) Specific competences (SC)
AO1: knowledge and understanding	***SC 3:*** *Formulate or investigate conjectures or problems, using reasoning, argumentation, creativity and the use of technological tools, to generate new mathematical knowledge.*
	SC 6: *Discover the links of mathematics with other areas of knowledge and deepen their connections, interrelating concepts and procedures, to model, solve problems and develop critical, creative and innovative skills in various situations.*
AO2: problem solving	***SC 1:*** *Model and solve problems of daily life and of science and technology applying different strategies and forms of reasoning to obtain possible solutions*
	SC 2: *Verify the validity of the possible solutions to a problem using reasoning and argumentation to verify their suitability.*
	SC 4: *Use computational thinking effectively, modifying, creating and generalizing algorithms that solve problems through the use of mathematics, to model and solve situations of daily life and in the field of science and technology*
	SC 5: *Establish, investigate and use connections between different mathematical ideas, establishing links between concepts, procedures, arguments and models to give meaning and structure mathematical learning.*
	SC 6: *Discover the links of mathematics with other areas of knowledge and deepen their connections, interrelating concepts and procedures, to model, solve problems and develop critical, creative and innovative skills in various situations.*
AO3: communication and interpretation	***SC 4:*** *Use computational thinking effectively, modifying, creating and generalizing algorithms that solve problems through the use of mathematics, to model and solve situations of daily life and in the field of science and technology.*
	SC 5: *Establish, investigate and use connections between different mathematical ideas, establishing links between concepts, procedures, arguments and models to give meaning and structure mathematical learning.*
	SC 6: *Discover the links of mathematics with other areas of knowledge and deepen their connections, interrelating concepts and procedures, to model, solve problems and develop critical, creative and innovative skills in various situations.*
	SC 8: *Communicate mathematical ideas, individually and collectively, using the appropriate support, terminology and rigor, to organize and consolidate mathematical thinking.*
	SC 9: *Use personal and social skills, identifying and managing their own emotions, respecting those of others and actively organizing work in heterogeneous teams, learning from mistakes as part of the learning process and facing situations of uncertainty, to persevere in the achievement of objectives in learning mathematics.*
AO4: technology	***SC 3:*** *Formulate or investigate conjectures or problems, using reasoning, argumentation, creativity and the use of technological tools, to generate new mathematical knowledge.*

[72] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). Mathematics I. https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/matematicas/criterios-eval-primercurso.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp ; Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). Mathematics II. https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/matematicas/criterios-eval-segundo-curso.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp

DP mathematics assessment objectives (AOs)	SB Mathematics (I and II) Specific competences (SC)
	SC 4: *Use computational thinking effectively, modifying, creating and generalizing algorithms that solve problems through the use of mathematics, to model and solve situations of daily life and in the field of science and technology.*
	SC 7: *Represent mathematical concepts, procedures and information by selecting different technologies, to visualize ideas and structure mathematical reasoning.*
AO5: reasoning	***SC 1:*** *Model and solve problems of daily life and of science and technology applying different strategies and forms of reasoning to obtain possible solutions.*
	SC 2: *Verify the validity of the possible solutions to a problem using reasoning and argumentation to verify their suitability.*
	SC 3: *Formulate or investigate conjectures or problems, using reasoning, argumentation, creativity and the use of technological tools, to generate new mathematical knowledge.*
	SC 7: *Represent mathematical concepts, procedures and information by selecting different technologies, to visualize ideas and structure mathematical reasoning.*
AO6: inquiry approaches	***SC 3:*** *Formulate or investigate conjectures or problems, using reasoning, argumentation, creativity and the use of technological tools, to generate new mathematical knowledge.*
	SC 5: *Establish, investigate and use connections between different mathematical ideas, establishing links between concepts, procedures, arguments and models to give meaning and structure mathematical learning.*
	SC 6: *Discover the links of mathematics with other areas of knowledge and deepen their connections, interrelating concepts and procedures, to model, solve problems and develop critical, creative and innovative skills in various situations.*

Table 15: Comparison of DP science subjects' assessment objectives and the specific competences of the SB comparison science subjects[73]

DP sciences AOs	SB Physics and Chemistry Specific Competences	SB Biology, Geology and Environmental Sciences Specific Competences	SB Physics Specific Competences	SB Chemistry Specific Competences	SB Biology Specific Competences
AO1: demonstrate knowledge	***SC 1:*** *…understand and explain natural phenomena and demonstrate the role of these sciences in improving common well-being and in everyday reality.* ***SC 3:****… use of mathematical language, the correct use of measurement units, safety in experimental work, for the production and interpretation of information in different formats and from different sources.*	***SC 1:*** *Interpret and transmit information and scientific data…* ***SC 2:*** *Locate and use reliable sources, identifying, selecting and organizing information…* ***SC 4:*** *Search for and use strategies in solving problems…to explain phenomena related to biological, geological and environmental sciences.*	***SC 1:*** *Use the theories, principles and laws that govern the most important physical processes…to recognize physics as a relevant science involved in the development of technology, the economy, society and environmental sustainability.* ***SC 2:*** *Adopt the accepted models, theories and laws of physics…* ***SC 3:*** *Use the language of physics with the mathematical formulation of its principles, magnitudes, units, equations…*	***SC 1:*** *Understand, describe and apply the fundamentals of the most important chemical processes…* ***SC 3:*** *Correctly use the codes of chemical language (chemical nomenclature, units, equations, etc.), applying its specific rules, to use them as the basis for adequate communication between different scientific communities and as a fundamental tool in the investigation of this science.*	***SC 1:*** *Interpret and transmit information and data from scientific works and argue about them…* ***SC 2:*** *Locate and use reliable sources, identifying, selecting and organizing information…* ***SC4:*** *Posing and solving problems, searching for and using the appropriate strategies...*
AO2: understanding and application	***SC 1:*** *Solve problems and situations related to physics and chemistry, applying the appropriate scientific laws and theories, to understand and explain natural phenomena and demonstrate the role of these sciences in improving common well-being and in everyday reality.* ***SC 2****:…using scientific thinking and skills related to the work of science, applying*	***SC 3:*** *Design, plan and develop research projects following the steps of scientific methodologies…* ***SC 5:*** *Design, promote and execute initiatives related to the conservation of the environment, sustainability and health, based on the fundamentals of biological, geological and environmental sciences, to promote sustainable and healthy lifestyles.*	***SC 2:*** *Adopt the accepted models, theories and laws of physics…* ***SC 3:*** *Use the language of physics with the mathematical formulation of its principles, magnitudes, units, equations, etc..* ***SC 5:*** *Apply work and inquiry techniques typical of physics, as well as experimentation, logical-*	***SC 1:*** *Understand, describe and apply the fundamentals of the most important chemical processes…* ***SC 3:*** *Correctly use the codes of chemical language (chemical nomenclature, units, equations, etc.), applying its specific rules…*	***SC 1:*** *Interpret and transmit information and data from scientific works and argue about them, with precision and using different formats, to analyze concepts, processes, methods, experiments or results of the biological sciences.* ***SC 6:*** *Analyze the function of the main*

[73] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). Specific subjects of the Science and Technology modality. https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/desarrollo-materias.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp

DP sciences AOs	SB Physics and Chemistry Specific Competences	SB Biology, Geology and Environmental Sciences Specific Competences	SB Physics Specific Competences	SB Chemistry Specific Competences	SB Biology Specific Competences
	them to the observation of nature and the environment, to the formulation of questions and hypotheses and to their validation through of experimentation, inquiry and the search for evidence.		*mathematical reasoning and cooperation…*	***SC 5:** Apply work techniques typical of experimental sciences and logical-mathematical reasoning in solving chemistry problems and in the interpretation of related situations, valuing the importance of cooperation, to value the role of chemistry in a society based on ethical and sustainable values.*	*biomolecules, bioelements and their structures and biochemical interactions, arguing about their importance in living organisms to explain their macroscopic characteristics from the molecular ones.*
AO3: analyse, evaluate, and synthesize	***SC 1:** Solve problems and situations related to physics and chemistry…* ***SC 2:** Reason with solvency, using scientific thinking and skills…formulation of questions and hypotheses and to their validation through of experimentation, inquiry and the search for evidence.* ***SC 6:** Participate actively in the collective and evolutionary construction of scientific knowledge…*	***SC 1:** …using different formats to analyze processes, methods, experiments or results of biological, geological and environmental sciences.* ***SC 2:** …critically evaluating [information] and verifying its veracity, to resolve questions related to biological, geological and environmental sciences independently.* ***SC 4:** Search for and use strategies in solving problems, critically analyzing the solutions and answers found and reformulating the procedure if necessary, to explain phenomena related to biological, geological and environmental sciences.* ***SC 6:** Analyze the elements of the geological record…*	***SC 6:** Recognize and analyze the multidisciplinary nature of physics, considering its relevant historical journey and its contributions to the advancement of scientific knowledge as a process in continuous evolution and innovation, to establish knowledge bases and relationships with other scientific disciplines.*	***SC 5:** Apply work techniques typical of experimental sciences and logical-mathematical reasoning in solving chemistry problems and in the interpretation of related situations, valuing the importance of cooperation, to value the role of chemistry in a society based on ethical and sustainable values.* ***SC 6:** Recognize and analyze chemistry as a multidisciplinary and versatile area of knowledge, highlighting the relationships with other sciences and fields of knowledge, to carry out through it a holistic approach to scientific and global knowledge.*	***SC 3:** Analyze research or dissemination papers related to the biological sciences, critically checking their veracity or if they have followed the steps of scientific methods, to assess the reliability of their conclusions.* ***SC 5:** Critically analyze certain actions related to sustainability and health…* ***SC 6:** Analyze the function of the main biomolecules, bioelements and their structures and biochemical interactions…*

DP sciences AOs	SB Physics and Chemistry Specific Competences	SB Biology, Geology and Environmental Sciences Specific Competences	SB Physics Specific Competences	SB Chemistry Specific Competences	SB Biology Specific Competences
AO4: investigation skills	***SC 1:*** *Solve problems and situations related to physics and chemistry, applying the appropriate scientific laws and theories, to understand and explain natural phenomena and demonstrate the role of these sciences in improving common well-being and in everyday reality.* ***SC 2:*** *using scientific thinking and skills related to the work of science, to apply them to the observation of nature and the environment, to the formulation of questions and hypotheses and to their validation through of experimentation, inquiry and the search for evidence.* ***SC 5:*** *Work collaboratively in diverse teams…predict the consequences of scientific advances and their influence on their own and community health and on sustainable environmental development.*	***SC 2:*** *Locate and use reliable sources, identifying, selecting and organizing information, critically evaluating it and verifying its veracity, to resolve questions related to biological, geological and environmental sciences independently.* ***SC 3:*** *Design, plan and develop research projects following the steps of scientific methodologies, taking into account the resources available realistically and seeking ways of collaboration, to investigate aspects related to biological, geological and environmental sciences.* ***SC 4:*** *Search for and use strategies in solving problems, critically analyzing the solutions and answers found and reformulating the procedure if necessary, to explain phenomena related to biological, geological and environmental sciences.*	***SC 3:*** *Use the language of physics with the mathematical formulation of its principles, magnitudes, units, equations, etc., to establish adequate communication between different scientific communities and as a fundamental tool in research.* ***SC 5:*** *Apply work and inquiry techniques typical of physics, as well as experimentation, logical-mathematical reasoning and cooperation, in solving problems and interpreting related situations, to value the role of physics in a society based on ethical and sustainable values.*	***SC 3:*** *Correctly use the codes of chemical language (chemical nomenclature, units, equations, etc.), applying its specific rules, to use them as the basis for adequate communication between different scientific communities and as a fundamental tool in the investigation of this science.*	***SC 3:*** *Analyze research or dissemination papers related to the biological sciences, critically checking their veracity or if they have followed the steps of scientific methods, to assess the reliability of their conclusions.* ***SC 4:*** *Posing and solving problems, searching for and using the appropriate strategies, critically analyzing the solutions and reformulating the procedure if necessary, to explain phenomena related to the biological sciences.*

Table 16: Comparison of DP economics assessment objectives and the specific competences of the SB economics subject[74]

DP economics AOs	Bachillerato Economics Specific Competences
AO1: Knowledge and understanding	***SC 4:*** *Know and understand the functioning of the financial system and monetary policy…*
	SC 3: *Distinguish and value the role of the different economic agents that intervene in the circular flow of income, understanding their interactions and recognizing…the benefits and costs that it generates*
AO2: Application and analysis	***SC 1:*** *Assess the problem of scarcity and the importance of making decisions in the economic field, analyzing its impact on different sectors, comparing alternative solutions offered by different systems, to understand how economic reality works.*
	SC 2: *…analyzing [market] failures, to study the repercussion of these in the environment and facilitate decision-making in the economic field.*
	SC 4: *Know and understand the functioning of the financial system and monetary policy, assessing its effects on the real economy and analyzing the elements that intervene in financial decisions, to plan and manage personal resources responsibly and autonomously and make well-founded financial decisions.*
	SC 5: *…analyzing the impact of economic globalization, the new economy and the digital revolution, to propose initiatives that promote equity, justice and sustainability.*
	SC 6: *Analyze current economic problems through case studies, research and experimentation, using economic analysis tools and taking into account the factors that condition the decisions of economic agents…*
AO3: Synthesis and evaluation	***SC 1:*** *Assess the problem of scarcity and the importance of making decisions in the economic field, analyzing its impact on different sectors, comparing alternative solutions offered by different systems, to understand how economic reality works.*
	SC 5: *…propose initiatives that promote equity, justice and sustainability.*
AO4: Use and application of appropriate skills	***SC 4:*** *Know and understand the functioning of the financial system and monetary policy, assessing its effects on the real economy and analyzing the elements that intervene in financial decisions, to plan and manage personal resources responsibly and autonomously and make well-founded financial decisions.*
	SC 5: *analyzing the impact of economic globalization, the new economy and the digital revolution, to propose initiatives that promote equity, justice and sustainability.*
	SC 6: *Analyze current economic problems through case studies, research and experimentation, using economic analysis tools*

[74] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). Economics. https://educagob.educacionyfp.gob.es/ca/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/economia/competencias-especificas.html

Table 17: Comparison of DP business management assessment objectives and the specific competences of the SB business and business model design subject[75]

DP business management AOs	Bachillerato Business and Business Model Design Specific Competences
AO1: Knowledge and understanding	***SC 1:*** *Analyze business and entrepreneurial activity, recognizing the power of transformation that they exert in society and reflecting on the value of innovation and digitization in this process, to understand the role they play within the overall functioning of the current economy.*
	SC 3: *Recognize and understand current business models…*
	SC 5: *Carry out forecast analysis of the designed business model, applying the necessary business analysis tools to understand the entire process carried out and validate the business model proposal.*
AO2: Application and analysis	***SC 1:*** *Analyze business and entrepreneurial activity, recognizing the power of transformation that they exert in society and reflecting on the value of innovation and digitization in this process, to understand the role they play within the overall functioning of the current economy.*
	SC 2: *Investigate the economic and social environment and its influence on business activity, analyzing the company-environment interrelationships and identifying viable strategies based on the criteria of corporate social responsibility, equality and inclusion, to assess the ability to business adaptation.*
	SC 3: *Recognize and understand current business models by comparing them with other traditional models and applying strategies and tools that facilitate creative design to propose business models that add value, satisfy needs and contribute to economic and social well-being.*
	SC 4: *Evaluate and select communication strategies applicable to the business world, using new formulas and obtaining the information that is generated both internally and externally by the company, to effectively manage the information necessary in the decision-making process and its correct transmission.*
	SC 5: *Carry out the forecast analysis of the designed business model, applying the necessary business analysis tools to understand the entire process carried out and validate the business model proposal.*
AO3: Synthesis and evaluation	***SC 4:*** *Evaluate and select communication strategies applicable to the business world, using new formulas and obtaining the information that is generated both internally and externally by the company, to effectively manage the information necessary in the decision-making process and its correct transmission.*
AO4: Use and application of appropriate skills	***SC 3:*** *Recognize and understand current business models by comparing them with other traditional models and applying strategies and tools that facilitate creative design to propose business models that add value, satisfy needs and contribute to economic and social well-being.*
	SC 4: *Evaluate and select communication strategies applicable to the business world, using new formulas and obtaining the information that is generated both internally and externally by the company, to effectively manage the information necessary in the decision-making process and its correct transmission.*
	SC 5: *Carry out the forecast analysis of the designed business model, applying the necessary business analysis tools to understand the entire process carried out and validate the business model proposal.*

[75] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d). Company and Business Model Design. (https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/empresa-diseno-modelos/competencias-especificas.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp

As demonstrated by the tables above, while the SB provides more extensive descriptions and details of the knowledge, skills and competences that the students should develop by the end of each subject, many of the same broad skills are seemingly assessed in both DP and the SB mathematics, sciences, economics and business subjects. More specifically, both programmes recognise the importance of developing foundational knowledge and understanding but also seek to develop and assess how students can use, explore, and articulate that understanding. In this sense, the skills-based criteria for assessment show broad alignment.

In the same way as the DP, a numerical grading system is used in the SB, with a minimum grade required to pass a study unit. For each subject, the pass mark is 5 out of 10.[76]

Despite the above-mentioned similarities, a notable difference between the assessment of both programmes is the significantly less homogenised approach taken by the SB when compared to the DP. The decentralised nature of the Spanish education system, where regional educational authorities and schools have certain powers over specific subject selection as well as weighting of assessment on final SB grades, is in sharp contrast with the more homogenised approach observed in the DP, where the types of assessment used and the weightings given to each assessment are the same regardless of where the qualification is studied.

Overall, there are some similarities between the assessment methods and types used by the DP and SB, with both featuring both internal and external assessments, and, generally, awarding greater weighting to the latter. The specific competences and evaluation criteria in SB subjects also share significant similarity with the skills assessed by the comparison DP subjects, with both programmes targeting the development of foundational knowledge and understanding but also application and higher order thinking skills. That said, the overall approach to assessment differs between the two programmes; while the SB takes a decentralised approach, allowing regional educational authorities to make decisions about certain elements of subject selection and the specific weighting awarded to each assessment type, the DP follows a more homogenised approach, with both assessment types and weighting being set centrally.

[76] Government of Spain, Ministry of Education, Vocational Training and Sports. (n.d.) Aims, general principles, pedagogical principles and objectives. https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/fines-principios-objetivos.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp

5. Subject-Level Alignment

This section focuses on answering RQ3 and the sub-questions associated to it, namely:

Table 18: Research question 3

RQ3: To what degree do the subjects align with regards to: 3.1: Content • Topics (i.e. scope of content area, breadth depth) • Learning activities (i.e. difficulty, demand). 3.2: Expected learning outcomes • Knowledge • Competences (i.e. subject-specific, 21st century competences).

For each subject area, there is a brief introduction to the subjects being compared, followed by an overview of the findings from the comparative analysis between the IB subjects and the SB comparison points regarding learning outcomes, content, and demand.

5.1 Mathematics

The following is the list of subjects used in the mathematics comparative analysis.

Mathematics: analysis and approaches[77]
Mathematics: analysis and approaches (AA) is a subject option from the mathematics group in the DP curriculum – offered at both SL and HL. This subject is intended for students who are interested in both real and abstract applications of mathematical concepts and enjoy problem solving and generalisation. SL is suitable for students who want to study a good level of mathematics, but not at an advanced level. Therefore, SL prepares students for further study in areas involving mathematical elements, such as geography. HL is suitable for students who want an in-depth study of mathematics and enjoy solving challenging problems. Therefore, HL prepares students for further study in mathematics, as well as other areas with a strong mathematical focus, such as physics and engineering.

Mathematics: applications and interpretation[78]
Mathematics: applications and interpretation (AI) is a subject option from the mathematics group in the DP curriculum – offered at both SL and HL. This subject is intended for students who are interested in exploring more practical applications of mathematics and would enjoy using mathematical models and technology. SL is most suitable for those who want to obtain a good level of knowledge of mathematics, with a focus on real-world applications. Therefore, SL prepares students for further study in areas with some practical mathematics elements, such as biology and business. HL is suitable for students wishing to gain more in-depth knowledge of mathematics, with a focus on real-world situations and the applications of mathematics.

[77] International Baccalaureate. (2019). *Mathematics: analysis and approaches guide*.
[78] International Baccalaureate. (2019). *Mathematics: applications and interpretation guide.*

SB mathematics I[79]
Mathematics I (SB mathematics I) is studied only by students in the Science and Technology modality of the SB. The subject is compulsory in the first year and prepares students for the second year, where either mathematics II or mathematics applied to social sciences II is studied. The mathematics content studied in this subject covers a broad range of topics that will contribute to preparing students for mathematics and science courses in higher education.

SB mathematics II[80]
Mathematics II (SB mathematics II) is only offered in the Science and Technology modality and is studied in the second year. Building on SB mathematics I, this subject revisits topics to cover more depth and advanced concepts, as well as introducing new topics. On completing SB mathematics II, students will be well prepared for higher education courses in mathematics and the sciences. The cumulative study of SB mathematics I and II aims to provide conceptual understanding through problem-solving, reasoning, and mathematical research. These subjects also include applications and analysis of issues relating to science and technology.

5.1.1 Learning Outcomes – Mathematics

This section compares and contrasts the learning outcomes of curricula falling within the category of mathematics.

For its mathematics learning outcomes, the DP sets out aims and assessment objectives for all subjects within the mathematics subject group – hence the extracted themes are the same for mathematics: analysis and approaches and mathematics: applications and interpretation. The learning outcomes for the SB mathematics subjects are represented by nine 'specific competences', each of which have some 'evaluation criteria'. The specific competences and their evaluation criteria are mostly the same for all mathematics subjects.[81]

The following summary table demonstrates the learning outcome themes that were extracted from DP mathematics and indicates if and where they were judged to have presence within the learning outcomes of the SB mathematics subjects reviewed.

Table 19: Presence of the DP mathematics subject group learning outcome themes in SB curricula

Themes extracted from the learning outcomes in the DP mathematics subject group	Presence in the SB	
1. Being aware of, and engaging with, mathematics in its wider context		Particularly present in evaluation criteria 6.2, which looks at the contribution of mathematics to progress and to solutions for challenges in society

[79] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Math*. Available from: https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/matematicas/desarrollo.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp
[80] Ibid.
[81] The evaluation criteria of SB mathematics I and SB mathematics II exhibit slight variations, reflecting a progression in specific skills. For instance, evaluation criterion 9.1 of SB mathematics II shares similarities with its SB mathematics I counterpart but introduces an additional element of decision-making. It is important to note that these nuanced differences do not affect the overall alignment to the DP.

2. Developing learning skills; having a positive and resilient attitude, working both independently and collaboratively, being reflective and evaluating work		Strongly present in specific competence 9 which centers on personal and social skills
3. Using inquiry-based approaches		Particularly present in specific competence 3 which speaks to formulating and investigating conjectures
4. Understanding the concepts, principles and nature of mathematics and applying concepts and procedures to a range of contexts		Present in several competences which refer to mathematical ideas, concepts, and contexts
5. Making links and generalisations		Strongly present in the specific competences 5 and 6 which refer to an demonstrating an integrated mathematical vision and making connections to real world and other areas of knowledge
6. Developing critical/creative thinking skills e.g. problem-solving and reasoning		Strongly present in several competences, with frequent references to solving problems, using reasoning, modelling, modifying, and creative thinking
7. Communicating mathematics clearly and in various forms		Particularly present in specific competence 8 which centres on communication
8. Knowing how technology and mathematics influence each other and using technology to develop ideas and solve problems		Present in evaluation criteria 1.1 and specific competence 3, both referring to use of technological tools

Key:

	This theme is well-evidenced in the learning outcomes of the SB.		*This theme is partially evidenced in the learning outcomes of the SB.*		*This theme is not evident in the learning outcomes of the SB.*

Presence of the DP's Learning Outcome Themes

There is strong alignment between the DP mathematics learning outcomes and those of the SB, with each of the DP's themes being well evidenced in the specific competences and evaluation criteria.

1. Being aware of, and engaging with, mathematics in its wider context

Similar to the DP, the SB learning outcomes encourage consideration of the wider contexts of mathematics. Indeed, the SB refers to contexts such as sustainability, responsible consumption, and equity. Furthermore, SB mathematics involves analysing the contribution of mathematics to progress and proposing solutions to issues in society, focusing on scientific and technological challenges. It can be noted that this is described as 'reflecting' on the contribution of mathematics in SB mathematics I, whilst in SB mathematics II it is described as 'valuing' the contribution of mathematics. However, unlike the DP, it can be noted that the outcomes do not explicitly state that ethical questions or multiple perspectives will be considered.

2. Developing learning skills; having a positive and resilient attitude, working both independently and collaboratively, being reflective and evaluating work

The DP's theme of transferable learning skills is well evidenced in the SB, primarily in specific competence 9, which centres on personal and social skills. Similarly to the DP, this competence includes skills such as learning from mistakes (reflecting), perseverance, having

a positive attitude, learning from criticism, and working effectively with others. It can be noted here that, in the first year, students will identify the most conducive social skills, while, in the second year, they will apply them.

3. Using inquiry-based approaches

In addition, the use of inquiry approaches is also present in the SB, with specific competence 3 describing that students will acquire new knowledge through formulating conjectures and investigation. It can be noted here that this will be done in a guided way in the first-year course (mathematics I) and autonomously in second year course (mathematics II).

4. Understanding the concepts, principles and nature of mathematics and applying concepts and procedures to a range of contexts

Many competences, including 5 and 6, also evidence the theme of understanding mathematics and applying it, as students interrelate different concepts and procedures. Application to specific contexts is especially present, with reference to solving problems in mathematical contexts, in daily life, in various situations, in the real-world, and in the field of science and technology.

5. Making links and generalisations

The DP theme of making links is an especially strong theme in the learning outcomes of the SB. Specific competence 5 centres on establishing connections between mathematical concepts and procedures, such that students should demonstrate an integrated mathematical vision and apply connections whilst solving problems. Moreover, specific competence 6 centres on making links to other areas of knowledge and the real world. It can also be noted that SB mathematics II expects students to be able to generalise algorithms.

6. Developing critical/creative thinking skills, e.g. problem-solving and reasoning

Similar to the DP, critical thinking skills are strongly present in the SB learning outcomes. Most of the nine specific competences incorporate critical thinking skills such as problem solving, reasoning, analysing, evaluating, creativity, and being innovative. Some specific ways that students will demonstrate critical thinking skills include: evaluating the efficiency of strategies and tools, verifying the validity of solutions, selecting the most appropriate solution/tools/strategies according to context, structuring reasoning, modifying and creating algorithms, assessing usefulness of representations, and modelling and solving problems of daily life and of science and technology.

7. Communicating mathematics clearly and in various forms

Similar to the DP, the SB also expects students to communicate mathematics clearly in various contexts, using appropriate notation and terminology. Indeed, specific competence 8 requires students to demonstrate organisation, precision, and rigor in communication, as well as different contexts, both individually and collectively.

8. Knowing how technology and maths influence each other and using technology to develop ideas and solve problems.

Specific competence 3 describes that students will acquire new knowledge through formulating conjectures and investigation which links to the DP theme of technology, as it states that students will use technology in the formulation or investigation of conjectures or problems. Technology is also present in specific competences 1 and 7, which describe

students selecting and using appropriate tools in modelling and solving problems. Alignment with the DP here is unsurprising, as SB mathematics I and II reside within the Science and Technology modality.

Other Themes in the SB

Most of the specific competences in SB subjects relate to a DP theme; however, there are a few skills in the SB which are more explicit or emphasised than in the DP. These are primarily located in specific competences 4, 5, 7, and 9, which focus on computational thinking, connections, representations, and personal and social skills.

Firstly, specific competence 4 has a more explicit focus on students using computational thinking to model and solve problems, though it can be noted that the DP similarly describes students using logical thinking in problem solving. Moreover, whilst the DP learning outcomes promote links to the real world and other subjects, the SB additionally emphasises making links between mathematical concepts and processes, which encourages deeper conceptual understanding and flexible thinking. The SB also has more explicit focus on representations, as specific competence 7's evaluation criteria expects students to 'select and use various forms of representation, assessing their usefulness for sharing information'.[82] Finally, the SB extends the personal and social skills also mentioned in the DP to include managing emotions, promoting group wellbeing, and making decisions – though it can be noted here that these skills are reflected in the IB learner profile.

Summary

Overall, there is a high level of alignment between the SB and DP subjects with regards to mathematics learning outcomes. Like the DP, the SB promotes critical thinking skills, consideration of global issues and contexts, transferable learning skills, clear communication, use of technology, making connections, and use of inquiry approaches. Thus, the SB takes a similarly holistic approach to the DP with regards to mathematics learning. The SB specific competences are more detailed than the DP's, which occasionally contribute to more skills being described, though most of these relate to a DP theme. However, it can be noted that the SB places more emphasis than the DP on computational thinking, representations, making connections within mathematics, and personal and social skills. The small differences in wording of SB mathematics II evaluation criteria shows a progression in skills from SB mathematics II; however, this does not affect overall alignment with the DP themes.

5.1.2 Content – Mathematics

This section compares and contrasts the content of the DP and SB curricula falling within the category of mathematics. In order to support visual comparison at-a-glance, the DP and SB mathematics curricula are presented below in diagrams which show the key topics and subtopics included in each.

[82] Government of Spain, Ministry of Education, Spain. (2023). *First year – Mathematics I. Specific skills*. Available from: https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/matematicas/criterios-eval-primer-curso.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp

Figure 10: DP mathematics: analysis and approaches content visualiser

	Standard level topics	Additional higher level topics
Topic 1 Number and Algebra	1.1 Standard form; 1.2 Arithmetic sequences and series; 1.3 Geometric sequences and series; 1.4 Financial applications and geometric sequences and series; 1.5 Integer exponents and intro to logarithms; 1.6 Simple proof; 1.7 Rational exponents and laws of logarithms; 1.8 Sum of infinite convergent geometric sequences; 1.9 Binomial theorem (natural number)	1.10 Counting principles and extended binomial theorem; 1.11 Partial fractions; 1.12 Complex numbers intro; 1.13 Polar and Euler form; 1.14 Complex roots, De Moivre's theorem and powers/roots of complex numbers; 1.15 Proof by counter example, contradiction, and induction; 1.16 Solutions of systems of linear equations
Topic 2 Functions	2.1 Gradients and equations of straight lines; 2.2 Intro to functions; 2.3 Graphing functions; 2.4 Key features of graphs; 2.5 Composite, identity, and inverse functions; 2.6 Quadratic functions; 2.7 Solving quadratic equations and inequalities & the discriminant; 2.8 Reciprocal and rational functions; 2.9 Exponential and logarithmic functions; 2.10 Graphical and analytical solutions; 2.11 Transformations	2.12 Polynomial functions; 2.13 Harder rational functions; 2.14 Odd, even, and inverse functions; 2.15 Graphical and analytical solutions of inequalities; 2.16 Further graphs, including modulus and solutions
Topic 3 Geometry and Trigonometry	3.1 Geometry recap; 3.2 Trigonometry recap; 3.3 Applications and diagrams; 3.4 Circles and radians; 3.5 Definitions, exact values, and sine rule for ambiguous case; 3.6 Identities and relationships; 3.7 Functions and transformations of sin, cos, and tan; 3.8 Solving trigonometric equations graphically and analytically	3.9 Reciprocal trigonometric ratios, identities, and inverse functions; 3.10 Compound angle identities and double angle for tan; 3.11 Symmetry properties; 3.12 Intro to vectors; 3.13 Scalar product and application; 3.14 Vector equation of a line and application; 3.15 Coincident, parallel, skew, and intersecting lines; 3.16 Cross product of vectors; 3.17 Planes; 3.18 Intersections and angles (planes)
Topic 4 Statistics and Probability	4.1 Sampling; 4.2 Presenting data (tables, histograms, cumulative freq.); 4.3 Measures of central tendency and dispersion; 4.4 Correlation and regression line; 4.5 Intro to probability; 4.6 Diagrams, conditional probability, combined or independent events; 4.7 Discrete random variables; 4.8 Binomial distribution; 4.9 Normal distribution; 4.10 Equation of regression line of x on y; 4.11 Formulae for conditional probabilities and independent events; 4.12 Standardisation of normal variables (z-values)	4.13 Bayes' theorem; 4.14 Continuous random variables
Topic 5 Calculus	5.1 Intro to limits and derivatives; 5.2 Increasing and decreasing functions; 5.3 Derivative of $f(x)=ax^n$; 5.4 Tangents and normal; 5.5 Definite integrals; 5.6 More derivatives and use of product, chain, and quotient rules; 5.7 The second derivative; 5.8 Maximum, minimum and inflection points, and optimization; 5.9 Kinematic problems; 5.10 Indefinite integrals and integration by inspection and substitution; 5.11 Definite integrals and area under, and between, curves	5.12 Continuity, differentiability, limits, and higher derivatives; 5.13 Evaluation of limits and L'hopitals rule; 5.14 Implicit differentiation; 5.15 Further derivatives and indefinite integrals; 5.16 Integration by substitution and by parts; 5.17 Volumes of revolution; 5.18 First order differential equations; 5.19 Maclaurin series
The toolkit and mathematical exploration	The exploration is a piece of written work that involves investigating an area of mathematics.	

Figure 11: DP mathematics: applications and interpretation content visualiser

	Standard level topics	Additional higher level topics
Topic 1 Number and Algebra	1.1 Standard form; 1.2 Arithmetic sequences and series; 1.3 Geometric sequences and series; 1.4 Financial applications of geometric sequences and series; 1.5 Integer exponents and intro to logarithms; 1.6 Approximation, estimation, bounds and errors; 1.7 Amortization and annuities using technology; 1.8 Using technology to solve systems of equations and polynomials	1.9 Laws of logarithms; 1.10 Rational exponents; 1.11 The sum of infinite geometric sequences; 1.12 Complex numbers; 1.13 Euler and Polar form; 1.14 Matrices; 1.15 Eigenvalues and eigenvectors
Topic 2 Functions	2.1 Gradients and equations of straight lines; 2.2 Intro to functions; 2.3 Graphing functions; 2.4 Key features of graphs; 2.5 Modelling with functions; 2.6 Modelling skills	2.7 Composite and inverse functions; 2.8 Transformations; 2.9 Modelling further functions; 2.10 Using logarithms to scale numbers and linearize data
Topic 3 Geometry and Trigonometry	3.1 Geometry recap; 3.2 Trigonometry recap; 3.3 Applications and diagrams; 3.4 Circles, sectors, and arcs; 3.5 Equations of perpendicular bisectors; 3.6 Voronoi diagrams	3.7 Radians; 3.8 Sin, Cos, Tan definitions, and Pythagorean identity; 3.9 Matrix transformations; 3.10 Vectors introduction and notation; 3.11 Vector equation of a line; 3.12 Vector application to kinematics; 3.13 Scalar and cross product; 3.14 Graph theory and simple, directed and subgraphs; 3.15 Adjacency matrices and weighted adjacency tables; 3.16 Decision math
Topic 4 Statistics and Probability	4.1 Sampling; 4.2 Presenting data (tables, histograms, cumulative freq.); 4.3 Measures of central tendency and dispersion; 4.4 Correlation and regression line; 4.5 Intro to probability; 4.6 Diagrams, conditional probability, combined or independent events; 4.7 Discrete random variables; 4.8 Binomial distribution; 4.9 Normal distribution; 4.10 Spearman's rank; 4.11 Hypothesis testing, chi-squared and t-tests	4.12 Collecting and organising data and testing for reliability and validity; 4.13 Regression, residuals, coefficient of determination; 4.14 Linear transformations, linear combinations, unbiased estimations; 4.15 Central Limit theorem; 4.16 Confidence Intervals; 4.17 Poisson Distribution; 4.18 Further hypothesis testing; 4.19 Transition matrices and Markov chains
Topic 5 Calculus	5.1 Intro to limits and derivatives; 5.2 Increasing and decreasing functions; 5.3 Derivative of $f(x)=ax^n$; 5.4 Tangents and normal; 5.5 Definite integrals; 5.6 Maximum and minimum points; 5.7 Optimisation; 5.8 Area using trapezoidal rule	5.9 More derivatives and the chain, product, and quotient rule; 5.10 Second derivatives; 5.11 Finding further integrals and integration by inspection and substitution; 5.12 Area of a region and volumes of revolution; 5.13 Kinematic problems; 5.14 Differential equations; 5.15 Slope fields and their diagrams; 5.16 Euler's method and numerical solutions to differential equations and coupled systems; 5.17 Phase portraits; 5.18 Simple second order differential equations
The toolkit and mathematical exploration	The exploration is a piece of written work that involves investigating an area of mathematics.	

Figure 12: SB mathematics: content visualiser for mathematics I and II

Mathematics I	A. Number sense	1. Sense of operations	2. Relationships			
	B. Meaning of measure	1. Measurement	2. Change			
	C. Spatial sense	1. Two-dimensional geometric shapes	2. Location and systems of representation	3. Visualization, reasoning and geometric modeling		
	D. Algebraic sense	1. Patterns	2. Mathematical model	3. Equality and inequality	4. Relations and functions	5. Computational thinking
	E. Stochastic sense	1. Organization and analysis of data	2. Uncertainty	3. Inference		
	F. Socio-affective sense	1. Beliefs, attitudes and emotions	2. Teamwork and decision making	3. Inclusion, respect and diversity		
Mathematics II	A. Number sense	1. Sense of operations	2. Relationships			
	B. Meaning of measure	1. Measurement	2. Change			
	C. Spatial sense	1. Geometric forms of two and three dimensions	2. Location and systems of representation	3. Visualization, reasoning and geometric modeling		
	D. Algebraic sense	1. Patterns	2. Mathematical model	3. Equality and inequality	4. Relations and functions	5. Computational thinking
	E. Stochastic sense	1. Uncertainty	2. Probability distributions			
	F. Socio-affective sense	1. Beliefs, attitudes and emotions	2. Decision making	3. Inclusion, respect and diversity		

Structure

The SB modality that students choose dictates the options they have for the study of mathematics. Students in the General modality study General Mathematics in the first year; those in the Humanities and Social Sciences modality may choose to study mathematics applied to social sciences I and II in the first and second year, respectively; and students in the Science and Technology modality are required to study SB mathematics I in the first year, and either SB mathematics II or mathematics applied to social sciences II to be studied in the second year. No mathematics is offered in the Arts modality. Therefore, unlike the DP, the SB has pathways in which the study of mathematics is optional and not required.

Focusing on the Science and Technology modality, students may choose a purer mathematics route by studying SB mathematics II, or take a more applied route by studying mathematics applied to social sciences II. This has similarities to the offering of AA and AI in the DP, as both routes have a different focus, whilst sharing content. However, the content size of mathematics applied to the social sciences II is smaller than SB mathematics II, hence this differs to the DP, where AA and AI are designed to be of similar size to one another.

Like the DP, the Science and Technology modality mathematics content is structured into the same five main topic areas for both SB mathematics I and SB mathematics II. Like DP HL and SL, SB mathematics II builds on SB mathematics I content in each topic area. For the Science and Technology modality, the five main content areas are: A. Number sense, B. Meaning of measure, C. Spatial sense, D. Algebraic sense, and E. Stochastic sense. It should be noted here that the official and publicly available curriculum for the SB describes the mathematics content in broader terms than the DP syllabi and does not detail all the specific concepts studied.

Content Alignment

The table below presents a simplified summary of the extent to which SB mathematics aligns with the main topics of the DP's subjects. As noted above, the mathematics content of the SB is only broadly defined in the official Ministry of Education, Vocational Training and Sports's publicly available curriculum; as such, to facilitate comparison, the content mapping was supported by the use of textbooks sourced online. The sources included official textbooks from the Spanish Ministry of Education and independent textbooks which follow the Spanish curriculum.[83] All sources were cross-checked with the curriculum and official textbooks.

As indicated in the content structure section above, SB mathematics II is studied following SB mathematics I; as such, the alignments shown for these subjects demonstrate the cumulative content learnt by students on this pathway in the Science and Technology modality.

[83] Pascual. L.G., Menéndez. A. V., et al. (2022). MATEMÁTICAS II 2º de Bachillerato. Available from: https://www.apuntesmareaverde.org.es/grupos/mat/LOMLOE/Bachillerato/Matematicas%20II.pdf; Muñoz. J., Moya. P., et al. (2022). MATEMÁTICAS I 1º de Bachillerato. Available from: https://www.apuntesmareaverde.org.es/grupos/mat/LOMLOE/Bachillerato/Matematicas_I.pdf; Rodríguez del Río, Roberto. (i.d). Matemáticas I. 1º bachillerato. Bachillerato a distancia. Available from https://sede.educacion.gob.es/publiventa/matematicas-i-1-bachillerato-bachillerato-a-distancia/bachillerato-matematicas/14452

Table 20: Summary of the content alignment between the DP mathematics: analysis and approaches (AA) topics and SB mathematics subjects

	AA topics	SB mathematics I	SB mathematics II
SL	1. Number and algebra		
	2. Functions		
	3. Geometry and trigonometry		
	4. Statistics and probability		
	5. Calculus		
AHL	1. Number and algebra		
	2. Functions		
	3. Geometry and trigonometry		
	4. Statistics and probability		
	5. Calculus		

Table 21: Summary of the content alignment between the DP mathematics: applications and interpretation (AI) topics and SB mathematics subjects

	AI topics	SB mathematics I	SB mathematics II
SL	1. Number and algebra		
	2. Functions		
	3. Geometry and trigonometry		
	4. Statistics and probability		
	5. Calculus		
AHL	1. Number and algebra		
	2. Functions		
	3. Geometry and trigonometry		
	4. Statistics and probability		
	5. Calculus		

Key:

	Strong presence of this topic in the SB.		*Partial presence of this topic in the SB.*		*Little or no presence of this topic in the SB.*

* Where applicable, content alignments found in assumed knowledge or pre-requisite subjects are carried forwards and combined with new alignments to represent the cumulative content covered.

SB mathematics I

DP Mathematics: analysis and approaches (AA)

The mapping of content shows that SB mathematics I has alignment with DP AA SL in all topics, though some DP AA SL topics are covered in less depth, while others go beyond the DP AA SL coverage, including AHL content.

SB mathematics I includes a large amount of content from Number and Algebra, with a strong presence of DP AA SL content and a partial presence of AHL content. Indeed, SB mathematics I covers standard form, sequences and series, rational exponents, laws of logarithms, complex numbers, De Moivre's theorem, and systems of linear equations in similar depth and detail to the DP. SB mathematics I does not include the DP subtopics regarding

proof, but instead covers limits of sequences. Another topic where SB mathematics I has alignment with both SL and AHL content is Geometry and Trigonometry. Indeed, SB mathematics I includes similar detail on trigonometry of right angles, cosine and sine rules, radians, exact values, trigonometric identities and relationships, trigonometric functions, reciprocal trigonometric functions, compound and double angle formula, symmetry properties, properties of vectors, scalar products, vector equations of lines, and coincident and parallel lines. However, SB mathematics I uses two dimensional vectors only and does not cover all AHL, such as the cross product and equations of planes. Instead, SB mathematics I covers conics, including ellipses, hyperbolas, parabolas and equilateral hyperbolas, which are not covered in the DP.

SB mathematics I has a strong presence of DP AA SL Functions content, covering domain and range, composite and inverse functions, quadratic equations and inequalities, and graphs and key features of quadratic, exponential, logarithmic, reciprocal, and rational functions. SB mathematics I also included a few sections of AHL subtopics, such as odd and even functions, absolute value function, and the remainder theorem for polynomials. However, SB mathematics I does not cover transformations or further AHL content, though it does cover root and piecewise functions.

SB mathematics I only has partial alignment with DP AA SL Statistics and Probability and Calculus content, due to significant areas not being covered. Indeed, SB mathematics I covers presenting data, measures of central tendencies and dispersion, correlation and regression, probability and Bayes theorem, but does not cover discrete random variables, or the binomial and normal distributions. Similarly, SB mathematics I covers in similar detail DP AA SL content regarding derivatives, such as a wide range of derivatives, increasing and decreasing functions, tangents, derivative rules, and maxima and minima, but does not cover subtopics related to integration. However, SB mathematics I covers in detail limits and continuity, including finding limits of functions, differentiating from first principles, and studying the continuity of functions, which aligns with some DP AA AHL content.

Overall, SB mathematics I covers a considerable amount of DP AA content from the DP curriculum. In general, it covers a similar amount of content as DP AA SL, though goes into more depth in some topics and less in others. For DP AA SL content, SB mathematics I is strongly aligned with Number and Algebra, Functions, and Geometry and Trigonometry, and partially aligned with Calculus and Statistics and Probability. For DP AA AHL content, SB mathematics I has partial alignment with Number and Algebra and Geometry and Trigonometry.

DP Mathematics: applications and interpretation (AI)

Similar to DP AA, SB mathematics I has the most alignment with the DP AI's topics of Number and Algebra and Geometry and Trigonometry. Indeed, SB mathematics I covers most of the DP AI's Number and Algebra content, except amortization and annuities, matrices, and eigenvalues and eigenvectors. It can be noted that SB mathematics I covers complex numbers in similar depth to DP AA – i.e. in more detail than DP AI's coverage. As noted above, SB mathematics I also includes limits of sequences. Regarding Geometry and Trigonometry, with the exception of Voronoi diagrams, SB mathematics I covers all DP AI SL content, as well as AHL subtopics of radians, definitions of sin, cos and tan, the Pythagorean identify, vectors, equations of vector lines, and the scalar product. However, SB mathematics I does not cover

graph theory, matrix transformation, adjacency matrices, or decision mathematics subtopics. As noted above, SB mathematics I covers further trigonometric identities, reciprocal trigonometric functions, and conic sections which are not in DP AI.

SB mathematics I has partial alignment with DP AI SL Functions content. Although covering a wide range of functions, SB mathematics I does not focus on the modelling of these functions. SB mathematics I covers some AHL subtopics such as composite and inverse functions. SB mathematics I includes piece-wise functions also.

SB mathematics I also has partial alignment with DP AI SL Calculus, as it does not cover integration, optimisation, or the trapezoidal rule. Instead, SB mathematics I covers AHL subtopics of further derivatives, derivative rules, second derivatives, as well as limits and continuity content which is not in DP AI. With regards to Statistics and Probability, SB mathematics I has limited alignment to DP AI, as it does not cover, discrete random variables, the binomial and normal distributions, or hypothesis testing, nor any AHL subtopics.

Overall, SB mathematics I has the most alignment with Number and Algebra and Geometry and Trigonometry content in the DP AI, covering nearly all SL subtopics and some AHL subtopics. Following this, SB mathematics I has partial alignment with DP AI SL Functions and Calculus content, occasionally including some AHL subtopics. Alignment with Statistics and Probability is limited.

Table 22: SB mathematics I content which is not covered in the DP*

Significant content not in AA (only)	Significant content not in AI (only)
• Piecewise functions	• Limits and continuity • De Moivre's theorem • Reciprocal trigonometric functions • Compound angle identities and double angle formula
Significant content not in either DP mathematics subject	
• Limits of sequences • Half angle formula • Conics (Ellipse, hyperbola, parabola, equilateral hyperbola) • Root functions, supply and demand functions • Derivatives of hyperbolic functions • Solving systems of trigonometric equations	

* Significant content does not include topics which are typically studied *prior* to upper secondary.

SB mathematics II

DP Mathematics: analysis and approaches (AA)

SB mathematics II must be studied following SB mathematics I, hence the content found in the analysis for SB mathematics I applies for SB mathematics II. SB mathematics II introduces new topics, recaps topics, and extends SB mathematics I topics. With regards to DP AA, SB mathematics II has increased alignment with AHL content in all five main topics, as well as some SL content, especially for Statistics and Probability and Calculus.

SB mathematics II revisits vectors and includes vectors in three-dimensions, also introducing the cross product. SB mathematics II also covers vector equations of planes and intersections and angles, which are AHL content in DP AA. In addition to these, SB mathematics II includes concepts not in DP AA, such as studying linear independence of vectors, different forms of plane equations, mixed product, bundles of planes, orthogonal projections, symmetrical points, and different distances in space.

SB mathematics II also includes both more DP AA SL and AHL content from Calculus. Indeed, SB mathematics II introduces integration, covering a wide range of anti-derivatives, definite and indefinite integrals, area under a curve, volumes of revolution and integration methods of substitution, by parts, and use of partial fractions. SB mathematics II also includes L'Hôpital's rule for limits. However, it can be noted that differential equations and the Maclaurin series are not present. Instead, SB mathematics II goes deeper into limits and continuity, increasing the rigour and level of problems than SB mathematics I. SB mathematics II also covers Rolle's and mean value theorems, the fundamental theorem of integral calculus, and more cases of partial fractions.

SB mathematics II combines knowledge from SB mathematics I, as well as the new content learnt regarding limits, continuity and derivatives, to cover a topic on representing functions. These include graphing difficult functions using knowledge to find domain, range, axis intersections, symmetries, asymptotes, parabolic branches, monotony, critical points, concavity and convexity, inflection points, and regions of the plane in which it is defined. The types of functions required to be graphed align with AHL Functions content.

SB mathematics II further aligns with both DP AA SL and AHL content in Statistics and Probability by covering probability in similar detail, including Bayes Theorem and other formulae, as well as discrete random variables, continuous random variables and the binomial and normal distributions. SB mathematics II also includes permutations and combinations and the binomial expansion, which increases alignment with AHL Number and Algebra – though methods of proof are not covered.

SB mathematics II has a substantial amount of content involving matrices, which is not an area covered in DP AA. This includes operations of matrices, properties of determinants, adjoint matrices, and various methods of calculating determinants and inverse matrices. Furthermore, SB mathematics II also covers the Rouché–Frobenius theorem, Gauss method, and Cramer's rule.

Overall, SB mathematics II has a strong presence of DP AA SL and AHL content in all topics, as well as including additional content not in DP AA. SB mathematics II goes into more detail regarding limits and continuity and vectors than DP AA and covers a substantial amount of content around matrices. Therefore, the breadth and depth of SB mathematics II somewhat exceeds that of DP AA HL and considerably surpasses that of DP AA SL.

DP Mathematics: applications and interpretation (AI)

As with DP AA, SB mathematics II has more alignment with the DP AI's areas of Statistics and Probability and Calculus than SB mathematics I, due to covering discrete random variables, and distributions. However, SB mathematics II does not cover hypothesis testing or any AHL Statistics and Probability content, such as nonlinear regression, linear combinations, the central limit theorem, Poisson distribution, or transition matrices and Markov chains. Instead, within this topic area, SB mathematics II covers continuous random variables and permutations and combinations. For Calculus, SB mathematics II covers more DP AI SL and AHL subtopics such as optimisation, integrals, integration methods, area and volumes of revolution, thought does not include differential equations, slope fields, Euler's methods and numerical solutions, or phase portraits. SB mathematics II instead revisits limits and continuity in more depth and covers more antiderivatives and methods of integration.

As mentioned with DP AA, SB mathematics II includes a substantial amount of content on matrices. Like DP AI HL, SB mathematics II covers the definition of a matrix, operations, determinants and inverse matrices, and solving systems of equations. However, SB mathematics II does not cover eigenvalues and eigenvectors, adjacency matrices, matrix transformations, or transition matrices. Instead, SB mathematics II covers more details regarding adjoint matrices, properties of determinants, calculating determinants, calculating inverses, matrix rank, and matrix expression of systems of equations (Rouché–Frobenius theorem, Gauss method, and Cramer's rule).

Compared to SB mathematics I, SB mathematics II does not significantly increase its alignment with the DP AI in the content area of Geometry and Trigonometry, as it focuses more on vectors (see DP AA for details), whereas DP AI covers graph theory and decision mathematics. No further alignments are found with Functions, as SB mathematics II does not emphasise modelling.

Overall, SB mathematics II is strongly aligned with DP AI Number and Algebra content, covering the majority of DP AI SL and AHL subtopics. Following this, SB mathematics II is strongly aligned with DP AI SL Geometry and Trigonometry and Calculus content, and partially aligned with the AHL content in these topics. SB mathematics II is also partially aligned with the DP AI SL content of Functions and Statistics and Probability. In addition, SB mathematics II includes a substantial amount of content that is not present in DP AI (see table below), some of which is covered in DP AA. Overall, the breadth and depth of SB mathematics II somewhat exceeds that of DP AI HL, and considerably surpasses that of DP AI SL.

*Table 23: SB mathematics II content which is not covered in the DP mathematics subjects**

Significant content not in AA (only)	Significant content not in AI (only)
• Matrices • Confidence intervals	• Further forms of equations of a line • General systems of linear equations (homogeneous and equivalent systems) • Vector equations of planes • Intersecting planes (a line and plane, two and three planes) • Combinations and permutations and binomial expansion • Limits and continuity • Integration methods and partial fractions
Significant content not in either DP mathematics subject	
• Matrices content (properties and further methods of calculating determinants and inverse matrices; Adjoint matrix; Matrix rank; Rouche-Frobenius theorem, Gauss method, Cramer's rule) • Vectors content (linear independence of vectors, parametric equations of a plane, segmental equations of a plane, equation of a plane from three points, conditions for four points to be coplanar; mixed product of vectors; bundles of planes; orthogonal projections; symmetrical points) • Distance (point to plane, between planes, line to plane, between lines) • Rolle and Mean Value Theorems • Formal definitions and rigor used in the topics of limits, continuity, and calculus • Further cases of partial fractions • Fundamental Theorem of integral calculus	

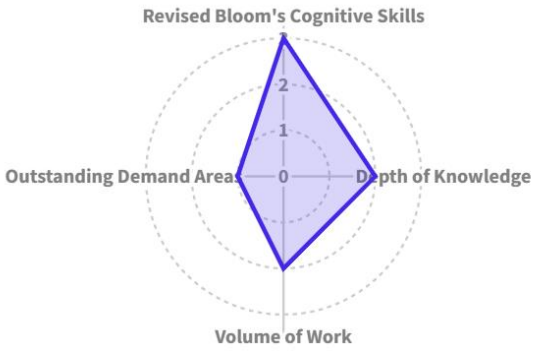
5.1.3 Demand – Mathematics

This section considers the alignment between the DP and SB mathematics curricula in terms of demand.

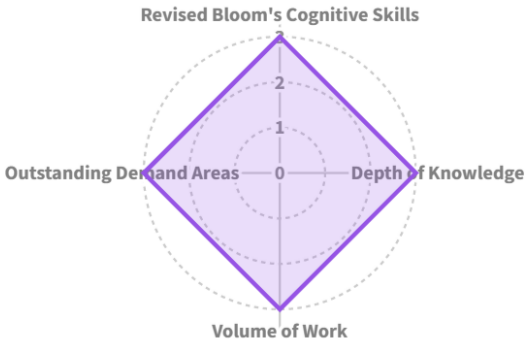
The DP and SB curricula were analysed using the same demand tool in order to create a demand profile for DP AA (SL and HL), DP AI (SL and HL), SB mathematics I, and SB mathematics II. These demand profiles are presented below in the form of radar diagrams, with superimposed diagrams also being featured to enable immediate visual comparison.

Figure 13: Visual representations of subject demand

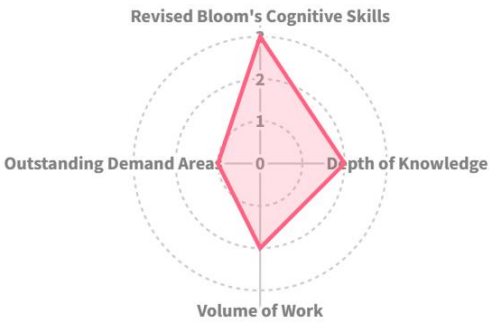
DP mathematics: analysis and approaches SL



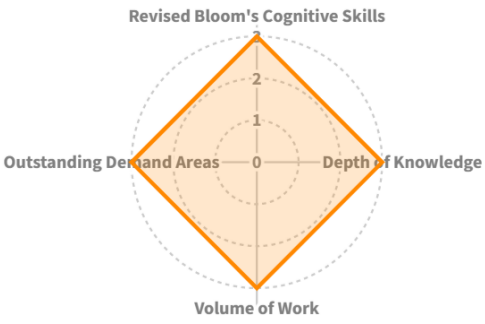
DP mathematics: analysis and approaches HL



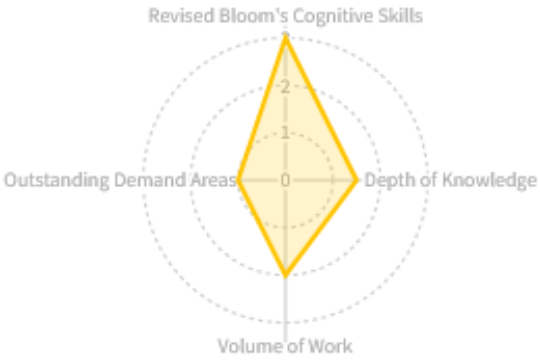
DP mathematics: applications and interpretation SL



DP mathematics: applications and interpretation HL

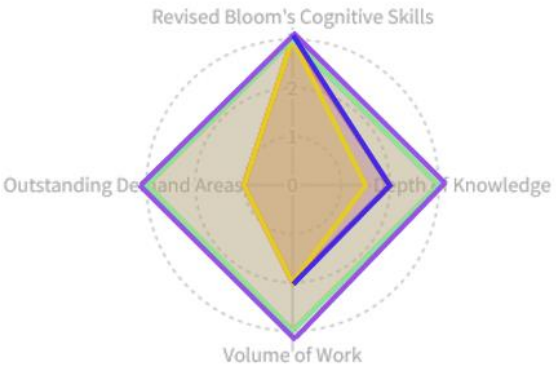


SB maths I

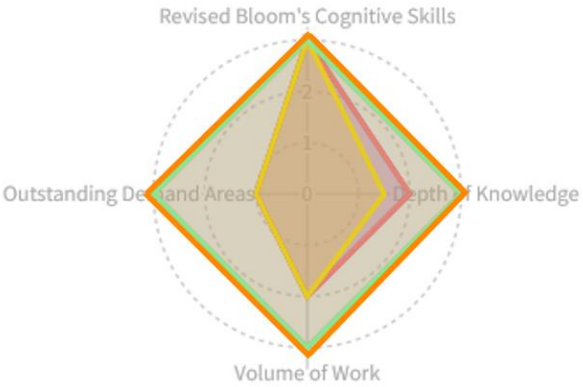


SB maths II

DP AA SL/HL and SB maths I and maths II



DP AI SL/HL and SB maths I and maths II



The panel of experts carried out a detailed analysis of each course and reached a consensus on the scores shown in the profiles above. The following points were particularly important within the panel discussion:

- Regarding the scores for **Bloom's Cognitive Skills**:
  - The DP mathematics subject group learning outcomes apply to all subjects, hence the scores are the same for AA (SL and HL) and AI (SL and HL). These outcomes were given a score of 3 on the basis that they strongly evidenced the development of critical and creative thinking skills through their focus on reasoning, inquiry-based approaches, reflection, generalisation, unfamiliar contexts, and consideration of wider implications.
  - The mathematics learning outcomes of the SB were drawn from the specific competences and evaluation criteria for SB mathematics I and SB mathematics II. There is little variation in the learning outcomes for these subjects, hence both were awarded the same score. The panel judged that higher-order thinking skills, such as evaluation, creative thinking and analysis, were present in several learning outcomes, hence a score of 3 was awarded. Specifically, there were references to modifying and creating algorithms, developing critical, creative and innovative skills, assessing the usefulness of representations, formulating and investigating conjectures, and using reasoning, and creativity to generating new mathematical knowledge. Whilst there is enough evidence of higher order thinking skills for both SB mathematics I and SB mathematics II to receive a score of 3, it can be noted that SB mathematics II contained slightly more evidence, demonstrating a progression from SB mathematics I. In particular, SB mathematics II included further skills of making decisions and acting more autonomously.

- Regarding the scores for **Depth of Knowledge**:
  - Both DP mathematics subjects at SL were given a score of 2. Both subjects were judged to cover the topics of Number and algebra, Functions, Geometry and trigonometry, Statistics and probability, and Calculus in considerable detail, building in complexity and requiring a substantial amount of pre-requisite knowledge. At HL, both DP mathematics subjects were awarded a score of 3 for depth of knowledge. The subjects were judged to cover topics in a high level of

detail, with many subtopics having high complexity and requiring a large amount of pre-requisite knowledge.
    - For SB, mathematics I received a score of 1.5, as some topics are studied in considerable depth, in cases comparable to that of DP SL; however, there was not enough evidence of depth to warrant a score of 2. For SB mathematics II, a score of 3 was given as all topics were studied in very high detail – comparable to the DP's HL subjects. The level of detail studied on matrices, for example, was deemed particularly high.

- Regarding the scores for **Volume of Work**:
    - Both DP mathematics subjects at SL were deemed to comprise a moderate-heavy volume of work and were given a score of 2. The panel concluded that the teaching time allotted to cover the different concepts was short (150 hours) but acknowledged that some subtopics contained basic concepts and recapped prior learning, hence 2 was deemed an appropriate score. For HL, both DP mathematics subjects were considered to have a heavy volume of work, due to the short amount of time allocated (240 hours) and the level of complexity of the content, which combined merited a score of 3.
    - SB mathematics I and II each have minimum teaching hours of 87.5 hours, which is less than the recommended hours for both DP SL and HL. Based on the size and depth of the content in each of these subjects, SB mathematics I was given a score of 2 for its moderate-heavy volume of work and SB mathematics II was given a score of 3 for its heavy volume of work. Indeed, the amount studied in SB mathematics I and II combined is of similar size to DP HL, yet the minimum number of teaching hours altogether is 175 hours, which was deemed a very short time allocation to cover the amount and complexity of the content.

- Regarding the scores for **Outstanding Areas of Subject Demand**:
    - Both DP mathematics subjects at SL and contained one area of outstanding demand, which was the 'mathematical exploration'. This element of the SL subjects was considered to apply skills typically needed in higher education, such as extended writing and presentation of mathematical concepts, student-led exploration, and academic writing skills. Therefore, a score of 1 was awarded to both SL subjects for the inclusion of this element. In addition to this, both subjects at HL had further areas of outstanding demand. For mathematics: analysis and approaches, some of the identified outstanding areas of demand were proof by induction, complex numbers (De Moivre's theorem), vectors (cross product, equations of planes and intersections), and Maclaurin series. For mathematics: applications and interpretation, some identified areas of outstanding demand were eigenvalues and eigenvectors, nonlinear regression, Markov chains, second order differential equations, slope fields, Euler's method, and phase portraits. Overall, there was a high number of outstanding areas of demand and a score of 3 was awarded to both HL subjects.
    - For SB subjects, a score of 1 was given to SB mathematics I, as its coverage of complex numbers was deemed to be particularly advanced, going into De Moivre's theorem for example. For SB mathematics II, a score of 3 was given, with complex numbers, matrices, vectors, limits and continuity, and continuous random variables

all containing subtopics which demonstrated opportunity for stretch and are beyond the usual scope of upper secondary mathematics.

5.2 Physics

Below is the list of subjects used in the physics comparative analysis.

DP physics[84]
Physics is a subject option from the DP sciences subject group, offered at both SL and HL. This subject has content that is common to both SL and HL, as well as AHL content that is featured only in the HL. Thus, the HL has greater breadth and depth than SL. This subject is intended to prepare students for university courses such as engineering, physics, and others requiring a strong science background. HL is suitable for those intending to pursue further study in an area requiring a strong background in physics.

SB physics and chemistry[85]
Physics and chemistry is a one-year modality subject that students may opt to study on the first year of the Science and Technology modality of the SB. The subject combines physics and chemistry content, building on prior scientific knowledge and skills acquired during compulsory secondary education. It intends to provide a strong foundation for further physics and/or chemistry study in the following year.

SB physics[86]
Physics is a one-year modality subject that students may opt to study on the second year of the Science and Technology modality of the SB. It builds on the SB physics and chemistry subject offered in the SB's first year, aiming to provide the appropriate foundation of knowledge and skills required for further scientific study at higher education level. Students must have completed the first-year SB physics and chemistry in order to take SB physics in their second year.

5.2.1 Learning Outcomes – Physics

This section compares and contrasts the learning outcomes of curricula falling within the category of physics.

The learning outcome themes for physics were extracted from the aims and assessment objectives of the DP Sciences subject group, hence the themes are the same for biology chemistry and physics.

The learning outcomes for the SB were drawn from the 'Specific Competences' (SCs) of both the SB physics and chemistry and the SB physics subjects. While there are some minor differences between the SCs of both SB subjects, these did not affect the level of alignment

[84] International Baccalaureate. (2023). *Physics guide*.
[85] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d.), Física y química. Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica-quimica/desarrollo.html
[86] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d.), Física. Available at: https://educagob.educacionyfp.gob.es/ca/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica/desarrollo.html

with the DP learning outcome themes; as such, most of the analysis applies to both subjects, flagging the slight differences observed when appropriate.

The following table demonstrates the learning outcome themes that were extracted from the DP learning outcomes and indicates the degree of presence they were judged to have within the learning outcomes of the SB physics curricula.

Table 24: Presence of the DP Sciences subject group learning outcome themes in the SB physics curricula

Themes extracted from the learning outcomes of the DP sciences subject group	Presence in the SB	
1. Conceptual understanding and making connections		Present in both sets of SCs
2. Use and application of knowledge, methods, tools, and techniques that characterise science		Present in both sets of SCs
3. Creativity and critical thinking (problem-solving, analysis, evaluation, synthesis)		Present in both sets of SCs
4. Skills for scientific inquiry		Present in both sets of SCs
5. Development of technological skills		Present in both sets of SCs
6. Effective collaboration and communication		Present in both sets of SCs
7. Awareness of global and local problems and the environmental, ethical, cultural, and social impact of science		Present in both sets of SCs

Key:

	This theme is well-evidenced in the skills of the SB		*This theme is partially evidenced in the skills of the SB*		*This theme is not evident in the skills of the SB.*

Presence of the DP's Learning Outcome Themes

As can be seen in the table above, all DP learning outcome themes are present within the SB physics curricula. The below write-ups provide a summary of the extent to which each DP theme is evidenced in the two SB subjects.

1. Conceptual understanding and making connections

The DP learning outcome theme of conceptual understanding and making connections is well evidenced in the SCs of the SB. For example, the specific competence 2 describes how students will use the laws of physics as "a basis for studying natural systems",[87] while specific competence 6 states that students will "recognise the multidisciplinary nature of physics…to establish a relationship with other scientific disciplines".[88] This highlights the emphasis that the SB places on the 'making connections' aspect of this DP theme. This is further supported by references within the SCs to mathematics and logic alongside the understanding and application of theoretical physics concepts. The specific competence 3 of the SB physics subject describes that students will be "establishing adequate communication between different scientific communities",[89] which again highlights the importance of making connections and linking ideas in the SB physics curricula.

[87] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Physics – 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica/competencias-especificas.html. [accessed July 2023]
[88] ibid
[89] ibid

2. Use and application of knowledge, methods, tools, and techniques that characterise science

This theme is strongly evident throughout the SB physics and SB physics and chemistry SCs. Of the SB physics curriculum, specific competence 1 states that students will use "theories, principles and laws that govern the most important physical processes", while specific competence 2 describes how students will "adopt the models, theories and accepted laws of physics for studying natural systems".[90] Specific competence 3 also discusses the "language of physics", while specific competence 5 states that students will apply "techniques of work and inquiry typical of physics".[91]

The SB physics and chemistry's SCs are worded slightly differently but also highlight the importance of this theme. Specific competence 1 states that students will learn to "apply appropriate scientific laws and theories",[92] while specific competence 2 builds on this by requiring students to "us[e] scientific thinking and skills related to the work of science".[93]

3. Creativity and critical thinking (problem-solving, analysis, evaluation, synthesis)

Although this theme is well evidenced in the SB, some aspects are more explicit than others. For example, the 'creativity' component is only partially referenced in specific competence 4 of the SB physics and chemistry curriculum. Here, it is stated that students will be working in different learning environments, to "encourage creativity";[94] however, this is not then expanded upon to detail how this creativity will be applied and in what contexts.

The other aspects of this theme are well evidenced throughout the SCs of both SB physics and SB physics and chemistry. Within the SB physics subject, SCs 1, 2 and 5 all reference using physics to solve problems, as does SC 1 of the physics and chemistry curriculum. Within physics, SC 4 describes how students will use resources critically, efficiently and autonomously, and SC 6 states that students will analyse the multidisciplinary nature of physics. The SB physics and chemistry subject contains specific competence 2 which details how students will firstly 'reason', then 'apply' this reasoning in order to formulate, and subsequently validate, questions and hypotheses.

4. Skills for scientific inquiry

Within the SB's SCs, there are references to practical work and skills; however, the nature of these is not expanded upon in the same way as the DP. For example, specific competence 1 of physics states that students will use theories, principles and laws from physics, "considering their experimental basis"[95], and specific competence 5 discusses the application of "work and inquiry typical of physics, as well as experimentation"[96]. Specific competence 2 of the SB physics and chemistry subject discusses the use of scientific skills in a more general sense to formulate questions and hypotheses and to "validate them through experimentation".[97] Whilst

[90] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Physics – 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica/competencias-especificas.html. [accessed July 2023]
[91] ibid
[92] ibid
[93] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Physics and chemistry - 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica-quimica/competencias-especificas.html. [accessed July 2023]
[94] ibid
[95] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Physics – 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica/competencias-especificas.html. [accessed July 2023]
[96] ibid
[97] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Physics and chemistry - 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica-quimica/competencias-especificas.html. [accessed July 2023]

these components discuss experiments and experimental skills, they do not describe the exact skills associated with such experiments, like planning, collecting data, organising data, which are detailed in the DP documentation. Moreover, the SCs also feature no reference to the importance of considering the ethics of experiment, a skill that is emphasised in the DP curriculum.

5. Development of technological skills

References to 'digital platforms' in the SB's SCs evidence the presence of this theme in the SB. However, there is no further detail within the SC statements as to what 'digital platforms' means in practice. Within SB physics and SB physics and chemistry, specific competence 4 discusses students researching using "digital platforms".[98] Additionally, specific competence 3 may require students to use technology skills as it references "information in different formats and from different sources";[99] that said, the use of technology is more explicitly stated in the DP documentation than that of the SB.

6. Effective collaboration and communication

This theme is strongly present in both the SB physics and the SB physics and chemistry curricula. The SCs 3 and 4 for SB physics describe that students will be using the language of physics to "establish adequate communication between different scientific communities".[100] This highlights the emphasis that the SB places not only on students communicating between themselves, but also appreciating how different areas of science in the wider world must make connections and communicate with each other.

The SCs for SB physics and chemistry also highlight the importance of communication and collaboration. They outline that students will not only study different "registers of communication of science" and "communicating effectively", but also work "collaboratively in diverse teams, applying coordination, communication and balanced responsibilities". [101]

7. Awareness of global and local problems and the environmental, ethical, cultural, and social impact of science

This theme is prominent throughout the SCs of SB physics. Both the mention of "practical applications demanded by society" in specific competence 2, and the requirement to "value the role of physics in a society based on ethical and sustainable values" placed by specific competence 5 further demonstrate the importance of this theme in the SB physics. The SCs in SB physics and chemistry go slightly beyond this theme in how they encourage students to "predict the consequences of scientific advances and their influence on community health and sustainable environmental development".[102]

Other Themes in the SB

No additional learning outcome themes were found in the SB physics and SB physics and chemistry curriculum that were not present in the DP. However, in the SB physics and

[98] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Physics and chemistry - 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica-quimica/competencias-especificas.html. [accessed July 2023]
[99] ibid
[100] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Physics – 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica/competencias-especificas.html. [accessed July 2023]
[101] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Physics and chemistry – 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica-quimica/competencias-especificas.html. [accessed July 2023]
[102] ibid

chemistry subject there is a heavy emphasis on utilising cognitive skills through the interconnection of physics and chemistry, with specific competence 1 discussing the importance of problem-solving and understanding physicochemical phenomena, analysing interactions in the light of physicochemical laws and theories. This merging of physics and chemistry is unsurprising given the design of the subject, but the mention of 'physicochemical phenomena' and its strong presence in the SCs constitutes a difference with the DP. Although the theme of linking concepts across multiple subjects is evident in the latter, it is described more broadly in the DP, without the same specific focus being given to physics and chemistry in particular.

The SB also provides a more detailed description than the DP of the communication and collaboration skills that it targets. While the SB encompasses the DP's theme of 'collaboration and communication', the SB specifically describes the importance of working collaboratively and in diverse teams as a way of developing other skills, such as reading, writing, speaking, technology and mathematics. Whilst all these skills are present within the DP, they are not so clearly linked to the communication and collaboration theme as they are in the SB.

Within the SB's physics-specific second-year course, specific competence 2 contains a specific reference to real-world areas within which students should be able to solve problems; for example, the technological and industrial fields. Although problem-solving and real-world contexts is a strong theme within the DP, the SB specifically includes the 'biosanitary field' as part of this competence. This is not a phrase commonly used in the UK scientific world, however, the areas (sanitation, medical waste, etc.) that it covers are all prominent and important areas of science. This overt linkage of problem-solving skills in physics to this particular area of 'biosanitation' is not found in the DP.

Summary

Overall, there is strong alignment between SB and the DP with regards to physics learning outcomes, with all DP learning outcome themes being well evidenced in the SB physics and SB physics and chemistry curricula. The DP and the SB cover very similar themes of connecting ideas between sciences, analytical and critical thinking skills, as well as investigative skills and an appreciation of the impact of physics on communities and the environment.

5.2.2 Content – Physics

This section compares and contrasts the content of the DP and SB curricula falling within the category of physics. In order to support visual comparison at-a-glance, the DP and SB physics curricula are presented below in diagrams which show the key topics and subtopics included in each.

Figure 14: DP physics content visualiser[103]

A. Space, time and motion	A.1 Kinematics	A.2 Forces and momentum	A.3 Work, energy and power	A.4 Rigid body mechanics (HL only)	A.5 Galilean and special relativity (HL only)
B. The particulate nature of matter	B.1 Thermal energy transfers	B.2 Greenhouse effect	B.3 Gas laws	B.4 Thermodynamics (HL only)	B.5 Current and circuits
C. Wave behaviour	C.1 Simple harmonic motion (SL + AHL)	C.2 Wave model	C.3 Wave phenomena (SL + AHL)	C.4 Standing waves and resonance	C.5 Doppler effect (SL + AHL)
D. Fields	D.1 Gravitational fields	D.2 Electric and magnetic fields	D.3 Motion in electromagnetic fields	D.4 Induction (HL only)	
E. Nuclear and quantum physics	E.1 Structure of the atom (SL + AHL)	E.2 Quantum physics (HL only)	E.3 Radioactive decay (SL + AHL)	E.4 Fission	E.5 Fusion and stars
Experimental programme	Practical work	Collaborative sciences project	Scientific investigation		

[103] '(HL only)' and '(SL + AHL)' are used to flag, respectively, topics only taught at HL and topics taught at both SL and HL, but which also feature additional higher level content.

Figure 15: SB physics and chemistry and SB physics topics visualiser

SB physics and chemistry[104]	*A. Chemical Bonding and Structure*	*The Periodic Table*	*Electronic structure of atoms*	*Atoms, ions and bonds*	*Nomenclature of simple substances*	
	B. Chemical Reactions	*Laws of Chemistry*	*Classification of chemical reactions*	*Quantities of matter calculations*	*Stoichiometry of chemical reactions*	
	C. Organic Chemistry	*Physical and Chemical properties*	*IUPAC rules for formulating and naming compounds*			
	D. Kinematics	Kinematic variables	Rectilinear and circular movement	Trajectory		
	E. Static and Dynamic	Static and dynamic particle behaviour	Vector mechanics	Momentum and Mechanical Impulse		
	F. Energy	Work and Power	Energies of a simple system	Thermodynamic variables of a system		
SB physics	**A. Gravitational Field**	Determination of gravitational field	Angular momentum	Mechanical energy	Planetary motion	Cosmology and the Universe
	B. Electromagnetic Field	Electric Field strength	Magnetic fields generated by wires	Field lines	Motors, generators and transformers	
	C. Vibrations and Waves	Oscillatory motion	Wave motion	Wave phenomena	Nature of light	Optical systems
	D. Relativistic, quantum, nuclear and particle physics	Fundamental principles of special relativity	Wave-particle duality and quantization	Particle physics and fundamental particles	Atomic nuclei and isotope stability	

[104] Chemistry topics have been greyed out for the combined SB physics and chemistry subject as they were not considered in the physics content comparisons.

Structure

The DP and SB programmes are both taught over two years of study, with both offering the opportunity for students to study physics at different levels – i.e. the SB offers a combined SB physics and chemistry subject in the first year, with the option to take the specialist SB physics subject in the second year; the DP offers students the opportunity to study DP physics at either SL or HL.

One notable difference between the structure of the physics subject area in the two programmes is the combined nature of the SB's first-year physics and chemistry subject; although DP physics covers some aspects of chemistry, such as the structure of the atom, physics and chemistry content are covered in separate subjects in the DP.

The DP physics subject is designed through a concept-based approach and organised into five over-arching, discipline-specific themes: Space Time and Motion, The Particulate Nature of Matter, Wave Behaviour, Fields and Nuclear and Quantum Physics. Each of these themes are then organised into at least four subtopics. In the SB, the first-year SB physics and chemistry subject is structured into six blocks: Chemical Bonding and Structure, Chemical Reactions, Organic Chemistry, Kinematics, Static and Dynamic, and Energy. In the second year, SB physics consists of four learning blocks which are: Gravitational Field, Electromagnetic Field, Vibrations and Waves, and Relativistic, Quantum, Nuclear and Particle Physics. As such, the combined SB physics and chemistry subject presents a significant structural difference to DP physics, which does not offer a combined physics and chemistry subject and instead offers two levels of physics study (SL and HL). Viewed on its own, the SB physics subject studied in the second year, structures its content into similar main areas to DP physics. Overall, however, students studying physics in the SB will experience a different structure of content to those studying physics in the DP.

Content Alignment

The table below represents a simplified summary of the SB's content alignment, at topic-level, with DP physics (SL and HL).

Like mathematics, the physics content of the SB is only broadly defined in the official Ministry of Education, Vocational Training and Sports' publicly available curriculum; as such, to facilitate comparison, the content mapping was supported by the use of textbooks sourced online. The sources included official textbooks from the Spanish Ministry of Education and independent textbooks which follow the Spanish curriculum. All sources were cross-checked with the curriculum and official textbooks.

Table 25: Summary of the content alignment between the DP physics topics and the SB physics

DP physics subtopics	Presence of SL content in SB physics and chemistry	Presence of AHL content in SB physics and chemistry	Presence of SL content in SB physics	Presence of AHL content in SB physics
A. Space, time and motion				
A.1 Kinematics		N/A		N/A
A.2 Forces and momentum		N/A		N/A
A.3 Work, energy and power		N/A		N/A
A.4 Rigid body mechanics	N/A		N/A	
A.5 Galilean and special relativity	N/A		N/A	

B. The particulate nature of matter				
B.1 Thermal energy transfers		N/A		N/A
B.2 Greenhouse effect		N/A		N/A
B.3 Gas laws		N/A		N/A
B.4 Thermodynamics	N/A		N/A	
B.5 Current and circuits		N/A		N/A
C. Wave behaviour				
C.1 Simple harmonic motion				
C.2 Wave model		N/A		N/A
C.3 Wave phenomena				
C.4 Standing waves and resonance		N/A		N/A
C.5 Doppler effect				
D. Fields				
D.1 Gravitational fields				
D.2 Electric and magnetic fields				
D.3 Motion in electromagnetic fields		N/A		N/A
D.4 Induction	N/A		N/A	
E. Nuclear and quantum physics				
E.1 Structure of the atom				
E.2 Quantum physics	N/A		N/A	
E.3 Radioactive decay				
E.4 Fission		N/A		N/A
E.5 Fusion and stars		N/A		N/A
Experimental programme				

Key:

	Strong presence of this topic in the SB.		*Partial presence of this topic in the SB.*		*Little or no presence of this topic in the SB.*	N/A	*This topic does not exist at the respective level.*

As seen in the table above, there is considerable similarity between the DP and SB physics subjects overall, with SB physics and chemistry combined and SB physics covering the vast majority of topic areas in the DP physics to similar depth and breath.

In the SB physics and chemistry (i.e. the SB's first-year combined subject), there is a heavy emphasis on mechanics, which is necessary in order to progress to higher demand field calculations. All DP physics SL content and most DP AHL content on 'Space, Time and Motion' is present in SB physics and chemistry, as is most of the DP SL content within 'Particle Nature of Matter'. 'Kinematics' and 'Forces and Momentum' are covered to a similar breadth and depth to those of the DP, as is 'Work, Energy and Power', though there are some aspects of the latter that are not explicit – for example, there is no mention of Sankey diagrams, or energy density of fuel sources. The majority of the DP HL 'Rigid Body Mechanics' is also covered in the SB physics and chemistry, with the exception of expressions involving moments of inertia. As the SB physics and chemistry is delivered as a combined physics and chemistry course, it is unsurprising that there is a heavy focus on thermodynamics in this year.

The full DP physics topic area of 'Wave Behaviour' is missing from the SB physics and chemistry subject, as is most of the DP physics' content in 'Nuclear and Quantum Physics'. However, both DP SL and AHL content on these areas is covered almost in full in the SB physics (i.e. second year subject). In fact, by the end of SB physics, students will have covered the vast majority of subtopics in the DP physics to similar depth, with some exceptions, such

as the coverage of ‘standing waves and resonance’ (in which the SB is missing discussion of damping), ‘fusion and stars’ (in which the SB does not mention Hertzsprung Russell diagrams and astronomical calculations, such as stellar radii and parallax), and ‘Galilean and special relativity’ (in which the SB does not include space/time diagrams and simultaneity).

Given the combined teaching of physics and chemistry within the first year of the SB, there is naturally a significant amount of chemistry content within the first year. This not only would be absent from the DP physics, but also may account for the absence of some content areas, such as the ‘greenhouse effect’ and ‘Doppler effect’. Notably, there are some topics in the SB that include a greater level of mathematical demand than the DP, such as the use of modulus dot products and cross products when dealing with vector notation and calculations. The SB also covers ‘imaging: convex/concave lenses and concave mirrors’, which is not covered in the DP.

Table 26: SB physics content which is not covered in the DP

Significant SB physics content which is not included in the DP*
• Mathematical requirements in use of modulus dot products and cross products when dealing with vector notation and calculations. • Imaging: convex/concave lenses and concave mirrors.

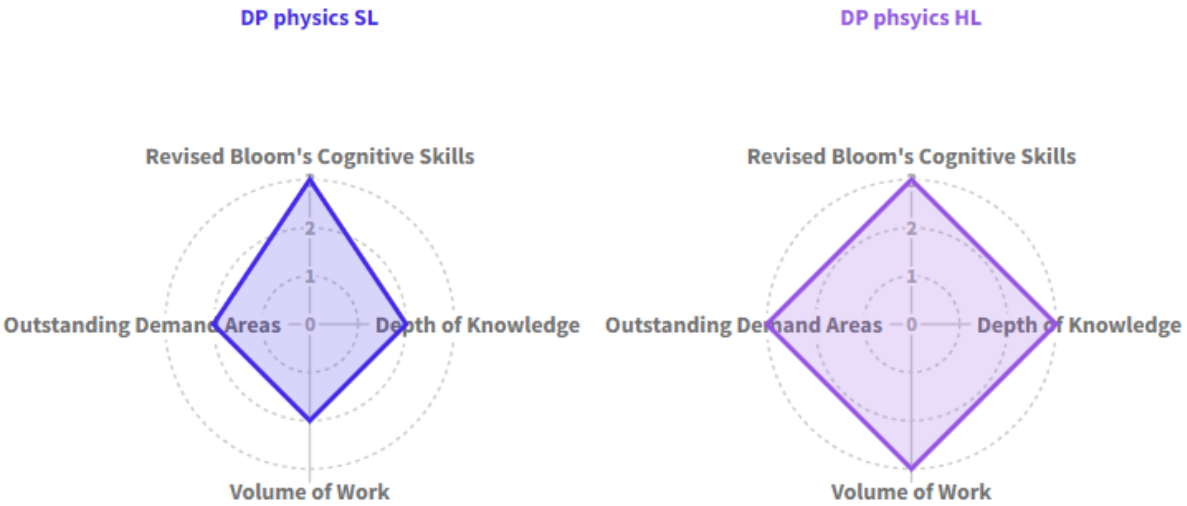
* This is only content pertaining to physics, the SB physics and chemistry subject also contains chemistry content – see section 5.3.2. Furthermore ‘significant content’ does not include topics which are typically studied *prior* to upper secondary.

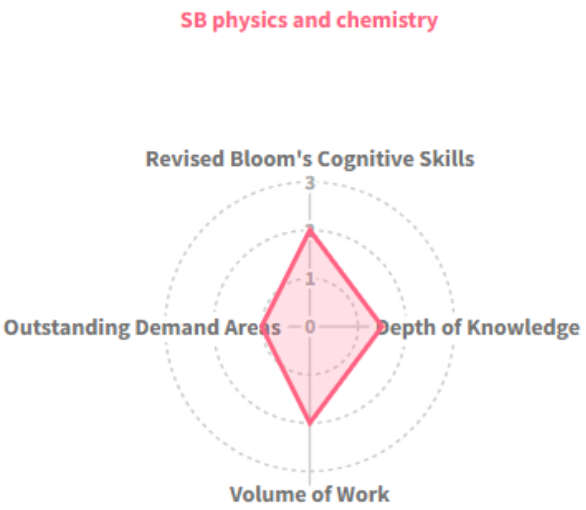
Overall, the physics coverage of the SB physics subjects is strongly aligned with that of DP physics, with SB physics and chemistry and SB physics combined covering the majority of both SL and AHL content.

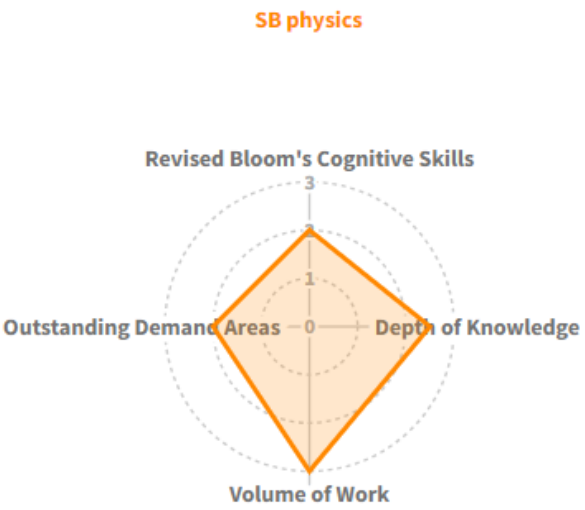
5.2.3 Demand – Physics

The DP and SB curricula were analysed using the same demand tool in order to create a demand profile for DP physics SL, DP physics HL, SB physics and chemistry and SB physics. These demand profiles are presented below in the form of radar diagrams, with the last diagram showing all profiles superimposed in one place, enabling immediate visual comparison.

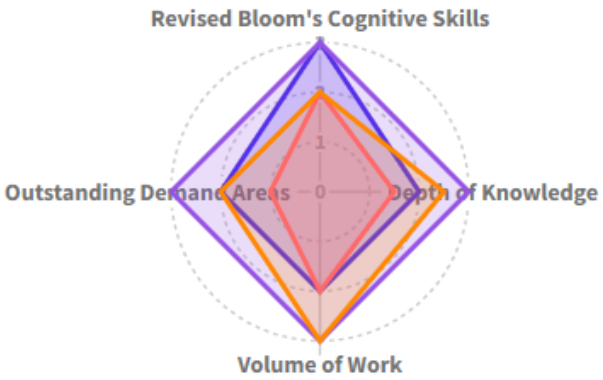
Figure 16: Visual representations of subject demand







DP physics, SB physics and chemistry, and SB physics



The panel of experts carried out a detailed analysis of each course and reached a consensus on the scores shown in the profiles above. The following points were particularly important within the panel discussion:

- Regarding the scores for **Bloom's Cognitive Skills**:
  - DP physics has the same learning outcomes for both SL and HL, meaning that these scores are the same. These were judged to merit a score of 3 due to the high levels of critical thinking, critical awareness and elements of synthesis and creation present in the majority of Aims and Assessment Objective 3.
  - For the SB physics and chemistry, a score of 2 was given due to the presence of a wide range of skills in SB. However, the score of 3 was not warranted because there was not a predominant focus on evaluation and creation/synthesis within the SB. Although elements of these skills are present, they are not emphasised enough to merit a score of 3.
  - The SB physics course also received a score of 2 as although there is also a wide range of skills present, the predominant focus was not on creation/synthesis and evaluation.

- Regarding the score for **Depth of Knowledge**:
  - DP physics SL was deemed to merit a score of 2 for depth of knowledge due to the mathematical pre-requisite skills and competences required to access the course, as well as the moderate to high level of cognitive complexity of the knowledge that students are expected to acquire. As to the HL course, the greater depth and additional opportunities provided for extended thinking in the additional higher level option topics pushed the score to a 3.
  - The SB physics and chemistry was awarded a score of 1.5. Although the content covered does not itself necessarily warrant a score above 1, when considered in light of the skills students are required to develop, then there is more potential for depth of knowledge. This was judged not to be enough to give a confident judgement of 2, but to deserve a score higher than a level 1, therefore a score of 1.5 was agreed upon.
  - The SB physics subject was given a score of 2.5. This is due to the greater depth of content covered, in addition to the skills-based approach taken by the subject. The subject was not given a score of 3 as there was not enough evidence of extended thinking that required complex reasoning over an extended period of time.

- Regarding the scores for **Volume of Work**:
  - The DP physics SL was judged to comprise a moderate-heavy workload (a score of 2) as students are exposed to multiple physics topics, with each topic being allocated a standard to short amount of time. The volume demands of the HL course, on the other hand, were found to be sufficient to meet a score of 3 as, even though the number of topics per hour is smaller, these topics are covered in great depth and with a focus on application.
  - The SB physics and chemistry subject was given a score of 2 for the volume of work category. This is because the coverage of physics and chemistry together means that a short amount of time is devoted to each content area. This

transdisciplinary approach results in a short time allocation per theme, therefore a score of 2 was deemed appropriate.
    - The SB physics was given a score of 3 for the volume of work category. There is a large amount of content covered in just 87.5 hours, and therefore a very short time allocation per theme.

- Regarding the scores for **Outstanding Areas of Subject Demand**:
    - For the DP physics SL course (awarded a score of 2), the IA scientific investigation research project that students need to undertake, the linking questions outlined in the syllabus and the collaborative sciences project were considered to be areas of stretch. In addition to the latter, the HL course features additional higher-level topics which were deemed to include additional areas of stretch, meriting a score of 3.
    - For the SB physics and chemistry, a score of 1 was given. There were no specific content areas that showed outstanding areas of subject demand; however, the project work that is described in the specific competences (working collaboratively, applying entrepreneurship, predicting consequences of scientific advances and how these advances might influence the community and environment) may provide a significant area of stretch to students.
    - The SB physics course was given a score of 2 for outstanding areas of subject demand. The reasons for this were the transdisciplinary approach and the areas of stretch within the content, including relativity, fields and circular motion, and the mathematical demand in some subtopics.

5.3 Chemistry

Below is the list of subjects used in the chemistry comparative analysis.

DP chemistry[105]
Chemistry is a subject option offered within the DP sciences subject group, at both SL and HL. This subject has content that is common to both SL and HL, as well as AHL content that is featured only in the HL. Thus, the HL has greater breadth and depth than SL. This subject is designed to prepare students for university courses such as medicine, biological science and environmental science. HL is suitable for those intending to pursue further study in an area requiring a strong background in chemistry.

SB physics and chemistry[106]
Physics and chemistry is a one-year modality subject that students may opt to study on the first year of the Science and Technology modality of the SB. The subject combines physics and chemistry content, building on prior scientific knowledge and skills acquired during compulsory secondary education. It intends to provide a strong foundation for further physics and/or chemistry study in the following year.

SB chemistry[107]
Chemistry is a one-year modality subject that students may opt to study on the second year of the Science and Technology modality of the SB. It builds on the SB physics and chemistry subject offered in the SB's first year, aiming to provide the appropriate foundation of knowledge and skills required for further scientific study at higher education level. Students must have completed the first-year SB physics and chemistry in order to take SB chemistry in their second year.

5.3.1 Learning Outcomes – Chemistry

This section compares and contrasts the learning outcomes of curricula falling within the category of chemistry.

For the DP, the learning outcome themes for chemistry were extracted from the aims and assessment objectives of the Sciences subject group, hence the themes are the same for biology chemistry and physics.

The learning outcomes for the SB were drawn from the 'Specific Competences' (SCs) of both the SB physics and chemistry and the SB chemistry subjects. While there are some minor differences between the SCs of both SB subjects, these did not affect the level of alignment with the DP learning outcome themes; as such, most of the analysis applies to both subjects, flagging the slight differences observed when appropriate.

[105] International Baccalaureate. (2023). *Chemistry guide*.
[106] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d.), Física y química. Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica-quimica/desarrollo.html
[107] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d.), Química Available at: https://educagob.educacionyfp.gob.es/ca/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/quimica/desarrollo.html

The following table demonstrates the learning outcome themes that were extracted from the DP learning outcomes and indicates if and where they were judged to have presence within the learning outcomes of the SB chemistry curricula.

Table 27: Presence of the DP sciences subject group learning outcome themes in the SB chemistry curricula

Themes extracted from the learning outcomes of the DP Sciences subject group	Presence in the SB	
1. Conceptual understanding and making connections		Present in both sets of SCs
2. Use and application of knowledge, methods, tools, and techniques that characterise science		Present in both sets of SCs
3. Creativity and critical thinking (problem-solving, analysis, evaluation, synthesis)		Present in both sets of SCs
4. Skills for scientific inquiry		Somewhat present in both sets of SCs
5. Development of technological skills		Absent from SB chemistry SCs, but present within the SB physics and chemistry competences.
6. Effective collaboration and communication		Present in both sets of SCs
7. Awareness of global and local problems and the environmental, ethical, cultural, and social impact of science		Present in both sets of SCs.

Key:

	This theme is well-evidenced in the competences of the SB		*This theme is partially evidenced in the competences of the SB*		*This theme is not evident in the competences of the SB.*

Presence of the DP's Learning Outcome Themes

As can be seen in the table above, all learning outcome themes extracted from the DP are present to some extent in the SB chemistry curricula. The below write-ups provide a summary of the extent to which each DP theme is present in the SB.

1. Conceptual understanding and making connections

Many of the SB chemistry SCs demonstrate the importance of conceptual understanding and making connections (within the subject, and with other science subjects). For example, specific competence 2 states that students will be "studying the properties of material systems"[108]. Specific competence 3 describes how students will use chemical nomenclature, units and equations "as a basis for adequate communication between different scientific communities"[109]. Specific competence 6 shows this theme most prominently when it describes students being required to highlight the relationship that chemistry has "with other sciences

[108] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Chemistry - 'Specific Competences'*. Available at: https://educagob.educacionyfp.gob.es/ca/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/quimica/competencias-especificas.html
[accessed July 2023]
[109] ibid

and fields of knowledge", promoting a "holistic approach" to scientific knowledge[110]. This provides evidence of the conceptual understanding and making connections theme within the SB.

This theme is further evidenced through the more detailed description of specific competence 2, where the SB acknowledges that students should not only learn chemical laws, theories and experimental observations of chemistry, but that they must also interact with a "coherent model of nature…through contact with everyday situations".[111]

2. Use and application of knowledge, methods, tools, and techniques that characterise science

There are many SCs within the SB chemistry curriculum that link closely with this theme. Specific competence 1 describes how students must understand, describe and apply the "fundamentals of the most important chemical processes".[112] Specific competence 2 enhances this with students adopting the "accepted models and laws of chemistry", [113] and specific competence 3 further shows the presence of this theme when it references the "codes of chemical language" and their use as a "fundamental tool in the research of this science".[114]

3. Creativity and critical thinking (problem-solving, analysis, evaluation, synthesis)

The theme of problem-solving is well-evidenced through the SB chemistry SCs.[115] Three of these discuss the requirement of students to "help overcome the negative connotations that are often attributed to the word "chemical'", which would require both problem solving and creative thinking. Specific competence 5 describes the need for "logical-mathematical reasoning in the resolution of chemistry problems" and specific competence 6 further reflects this theme through asking students to "recognise and analyse chemistry".

The specific competences of the SB physics and chemistry curriculum also include problem-solving aspects; such as SC 1: "solve problems and situations related to physics and chemistry, applying the appropriate scientific laws and theories".[116]

The SB features a lighter focus on the evaluation and synthesis aspect of this theme, but there are many references to analysis, problem-solving and critical thinking, showing that this theme is present within SB chemistry.

4. Skills for scientific enquiry

Within the chemistry SCs, only specific competence 5 relates to this DP theme: "apply work techniques typical of experimental sciences…in the resolution of chemistry problems".[117] It can be inferred that 'work techniques' of experimental sciences would involve carrying out practical procedures and investigations; however, there is no explicit reference to this in the SCs.

[110] ibid
[111] ibid
[112] ibid
[113] ibid
[114] ibid
[115] ibid
[116] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Physics and chemistry - 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica-quimica/competencias-especificas.html. [accessed July 2023]
[117] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Chemistry - 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/ca/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/quimica/competencias-especificas.html

The more detailed description of specific competence 6 references that students will "develop their learning through experimental study and observation",[118] but there is no further description of the exact nature of the 'experimental study'. Thus, while the DP strongly emphasises the importance of practical work and experimental techniques, this theme is less apparent in the SB.

5. Development of technological skills

None of the SCs within the SB chemistry curriculum cover this DP theme of technology skills. The only reference to it is within the first-year SB physics and chemistry course, where specific competence 4 states that students will use digital platforms and varied resources to create materials in various formats. This mention of 'digital platforms' is the only reference to technology found, meaning the DP theme is only somewhat present in the SB.

6. Effective collaboration and communication

Only specific competence 5 out of all SB chemistry's SCs references communication skills, stating that students should "value the importance of cooperation".[119] However, within the SB physics and chemistry SCs, the theme of communication and collaboration is more prominent. Specific competence 3 states that students should manage "different registers of communication",[120] and "individual and teamwork"[121] is mentioned in specific competence 4. Specific competence 5 really highlights the presence of this theme by detailing that students are to "work collaboratively in diverse teams, applying coordination, communication, and balanced responsibility skills".[122] There is also an element of communication within specific 6 of the SB physics and chemistry, which mentions that students "become active agents of the dissemination of scientific thought".[123]

The more detailed description of specific competence 5 further emphasises the importance of collaboration. Students will recognise the importance of working as a team, and how collaboration between individuals is fundamental to achieving scientific progress.

7. Awareness of global and local problems and the environmental, ethical, cultural, and social impact of science

This DP theme regarding global and local problems is evident in many SCs of the SB chemistry. Specific competence 2 discusses how students are to "infer general solutions to everyday problems related to…chemistry and its repercussions on the environment". Specific competence 4 encourages students to recognise why responsible use of chemical products is important, and specific competence 5 states that students should work towards the "resolution of chemistry problems…and to value the role of chemistry in a society based on ethical and sustainable values".

The SCs in the SB physics and chemistry curriculum further enhance the presence of this theme in the SB. Specific competence 5 describes that students are to "predict the consequences of scientific advances and their influence on…health and sustainable

[118] ibid
[119] Government of Spain, Ministry of Education (2023). *Chemistry - 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/quimica/desarrollo.html [accessed July 2023]
[120] Government of Spain, Ministry of Education (2023). *Physics and chemistry - 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/fisica-quimica/competencias-especificas.html. [accessed July 2023]
[121] ibid
[122] ibid
[123] ibid

environmental development". Specific competence 6 explains how students will participate in the "construction of scientific knowledge, in its daily and close environment" and goes on to say that students should preserve "the environment and public health [and] economic development".
Although there is less evidence of the 'culture' aspect of this DP theme, the strong presence of the environmental, ethical and social aspects show similarity to the SB.

Other Themes in the SB
No additional learning outcome themes were found in the SB chemistry and SB physics and chemistry curriculum that were not present in the DP. However, in SB physics and chemistry there is a heavy emphasis on utilising cognitive skills through the interconnection of physics and chemistry, with specific competence 1 discussing the importance of problem-solving and understanding physicochemical phenomena, analysing interactions in the light of physicochemical laws and theories. This merging of physics and chemistry is unsurprising given the design of the subject, but the mention of 'physicochemical phenomena' and its strong presence in the SCs constitutes a difference with the DP. Although the theme of linking concepts across multiple subjects is evident in the latter, the DP's is defined more broadly, without the same specific focus being given to physics and chemistry in particular.

The SB also provides a more detailed description than the DP of the communication and collaboration skills that it targets. While the SB encompasses the DP's theme of 'collaboration and communication', the SB specifically describes the importance of working collaboratively and in diverse teams as a way of developing other skills, such as reading, writing, speaking, technology and mathematics. Whilst all these skills are present within the DP, they are not so clearly linked to the communication and collaboration theme as they are in the SB.

In the second year SB chemistry subject, the SB places a strong emphasis on understanding the way chemistry and chemicals are perceived in the media. Specific competence 4 highlights the importance of understanding how chemical products are used responsibly, but also describe the importance of overcoming and negative connotations of the word 'chemical'. The way that the SB requires students to not only understand that the media can portray a negative image of chemicals, but to then overcome these negative influences is something that is not as heavily evidenced in the DP.

Summary
Whilst all learning outcome themes from the DP have been found in the SB, the detail in which they are described varies. Conceptual understanding and making connections, techniques that characterise science and creativity and critical thinking are all themes that are strongly present throughout the SCs of the SB. Nonetheless, investigative skills and the development of technology skills are less apparent themes in the SB. These skills are briefly mentioned or can be inferred from the SC statements or descriptions; however, they are not as clearly defined as they are within the DP. The final two themes (communication and collaboration, and the awareness of global and local problems) differ in terms of which aspects of them are particularly emphasised. Collaboration is a very prevalent theme in the SB, however, the communication aspect of this skill is mentioned in a much more subtle way than in the DP. There are references to the importance of communication, but not the same level of explicit description of students developing specific skills associated with communication. The awareness of global problems is strong in the SB in the context of the environment and

sustainability, however, in the SB there is less reference to the ethical and cultural elements of this theme.

5.3.2 Content – Chemistry

This section compares and contrasts the content of the DP and SB curricula falling within the category of chemistry. In order to support visual comparison at-a-glance, the DP and SB chemistry curricula are presented below in diagrams which show the key topics and subtopics included in each.

Figure 17: DP chemistry content visualiser[124]

Structure	**Structure 1. Models of the particulate nature of matter**	Structure 1.1 – Introduction to the particulate nature of matter	Structure 1.2 – The nuclear atom (SL + AHL)	Structure 1.3 – Electron Configurations (SL + AHL)	Structure 1.4 – Counting particles by mass: The mole	Structure 1.5 – Ideal gases
	Structure 2. Models of bonding and structure	Structure 2.1 – The ionic model	Structure 2.2 – The covalent model (SL + AHL)	Structure 2.3 – The metallic model (SL + AHL)	Structure 2.4 – From models to materials (SL + AHL)	
	Structure 3. Classification of matter	Structure 3.1 – The periodic table: Classification of elements (SL + AHL)	Structure 3.2 – Functional groups: Classification of organic Compounds (SL + AHL)			
Reactivity	**Reactivity 1. What drives chemical reactions?**	Reactivity 1.1 – Measuring enthalpy changes	Reactivity 1.2 – Energy cycles in reactions (SL + AHL)	Reactivity 1.3 – Energy from fuels	Reactivity 1.4 – Entropy and spontaneity (HL only)	
	Reactivity 2. How much, how fast and how far?	Reactivity 2.1 – How much? The amount of chemical change	Reactivity 2.2 – How fast? The rate of chemical change (SL + AHL)	Reactivity 2.3 – How far? The extent of chemical change (SL + AHL)		
	Reactivity 3. What are the mechanisms of chemical change?	Reactivity 3.1 – Proton transfer reactions (SL + AHL)	Reactivity 3.2 – Electron transfer reactions (SL + AHL)	Reactivity 3.3 – Electron sharing reactions	Reactivity 3.4 – Electron-pair sharing reactions (SL + AHL)	
Experimental programme	Practical work	Collaborative sciences project	Scientific investigation			

[124] '(HL only)' and '(SL + AHL)' are used to flag, respectively, topics only taught at HL and topics taught at both SL and HL, but which also feature additional higher level content.

Figure 18: SB physics and chemistry, and SB chemistry content visualiser

SB physics and chemistry[125]	**A. Chemical Bonding and Structure**	The Periodic Table	Electronic structure of atoms	Atoms, ions and bonds	Nomenclature of simple substances	
	B. Chemical Reactions	Laws of Chemistry	Classification of chemical reactions	Quantities of matter calculations	Stoichiometry of chemical reactions	
	C. Organic Chemistry	Physical and Chemical properties	IUPAC rules for formulating and naming compounds			
	D. Kinematics	*Kinematic variables*	*Rectilinear and circular movement*	*Trajectory*		
	E. Static and Dynamic	*Static and dynamic particle behaviour*	*Vector mechanics*	*Momentum and Mechanical Impulse*		
	F. Energy	*Work and Power*	*Energies of a simple system*	*Thermodynamic variables of a system*		
SB chemistry	**A. Chemical Bonding and Structure**	1. Atomic spectra	2. Quantum principles of atomic structure	3. Periodic Table and properties of atoms		
	B. Chemical Reactions	1. Chemical Thermodynamics	2. Chemical Kinetics	3. Chemical Equilibrium	4. Acid-Base reactions	5. Redox Reactions
	C. Organic Chemistry	1. Isomerism	2. Organic Reactivity	3. Polymers		

[125] Physics topics have been greyed out for the combined SB physics and chemistry subject as they were not considered in the chemistry content comparisons.

Structure

The DP and SB programmes are both taught over two years of study, with both offering the opportunity for students to study chemistry at different levels – i.e. the SB offers a combined SB physics and chemistry subject in the first year, with the option to take the specialist SB chemistry subject in the second year; the DP offers students the opportunity to study DP chemistry at either SL or HL.

One notable difference between the structure of the chemistry subject area in the two programmes is the combined nature of the SB's first-year physics and chemistry subject. In the DP, chemistry and physics content is taught in separate subjects, i.e. DP chemistry and DP physics, respectively.

The DP chemistry subject is designed through a concept-based approach and organised into two over-arching, discipline-specific topics – Structure and Reactivity. Each of these topics covers various key areas within them and is further divided into subtopics. Overall, DP chemistry SL consists of 22 subtopics, while DP chemistry HL extends learning in 13 of the 22 subtopics and contains one additional HL-only subtopic. SB physics and chemistry is structured into six blocks of learning: three for physics and three for chemistry. The chemistry blocks of learning are: A. Chemical Bonding and Structure of Matter, B. Chemical Reactions, and C. Organic Chemistry. SB chemistry, which is the optional second-year modality subject, consists of the same three blocks of learning, which build on the chemistry understanding from the SB physics and chemistry subject taught in the first year.

Content alignment

The table below represents a simplified summary of the SB's content alignment, at topic-level, with DP chemistry (SL and HL).

Table 28: Summary of content alignment between the DP chemistry topics and SB chemistry

DP chemistry topics	Presence of SL content in SB physics and chemistry	Presence of AHL content in SB physics and chemistry	Presence of SL content in SB chemistry	Presence of AHL content in SB chemistry
Structure 1. Models of the particulate nature of matter				
Structure 1.1 – Introduction to the particulate nature of matter		N/A		N/A
Structure 1.2 – The nuclear atom				
Structure 1.3 – Electron configurations				
Structure 1.4 – Counting particles by mass: The mole		N/A		N/A
Structure 1.5 – Ideal gases		N/A		N/A
Structure 2. Models of bonding and structure				
Structure 2.1 – The ionic model		N/A		N/A
Structure 2.2 – The covalent model				
Structure 2.3 – The metallic model				
Structure 2.4 – From models to materials				
Structure 3. Classification of matter				
Structure 3.1 – The periodic table: Classification of elements				

Structure 3.2 – Functional groups: Classification of organic compounds				
Reactivity 1. What drives chemical reactions?				
Reactivity 1.1 – Measuring enthalpy changes		N/A		N/A
Reactivity 1.2 – Energy cycles in reactions				
Reactivity 1.3 – Energy from fuels		N/A		N/A
Reactivity 1.4 – Entropy and spontaneity (AHL only)	N/A		N/A	
Reactivity 2. How much, how fast and how far?				
Reactivity 2.1 – How much? The amount of chemical change		N/A		N/A
Reactivity 2.2 – How fast? The rate of chemical change				
Reactivity 2.3 – How far? The extent of chemical change				
Reactivity 3. What are the mechanisms of chemical change?				
Reactivity 3.1 – Proton transfer reactions				
Reactivity 3.2 – Electron transfer reactions				
Reactivity 3.3 – Electron sharing reactions		N/A		N/A
Reactivity 3.4 – Electron-pair sharing reactions				
Experimental programme				

Key:

	Strong presence of this topic in the SB.		*Partial presence of this topic in the SB.*		*Little or no presence of this topic in the SB.*	N/A	*This topic does not exist at the respective level.*

NB: Where applicable, content alignments found in pre-requisite subjects are carried forwards and combined with new alignments to represent the cumulative content covered.

As mentioned above, DP chemistry SL consists of 22 subtopics. SB physics and chemistry subject covers eleven of these subtopics in similar depth and detail, including the nuclear atom and the ionic, covalent and metallic models. There are two DP chemistry SL topics that are not covered in the same level of detail: 'Structure 3. Classification of Matter' and 'Reactivity 2. How Much, How Fast and How Far?'. For Structure 3, SB physics and chemistry covers '3.2 Functional Groups: classification of organic compounds' but does not include coverage of '3.1 The Periodic Table: classification of elements', which is covered by the DP. For 'Reactivity 2 How Much, How Fast and How Far?', SB physics and chemistry covers '2.1 – How much? The amount of chemical change' but does not cover '2.2 How fast? The rate of chemical change' and '2.3 How far? The extent of chemical change'. SB physics and chemistry also does not cover two DP chemistry SL topics: 'Reactivity 1 What Drives Chemical Reactions' and 'Reactivity 3. What are the Mechanisms of Chemical Change?'.

As to comparison with DP chemistry HL, SB physics and chemistry covers only one of the 13 AHL subtopics in similar depth and detail – i.e. 'Structure 1.3 electron configurations'. It also partially covers 'Structure 2.2 the covalent model'.

In turn, SB chemistry covers 20 of the 22 DP chemistry SL subtopics in similar depth and detail, including proton transfer reactions and measuring enthalpy changes. There is partial presence of the remaining two subtopics, which are: 'Reactivity 1.3 – Energy from fuels' and 'Reactivity 3.3 – Electron sharing reactions'. For Reactivity 1.3, SB chemistry covers combustion reactions but does not cover the advantages and disadvantages of fossil fuels and biofuels, which is covered in DP chemistry. In Reactivity 3.3, electron sharing reactions may be covered in SB chemistry, however, free radical substitution reactions are not specifically referenced.

Comparing to DP chemistry HL, SB chemistry covers 9 of 13 AHL subtopics and the HL-only topic of 'Reactivity 1.4 – Entropy and spontaneity'. There are also three DP chemistry HL subtopics that are partially presence in SB chemistry: 'Reactivity 2.2 – How fast? The rate of chemical change', 'Reactivity 3.2 – Electron transfer reactions', 'Reactivity 3.4 – Electron-pair sharing reactions'. SB chemistry does not cover the AHL 'Structure 3.2 – Functional groups: Classification of organic compounds', but it does cover polymers in greater depth than the DP, by including their applications, properties and associated environmental risks.

Table 29: SB chemistry content which is not covered in the DP

Significant SB chemistry content which is not included in the DP*
○ Polymers applications, properties and associated environmental risks

*This is only content pertaining to chemistry, the SB physics and chemistry subject also contains physics content – see section 5.2.2. Furthermore, 'significant content' mostly does not include topics which are typically studied *prior* to upper secondary.

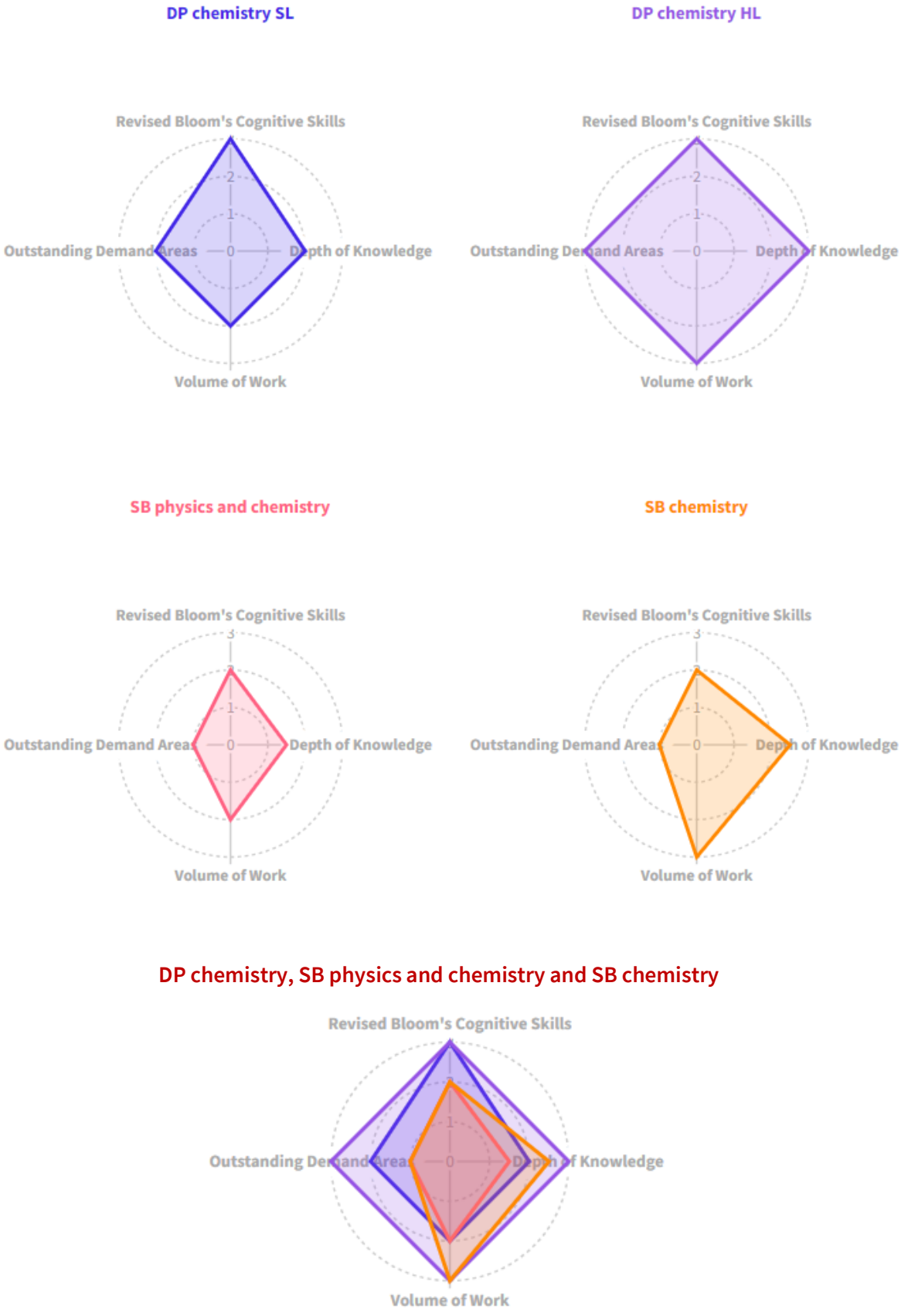
Overall, SB physics and chemistry has less subject depth and breadth than DP chemistry SL, as two topics are entirely absent (Reactivity 1. What drives chemical reactions? and Reactivity 3. What are the mechanisms of chemical change) and a further two topics are only partially present (Structure 3. Classification of matter and Reactivity 2. How much, how fast, how far?). Overall, SB physics and chemistry has limited alignment with the DP chemistry HL, with only two subtopics being partially present.

In turn, SB chemistry covers most of the content in DP chemistry SL and more; it aligns more closely with DP chemistry HL in both breadth and depth, with most HL subtopics being covered. Although the DP chemistry AHL subtopic 'Structure 3.2 – Functional groups: Classification of organic compounds' is not covered in SB chemistry, SB chemistry includes slightly more depth in other areas of organic chemistry, such as polymers.

5.3.3 Demand – Chemistry

The DP and SB curricula were analysed using the same demand tool in order to create a demand profile for DP chemistry SL, DP chemistry HL, SB physics and chemistry and SB chemistry. These demand profiles are presented below in the form of radar diagrams, with the last diagram showing all profiles superimposed in one place, enabling immediate visual comparison.

Figure 19: Visual representations of subject demand



The panel of experts carried out a detailed analysis of each course and reached a consensus on the scores shown in the profiles above. The following points were particularly important within the panel discussion:

- Regarding the scores for **Bloom's Cognitive Skills**:
  - DP chemistry has the same learning outcomes for both SL and HL, meaning that these scores are the same. These were judged to merit a score of 3 due to the high levels of critical thinking, critical awareness and elements of synthesis and creation present in the majority of Aims and Assessment Objectives 3.
  - For SB physics and chemistry, a score of 2 was given due to the presence of a wide range of skills in SB. However, a score of 3 was not warranted because there was not a predominant focus on evaluation and creation/synthesis within the SB. Although elements of these skills are present, they are not emphasised enough to merit a score of 3.
  - A score of 2 was also awarded to the SB chemistry course. Although the subject also covers a range of skills, and there is some evidence of synthesis, analysis and evaluation, this was not found to be the predominant focus of the SCs, and therefore a score of 3 was not judged to be appropriate.

- Regarding the score for **Depth of Knowledge**:
  - DP chemistry SL was deemed to merit a score of 2 for depth of knowledge due to the mathematical pre-requisite skills and competences required to access the course, as well as the moderate to high level of cognitive complexity of the knowledge that students are expected to acquire. As to the HL course, the greater depth and additional opportunities provided for extended thinking in the additional higher level option topics pushed the score to a 3.
  - SB physics and chemistry was awarded a score of 1.5. Although the content covered does not itself necessarily warrant a score above 1, when considered in light of the skills students are required to develop, there is more potential for depth of knowledge. This did not conduce a confident judgement of 2, but was deserving of a score higher than 1, therefore a score of 1.5 was agreed upon.
  - SB chemistry was given a score of 2.5. This is due to the greater depth of content covered, in addition to the skills-based approach taken by the subject. The subject was not given a score of 3 as there was not enough evidence of extended thinking that required complex reasoning over an extended period of time.

- Regarding the scores for **Volume of Work**:
  - DP chemistry SL was judged to comprise a moderate-heavy workload (a score of 2) as students are exposed to various chemistry topics, with each topic being allocated a standard to short amount of time. The volume demands of the HL course, on the other hand, were found to be sufficient to meet a score of 3 – even though the number of topics per hour is smaller, these topics are covered in great depth and with a focus on application.
  - SB physics and chemistry subject was given a score of 2 for the volume of work category. This is because the coverage of physics and chemistry together means that a short amount of time is devoted to each content area. This transdisciplinary

approach results in a short time allocation per theme, therefore a score of 2 was deemed appropriate.
    - SB chemistry was given a score of 3 for the volume of work category. There is a large amount of content covered in just 87.5 hours, and therefore a very short time allocation per theme.

- Regarding the scores for **Outstanding Areas of Subject Demand**:
    - For the DP chemistry SL course (awarded a score of 2), the IA scientific investigation research project that students need to undertake, the linking questions outlined in the syllabus and the collaborative sciences project were considered to be areas of stretch. In addition to the latter, the HL course features additional higher-level topics which were deemed to include additional areas of stretch, meriting a score of 3.
    - For SB physics and chemistry, a score of 1 was given. There were no specific content areas that showed outstanding areas of subject demand; however, the project work that is described in the specific competences (working collaboratively, applying entrepreneurship, predicting consequences of scientific advances and how these advances might influence the community and environment) may provide a significant area of stretch to students.
    - The SB chemistry course was judged to be a 1 for outstanding areas of subject demand. The transdisciplinary approach to learning and the real-life applications within the course provide stretch areas for students, but in a limited capacity, therefore there are not enough opportunities for stretch areas to warrant a score of 2.

5.4 Biology

Below is the list of subjects used in the biology comparative analysis.

DP biology[126]
Biology is a subject option within the DP sciences subject group, offered at both SL and HL. This subject has content that is common to both SL and HL, as well as AHL content for HL. Thus, HL has greater breadth and depth than SL. This subject is designed to prepare students for university courses such as biology, medicine, dentistry, and biomedical engineering. HL is suitable for those intending to pursue further study in an area requiring a strong background in biology.

SB biology, geology and environmental sciences (BGE)[127]
Biology, geology and environmental sciences is a one-year modality subject that students may opt to study on the first year of the Science and Technology modality of the SB. The subject combines biology, geology and environmental sciences content, building on prior scientific knowledge and skills acquired during compulsory secondary education. It intends to provide a strong foundation for further biology and/or geology study in the following year.

SB biology[128]
Biology is a one-year modality subject that students may opt to study on the second year of the Science and Technology modality of the SB. It builds on the SB biology, geology and environmental sciences subject offered in the SB's first year, aiming to provide the appropriate foundation of knowledge and skills required for further scientific study at higher education level. Students must have completed the first-year SB biology, geology and environmental sciences subject in order to take SB biology in their second year.

The second year of the SB allows students to choose what subject to specialise in. If they continue their studies in biology, this year provides a more complete biology syllabus which includes various challenging topics and practical experiments that are more specific to the subject area of biology.

5.4.1 Learning Outcomes – Biology

This section compares and contrasts the learning outcomes of curricula falling within the category of biology.

The learning outcome themes for biology were extracted from the aims and assessment objectives of the DP Sciences subject group, hence the themes are the same for biology chemistry and physics.

[126] International Baccalaureate. (2023). *Biology guide*.
[127] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d.), Biología, Geología y Ciencias Ambientales. Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/biologia-geologia-cienciasamb/desarrollo.html
[128] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d.), Biología. Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/biologia/desarrollo.html

The learning outcomes for the SB were drawn from the 'Specific Competences' (SCs) of both the SB biology, geology and environmental sciences and the SB biology subjects. While there are some minor differences between the SCs of both SB subjects, these did not affect the level of alignment with the DP learning outcome themes; as such, most of the analysis applies to both subjects, flagging the slight differences observed when appropriate.

The following table demonstrates the learning outcome themes that were extracted from the DP learning outcomes and indicates if and where they were judged to have presence within the learning outcomes of the SB biology curricula.

Table 30: Presence of the DP sciences subject group learning outcome themes in the SB biology curricula

Themes extracted from the learning outcomes of the DP sciences subject group	Presence in the SB	
1. Conceptual understanding and making connections		Present in both Biology and Biology, Geology and Environmental Sciences.
2. Use and application of knowledge, methods, tools, and techniques that characterise science		Present in both Biology and Biology, Geology and Environmental Sciences.
3. Creativity and critical thinking (problem-solving, analysis, evaluation, synthesis)		Present in both Biology and Biology, Geology and Environmental Sciences, but more apparent in the SCs of Biology.
4. Skills for scientific inquiry		Present in both, but more apparent in the SCs of Biology, Geology and Environmental Sciences.
5. Development of technological skills		Not explicitly present but may perhaps be inferred from some of the skills – see full analysis below.
6. Effective collaboration and communication		Somewhat present, slightly more apparent in the SCs for Biology, Geology and Environmental Sciences.
7. Awareness of global and local problems and the environmental, ethical, cultural, and social impact of science		Partially present, slightly more apparent in the SCs for Biology, Geology and Environmental Sciences.

Key:

	This theme is well-evidenced in the competences of the SB		*This theme is partially evidenced in the competences of the SB*		*This theme is not evident in the competences of the SB.*

Presence of the DP's Learning Outcome Themes

As can be seen in the table above, almost all learning outcome themes extracted from the DP are present to some extent in the SB biology curricula, with the exception of the development of technology skills. The below write-ups provide a summary of the extent to which each DP theme is present in the SB.

1. Conceptual understanding and making connections

Many of the SB biology SCs demonstrate the importance of conceptual understanding and making connections (within the subject, and with other science subjects). For example, specific competence 1 states that students will interpret "information and data from scientific

works".[129] These "scientific works" are not necessarily specific to biology, so it can be inferred that these may incorporate aspects of physics, chemistry, general science, or other subjects such as geology. SC 3 describes how students will "analyse research, or dissemination works related to the biological sciences";[130] in order to be capable of this, students will have to make connections within, and across, science subjects. SC 4 includes the description of how students will "explain phenomena related to biological sciences";[131] to succeed in this competence, it is essential that students make connections and have strong conceptual understanding. The similarity between the DP and SB regarding this theme is further enhanced by specific competence 6, where students will "analyse the function of the main biomolecules, bioelements and their biochemical structures and interactions".[132]

2. Use and application of knowledge, methods, tools, and techniques that characterise science

The SB biology specific competence 3 states that students will check that "they have followed the steps of scientific methods",[133] while SC 4 also reinforces this theme by describing how students would "reformulate the procedure if necessary".[134] SC 4 summarises techniques that characterise science when it states "pose and solve problems…critically analysing solutions…reformulating the procedure…to explain phenomena".[135] The SCs of the SB biology, geology and environmental sciences curriculum also reflect this theme, with specific competence 3 including "following the steps of scientific methodologies",[136] therefore showing strong coverage of the importance of techniques that characterise science.

3. Creativity and critical thinking (problem-solving, analysis, evaluation, synthesis)

Some of the SCs within the SB also show the importance of critical thinking and the focus on skills such as problem-solving, analysis, evaluation and synthesis. Throughout nearly all the SCs, students are required to "analyse concepts, processes…critically evaluate…critically analyse" various components.[137] There are also references to students having to compare and contrast sources of information in order to evaluate it, and specific competence 4 describes students being able to "pose and solve problems".[138] In addition to this, specific competence 3 requires students to "analyse research, critically checking their veracity"[139], which further highlights the presence of this theme in the SB biology curriculum.

4. Skills for scientific inquiry

Within the SCs for SB biology, only specific competence 4 relates to this DP theme: "…using appropriate strategies…and reformulating the procedure if necessary".[140] This is referring to students' investigation skills as it is written in the context of explaining scientific phenomena;

[129] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Biology - 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/biologia/competencias-especificas.html [accessed July 2023]
[130] ibid
[131] ibid
[132] ibid
[133] ibid
[134] ibid
[135] ibid
[136] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Biology, Geology and Environmental Sciences - 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/biologia-geologia-cienciasamb/competencias-especificas.html [accessed July 2023]
[137] Government of Spain, Ministry of Education, Vocational Training and Sports (2023). *Biology - 'Specific Competences'.* Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/biologia/competencias-especificas.html [accessed July 2023]
[138] ibid
[139] ibid
[140] ibid

however, this theme is not as prevalent in the SB as it is in the DP. Throughout the SB biology SCs, there are references to scientific procedures and scientific investigations, but these are made within the context of students' analysis and evaluative skills, rather than planning and carrying out the investigations themselves. This theme has slightly more presence within the SCs of the SB biology, geology and environmental sciences curriculum. Specific competence 3 discusses this theme when describing how students "design, plan and develop research projects following the steps of scientific methodologies".[141] Due to only two clear references being made to this theme in the SB, it can be ascertained that the DP places more emphasis on this theme than the SB.

5. Development of technological skills

The development of technology skills is not as explicitly referenced in the SB as it is in the DP. Some aspects of technology could be inferred from the wording of the SB's SCs, but this is open to interpretation; as such, it cannot be stated with confidence that the SB contains this theme. There are some statements from the SB biology SCs that have the potential to require technology; for example, specific competence 1 states that students will be interpreting and transmitting information and data from scientific works "using different formats",[142] and specific competence 2 describes how students will "locate and use reliable sources".[143] Technology may be used for each of these processes, but as none of the SC statements references technology specifically, there is no clear evidence that this DP theme is present in the SB.

The evaluation criteria for specific competence 1 do have some reference to technology skills when it is discussing transmission of information or opinions: "using the appropriate format (models, graphs, tables, videos, reports, diagrams…or digital content, among others)".[144] Although this is not stated as part of the competence itself, it is described as what students would need to do in order to demonstrate their successful grasp of that competence.

6. Effective collaboration and communication

Specific competence 1 of SB biology is the only one that references communication skills, and it is not as clearly outlined as it is in the DP – it simply describes how students will interpret information from scientific works "and argue about them".[145] This is not a direct reference to communication skills; however, in order to argue about something, a student's communication skills must be developed to a certain degree. There is no further reference to working collaboratively, presenting an idea or project, or engaging in a debate; therefore communication and collaboration skills are much more prevalent in the DP than they are in the SB.

The SB's 'evaluation criteria' dissect this specific competence further and supports the presence of this DP theme. The evaluation criteria state that successful demonstration of this SC would be that the student would "communicate information or reasoned opinions…transmitting them in a clear manner…and responding in a well-founded and precise manner to the questions that may arise".[146] This demonstrates the presence of the

[141] Government of Spain, Ministry of Education (2023). *Biology, Geology and Environmental Sciences - 'Specific Competences'*. Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/biologia-geologia-cienciasamb/competencias-especificas.html [accessed July 2023]
[142] Government of Spain, Ministry of Education (2023). *Biology - 'Specific Competences'*. Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/biologia/competencias-especificas.html [accessed July 2023]
[143] ibid
[144] ibid
[145] ibid
[146] ibid

'communication' aspect of this DP theme, but there is still no particular reference to the 'collaboration' component, and therefore this theme is still only partially present in the SB.

7. Awareness of global and local problems and the environmental, ethical, cultural, and social impact of science

There is only one specific competence that aligns with this DP theme in SB biology – that of specific competence 5. It details how students will "critically analyse certain actions related to sustainability and health" and further develops this idea by outlining how they will then "argue about the importance of adopting a sustainable and healthy lifestyle".[147] The same specific competence within the SB biology, geology and environmental sciences curriculum has a slightly different wording but further echoes this sentiment, describing that students will design and execute initiatives "related to environmental conservation, sustainability and health…to promote healthy lifestyles".[148]

Within this DP theme, there is the inclusion of the social, ethical and cultural impact of science, which is only evident in the SB's evaluation criteria for this specific competence. Here, it is stated that to successfully demonstrate this competence, students will understand research as something that is "in constant evolution influenced by the political and social context".[149] Whilst this does not go into further detail, it does show that there is some presence of this part of the DP theme.

Other Themes in the SB

Whilst there are no overall themes in the SB biology curricula that are not present in the DP, there is reference to an aspect not found so specifically within the DP. In the evaluation criteria for specific competence 3, the SB refers to the fact that students should "highlight the role of women"[150] in scientific research. The specific understanding of women's role in research is not necessarily missing from the DP, but it is not as overtly expressed as it is in the SB.

Summary

There are many similarities between the learning outcome themes of the DP and the specific competences covered by the SB. Some themes, such as critical thinking and analysis, are clearly expressed in the specific competences themselves, whereas others, such as collaboration and communication, are described within the evaluation criteria of the specific competences. Overall, all DP learning outcome themes are represented to some extent in the SB biology curricula.

5.4.2 Content – Biology

This section compares and contrasts the content of the DP and SB curricula falling within the category of biology. In order to support visual comparison at-a-glance, the DP and SB biology curricula are presented below in diagrams which show the key topics and subtopics included in each.

[147] ibid
[148] Government of Spain, Ministry of Education (2023). *Biology, Geology and Environmental Sciences - 'Specific Competences'*. Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/biologia-geologia-cienciasamb/competencias-especificas.html [accessed July 2023]
[149] Government of Spain, Ministry of Education (2023). *Biology, - 'Specific Competences'*. Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/biologia/competencias-especificas.html [accessed July 2023]
[150] ibid

Figure 20: DP biology content visualiser[151]

A: Unity and diversity	**1. Molecules**	A1.1 Water (SL + AHL)	A1.2 Nucleic acids (SL + AHL)	
	2. Cells	A2.1 Origins of cells (HL only)	A2.2 Cell structure (SL + AHL)	A2.3 Viruses (HL only)
	3. Organisms	A3.1 Diversity of Organisms (SL + AHL)	A3.2 Classification and cladistics (HL only)	
	4. Ecosystems	A4.1 Evolution and speciation (SL + AHL)	A4.2 Conservation of biodiversity	
B: Form and function	**1. Molecules**	B1.1 Carbohydrates and lipids	B1.2 Proteins (SL + AHL)	
	2. Cells	B2.1 Membranes and membrane transport (SL + AHL)	B2.2 Organelles and compartmentalization (SL + AHL)	B2.3 Cell specialization (SL + AHL)
	3. Organisms	B3.1 Gas exchange (SL + AHL)	B3.2 Transport (SL + AHL)	B3.3 Muscle and motility (HL only)
	4. Ecosystems	B4.1 Adaptation to environment	B4.2 Ecological niches	
C: Interaction and interdependence	**1. Molecules**	C1.1 Enzymes and metabolism (SL + AHL)	C1.2 Cell respiration (SL + AHL)	C1.3 Photosynthesis (SL + AHL)
	2. Cells	C2.1 Chemical signalling (HL only)	C2.2 Neural signalling (SL + AHL)	
	3. Organisms	C3.1 Integration of body systems (SL + AHL)	C3.2 Defence against disease	
	4. Ecosystems	C4.1 Populations and communities	C4.2 Transfers of energy and matter	
D: Continuity and change	**1. Molecules**	D1.1 DNA replication (SL + AHL)	D1.2 Protein synthesis (SL + AHL)	D1.3 Mutations and gene editing (SL + AHL)
	2. Cells	D2.1 Cell and nuclear division (SL + AHL)	D2.2 Gene expression (HL only)	D2.3 Water potential (SL + AHL)
	3. Organisms	D3.1 Reproduction (SL + AHL)	D3.2 Inheritance (SL + AHL)	D3.3 Homeostasis (SL + AHL)
	4. Ecosystems	D4.1 Natural selection (SL + AHL)	D4.2 Sustainability and change (SL + AHL)	D4.3 Climate change (SL + AHL)
Experimental programme	Practical work	Collaborative sciences project	Scientific investigation	

[151] '(HL only)' and '(SL + AHL)' are used to flag, respectively, topics only taught at HL and topics taught at both SL and HL, but which also feature additional higher level content.

Figure 21: SB biology content visualiser

SB biology, geology and environmental sciences	**A. Scientific project**	Formulating hypotheses and researching	Scientific laboratory or field experiments	Analysis and communication of results	Scientific works and people engaged in science	The evolution of scientific knowledge	
	B. Ecology and sustainability	Environmental Impact	The ecological footprint	Local and Global sustainability initiatives	Ecosystems and Biodiversity	Climate change	
	C. History of the Earth and Life	Geological time	The history of the Earth	The Geological record	Life on Earth	Taxonomy and Classification	
	D. Earth's dynamics and composition	Atmosphere, hydrosphere and geosphere	Plate tectonics	Human activities	Classification and Structure of rocks and minerals		
	E. Animal physiology and histology	Nutrition	Physiology and co-ordination	Reproduction			
	F. Plant physiology and histology	Photosynthesis	Transport in plants	Plant responses	Reproduction	Adaptations	
	G. Microorganisms and acellular forms	Classification of bacteria	Bacterial metabolism	Zoonoses and Epidemics	Antibiotic Resistance	Acellular forms (viruses, viroids and prions)	
SB biology	**A. Biomolecules**	Organic and inorganic biomolecules	Water and mineral salts	Chemical characteristics	Monosaccharides, disaccharides and polysaccharides	Proteins, amino acids and vitamins	Nucleic acids
	B. Molecular Genetics	DNA replication in prokaryotes	Gene expression in prokaryotes	Mutations	Cell differentiation	Prokaryotic and eukaryotic genomes	
	C. Cell Biology	Cell theory and microscopy	Plasma membrane structure and transport	Cellular structures	The cell cycle and cell division	Cancer	
	D. Metabolism	Anabolism and catabolism	Aerobic and anaerobic respiration	Heterotrophic and autotrophic nutrition			
	E. Biotechnology	Genetic engineering techniques	The importance and impact of biotechnology				
	F. Immunology	What is immunity?	External barriers	Innate and specific immunity	Humoral and cellular immunity	Phases of infectious diseases	Pathologies of the immune system

Structure

The DP and SB programmes are both taught over two years, with both offering the opportunity for students to study biology at different levels – i.e. the SB offers a combined SB biology, geology and environmental sciences subject in the first year, with the option to take the specialist SB biology subject in the second year; the DP offers students the opportunity to study DP biology at either SL or HL.

One notable difference between the structure of the biology subject area in the two programmes is the combined nature of the SB's first-year biology, geology and environmental sciences subject. Although DP biology covers some environmental sciences content, such as D4.3 Climate change, biology is studied primarily as a single-subject course in the DP.

The DP biology subject is designed through a concept-based approach and organised into four over-arching, discipline-specific themes – Unity and Diversity, Form and Function, Interaction and interdependence and Continuity and Change. Each of these themes is divided into four levels of organisation; Molecules, Cells, Organisms and Ecosystems, thereby providing 16 topics which are further divided into subtopics. Overall, DP biology SL consists of 16 topics which are divided into 34 subtopics, while the DP HL biology extends learning in 14 of the 16 topics, and more specifically in 27 of the 34 subtopics and it also contains 6 additional HL-only subtopics.

SB biology, geology and environmental sciences is structured into seven blocks, with the first block, Science project, focusing on the development of practical, investigative and analytical skills. The other six blocks of content are: Ecology and sustainability, History of Earth and Life, Earth's dynamics and composition, Animal physiology and histology, Plant physiology and histology and Microorganisms and acellular forms. SB biology, which is the optional second year modality subject, consists of six blocks of learning which are: Biomolecules, Molecular genetics, Cell biology, Metabolism, Biotechnology and Immunology. In this sense, both SB biology, geology and environmental sciences and SB biology organise their content around a higher number of overarching themes than DP biology.

Content Alignment

The table below represents a simplified summary of the SB's content alignment, at topic-level, with DP biology (SL and HL).

Table 31: Summary of content alignment between the DP biology topics and SB biology

DP biology topics	Presence of SL content in SB biology, geology and environmental sciences	Presence of AHL content in SB biology, geology and environmental sciences	Presence of SL content in SB biology	Presence of AHL content in SB biology
A1 Unity and diversity – Molecules				
A2 Unity and diversity – Cells				
A3 Unity and diversity – Organisms				
A4 Unity and diversity – Ecosystems				
B1 Form and function – Molecules				
B2 Form and function – Cells				
B3 Form and function – Organisms				
B4 Form and function – Ecosystems		N/A		N/A

C1 Interaction and interdependence – Molecules				
C2 Interaction and interdependence – Cells				
C3 Interaction and interdependence – Organisms				
C4 Interaction and interdependence – Ecosystems		N/A		N/A
D1 Continuity and change – Molecules				
D2 Continuity and change – Cells				
D3 Continuity and change – Organisms				
D4 Continuity and change – Ecosystems				
Experimental programme				

Key:

	Strong presence of this topic in the SB		*Partial presence of this topic in the SB*		*Little or no presence of this topic in the SB*

NB: Where applicable, content alignments found in pre-requisite subjects are carried forwards and combined with new alignments to represent the cumulative content covered.

Of the 16 DP biology SL topics found in the DP, SB biology, geology and environmental sciences covers four of these to a similar depth and level of detail. These topics are: A4 Unity and diversity, C2 and C4 Interaction and interdependence (Cells and Ecosystems), and D4 Continuity and change. Additionally, there are eight DP biology SL topics that are not covered to the same level of detail, namely: A2 and A3 Unity and diversity, B3 and B4 Form and function, C1 and C3 Interaction and interdependence, and D2 and D3 Continuity and change. For example, in B3 Form and function, the SB covers the transport of water in plants, but the adaptations of the veins and arteries to transport blood are not covered. Moreover, four of the topics in the DP biology SL are entirely absent from the SB biology, geology and environmental sciences: A1 Unity and diversity, B1 and B2 Form and function, and D1 Continuity and change.

In comparison to the DP biology HL, the SB biology, geology and environmental sciences fully covers one (C3 Interaction and interdependence) of the 14 AHL topics to a similar depth and level of detail. It also contains partial presence of seven of the AHL topics, which are A2, A3 and A4 Unity and diversity, B3 Form and function, C2 Interaction and interdependence, and D3 and D4 Continuity and change (Organisms and Ecosystems). Moreover, SB biology, geology and environmental sciences does not cover the following six DP biology AHL topics: A1 Unity and diversity, B1 and B2 Form and function, C1 Interaction and interdependence, and D1 and D2 Continuity and change.

In turn, SB biology covers four DP biology SL subtopics in similar depth and detail, namely: A1 and A2 Unity and diversity, B1 Form and function - Molecules and D2 continuity and change - Cells. There is also partial presence of three other subtopics, namely: B2 Form and function and C3 Interaction and interdependence, and D2 Continuity and change. For example, for B2 Form and function - Cells, SB biology covers the structure of a plasma membrane, but does not cover the differences between totipotent, pluripotent and multipotent stem cells, which are covered in DP biology SL.

Compared to DP biology HL, SB biology covers two of the 14 AHL topics, which are: B1 Form and function – Molecules and C1 Interaction and interdependence - Molecules. Moreover, four DP biology AHL topics are partially present in SB biology, namely: A1 Unity and diversity - Molecules, B2 Form and function - Cells and D1 and D2 Continuity and change (Molecules and Cells). However, SB biology does not cover eight of the AHL topics, including the climate change content in the D4 Continuity and change topic. Nonetheless, SB biology does cover additional content on the importance and impact of biotechnology: applications in health, agriculture, environment, new materials, food industry, and prominent role of microorganisms, which is not covered in DP biology.

In summary, SB biology, geology and environmental sciences has less subject depth and breadth than DP biology SL, with four DP SL topics not being covered and a further eight topics being only partially present. SB biology, geology and environmental sciences does cover some DP biology HL content – with eight of 14 AHL topics being at least partially present – but most HL has significantly more depth and breadth.

When judging the alignment between SB biology, geology and environmental and SB biology combined, all DP biology SL and AHL topics are at least partially covered by the SB, with a particularly aligned overall coverage of units C1 Interaction and interdependence – Molecules and A1 Unity and diversity – Molecules.

The experimental programme of the DP is also partially covered in the SB through multiple references to students formulating and designing their own experiments. Investigative techniques are mentioned throughout the SB; however, they are interwoven amongst content, rather than being specifically focused on in their own right through a project-based approach. Therefore, due to the difference in delivery and emphasis on practical skills, the SB does not fully align with the DP's experimental programme.

Within the SB there are some areas of content that are not covered by the DP. The SB puts particular focus on the importance of biotechnology and the impact that this has on individuals, society and the world. The SB also includes the use of biotechnology in various industrial areas such as health, agriculture, the environment, food production and creation of new materials. Although the DP does include micro-organisms in the biology course, there is a heavier emphasis in the SB on these aspects. For example, the differences between eubacteria and archaeobacteria, the mechanisms of bacterial metabolism and characteristics of acellular forms (viruses, viroids and prions). These elements are not as prevalent in the DP.

Table 32: SB biology content which is not covered in DP biology

Significant SB biology content which is not included in the DP*
○ The importance and impact of biotechnology ○ applications of biotechnology in health, agriculture, environment, new materials, food industry ○ Detailed aspects of micro-organisms.

*Significant content mostly does not include topics which are typically studied *prior* to upper secondary.

In summary, there is a strong alignment between the SB biology subjects and DP biology, with the former covering of all DP topics to at least some extent. Overall, SB biology surpasses DP

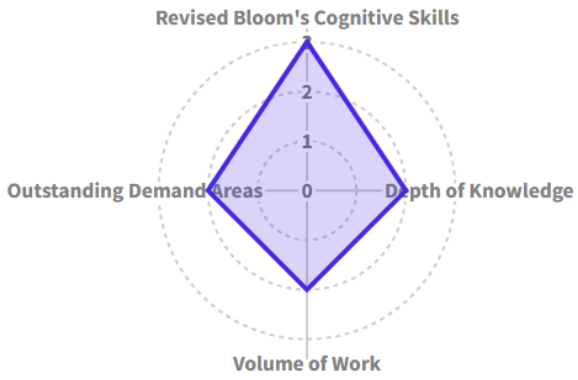
biology SL in breadth and depth, and matches DP biology HL in breadth, though it does not feature the same depth of content as the latter.

5.4.3 Demand – Biology

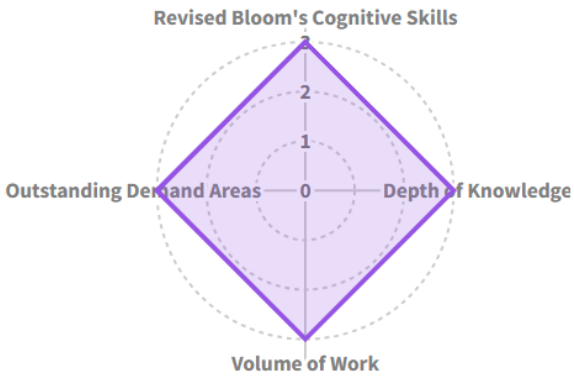
The DP and SB curricula were analysed using the same demand tool in order to create a demand profile for DP biology SL, DP biology HL, SB biology, geology and environmental sciences and the SB biology. SB biology represents the overall two-year pathway of studying biology study. These demand profiles are presented below in the form of radar diagrams, with the last diagram showing all profiles superimposed in one place, enabling immediate visual comparison.

Figure 22: Visual representations of subject demand

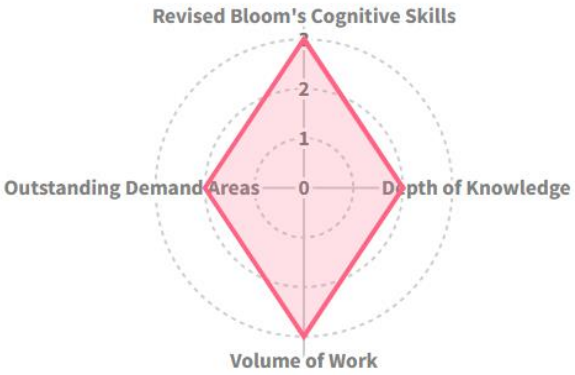
DP biology SL



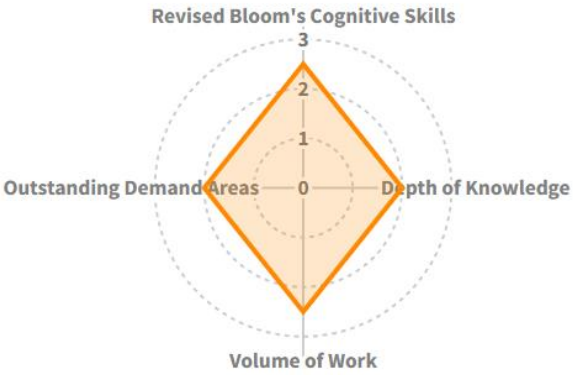
DP biology HL



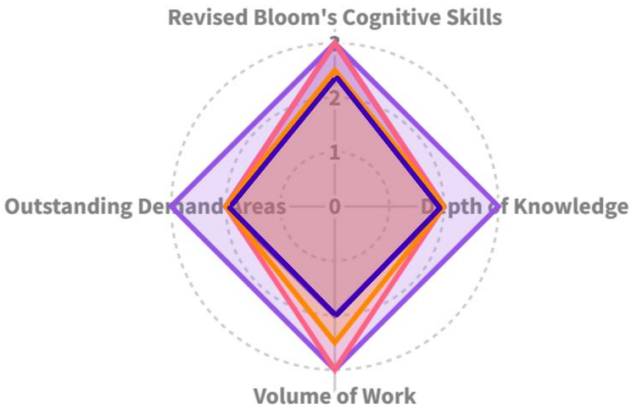
SB BGE



SB biology



DP and SB biology



The panel of experts carried out a detailed analysis of each course and reached a consensus on the scores shown in the profiles above. The following points were particularly important within the panel discussion:

- Regarding the scores for **Bloom's Cognitive Skills**:
  - DP biology has the same learning outcomes for both SL and HL, meaning that these scores are the same. These were judged to merit a score of 3 due to the high levels of critical thinking, critical awareness and elements of synthesis and creation present in the majority of Aims and Assessment Objective 3.
  - A score of 3 was awarded to SB biology, geology and environmental sciences course. This was due to the strong presence of evaluation and creation skills in the SCs; there is a predominant focus on analysis and evaluation within the SB, thereby warranting a score of 3.
  - SB biology received a score of 2.5 for Bloom's cognitive skills, as whilst all six SCs of the second year course include analysis, and some describe critical analysis of actions, concepts and processes, they do not feature the same predominant focus on synthesis or creation as the SB BGE. Indeed, by itself, the second-year course warranted a score of 2, thus on overall score of 2.5 was deemed appropriate for the pathway.

- Regarding the score for **Depth of Knowledge**:
  - DP biology SL was deemed to merit a score of 2 for depth of knowledge due to the pre-requisite skills and competences (e.g. interpretation of graphs data, mathematics skills, some chemistry and geography links) required to access the course, as well as the moderate to high level of cognitive complexity of the knowledge that students are expected to acquire. As to the HL course, the greater depth and additional opportunities provided for extended thinking in the additional HL topics pushed the score to a 3.
  - A score of 2 was given to the SB biology, geology and environmental sciences subject. There is evidence that students will engage in complex reasoning and higher-level thinking, but it is not evident that this takes place over an extended period of time, preventing a score of 3.
  - The SB biology course was judged to merit a score of 2 for depth of knowledge. Whilst there is evidence of complex reasoning, analysis and critical evaluation present throughout the SCs, there is not enough evidence that this is occurring over an extended period of time, preventing a score of 3.

- Regarding the scores for **Volume of Work**:
  - The DP biology SL was judged to comprise a moderate-heavy workload (a score of 2) as students are exposed to multiple biology topics, with each topic being allocated a standard to short amount of time. The volume demands of the HL course, on the other hand, were found to be sufficient to meet a score of 3 – even though the proportion of topics per allocated teaching hour is smaller, these topics are covered in great depth and with a focus on application.
  - For SB biology, geology and environmental sciences, a score of 3 was given for volume of work. The main rationale for this was the time constrained-nature of the

subject, rather than the complexity of content per se. There is a lot of content that is being delivered in a very restricted time (87.5h), justifying a score of 3.
    - A score of 2.5 was given to the SB biology subject for volume of work. A standard amount of time was deemed to be devoted to content coverage and a significant proportion of that time is spent on issues beyond basic conceptual depth. Thus, combined with the heavy workload of the first year, a volume of work of 2.5 was deemed appropriate for the SB biology pathway.

- Regarding the scores for **Outstanding Areas of Subject Demand**:
    - For the DP biology SL course (awarded a score of 2), the IA scientific investigation research project that students need to undertake, the linking questions outlined in the syllabus and the collaborative sciences project were considered to be areas of stretch. In addition to the latter, the HL course features additional higher-level topics which were deemed to include additional areas of stretch, meriting a score of 3.
    - The SB biology, geology and environmental sciences subject received a score of 2 for outstanding areas of subject demand. The transdisciplinary approach to the course coupled with the science project students are required to complete and the real-life applications of content promoted throughout the subject result in a significant number of potential stretch areas for students.
    - The SB biology pathway received a score of 2 for outstanding areas of demand, as the second-year course continued the transdisciplinary approach taken in SB BGE, as well as other small areas of potential stretch for students. Cumulatively, this was still a significant, rather than ‘high’, number of areas, thus remained as a score of 2, rather than increasing to a 3.

5.5 Economics

Below is the list of subjects used in the economics comparative analysis.

DP economics[152]
Economics is a subject option within the DP individuals and societies subject group, offered at both SL and HL. This subject has content that is common to both SL and HL, as well as HL-only content. Thus, HL has greater breadth and depth than SL. This subject is designed to prepare students for university courses or careers in fields such as economics, management, finance, law, research, government and non-governmental organizations, or international relations/development. HL is suitable for those intending to pursue further study in an area requiring a strong background in economics.

SB economics[153]
Economics is a one-year modality subject that students may opt to study in the first year of the Humanities and Social Sciences modality of the SB. It aims to provide students with the necessary foundational economic knowledge to understand the economic context that surrounds them, both for the purposes of supporting further economics study and to allow students to make rational economic decisions as informed citizens.

5.5.1 Learning Outcomes – Economics

This section compares and contrasts the learning outcomes of curricula falling within the category of Economics.

The learning outcome themes for DP economics were extracted from the Individuals and societies aims, economics aims and assessment objectives of the DP. These themes cover areas such as technical knowledge, critical analysis, formulation of arguments and self-reflection. The learning outcomes for the SB were drawn from the 'Specific Competences' (SCs) of SB economics.

The following table demonstrates the learning outcome themes that were extracted from the DP learning outcomes and indicates if and where they were judged to have presence within the learning outcomes of the SB economics curriculum.

[152] International Baccalaureate. (2020). *Economics guide*.
[153] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d.), Economia. Available at: https://educagob.educacionyfp.gob.es/ca/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/economia/desarrollo.html

Table 33: Presence of the DP economics learning outcome themes in the SB economics curriculum

Themes extracted from the DP economics learning outcomes	Presence in the SB	
1. Develop and display knowledge and understanding of current economic issues, theories, concepts and arguments		Present throughout the SCs
2. Develop skills in critical analysis and evaluation when looking at economic theories, concepts and arguments		Present throughout the SCs
3. Be able to apply models, theories and tools to analyse complex economic data and test hypotheses		Present throughout the SCs
4. Formulate arguments and make recommendations through an understanding of real-world economics and economic theories		Present throughout the SCs
5. Critically study a range of economic, social, cultural and historical contexts and be aware of current economic situations and factors affecting them.		Present throughout the SCs
6. Be able to reflect on the human nature of economics and show an understanding of the uncertainty behind opinions and theories.		Somewhat evidenced in specific competence 2, though not fully

Key:

	This theme is well-evidenced in the competences of the SB		*This theme is partially evidenced in the competences of the SB*		*This theme is not evident in the competences of the SB.*

Presence of the DP's Learning Outcome Themes

As can be seen in the table above, almost all learning outcome themes extracted from the DP are present to some extent in the SB economics curriculum, with the exception of the ability to reflect on the human nature of economics. All other DP themes were found in SB economics, albeit to different extents. The write-ups below summarise the extent to which each DP theme is present in SB economics.

1. Develop and display knowledge and understanding of current economic issues, theories, concepts and arguments

This DP theme surrounding the development and display of knowledge and understanding of current economic issues, theories, concepts and arguments is well evidenced in the SB economics, being present across all six SCs, in sentences such as: "Understand the problem of scarcity by identifying the reasons and comparing",[154] or "Recognize and understand the functioning of the market". Both the reasons for scarcity and the functioning of markets constitute current economic issues and concepts that change over time; as such, studying these requires engagement with current economic issues, theories and concepts.

2. Develop skills in critical analysis and evaluation when looking at economic theories, concepts and arguments

[154] Government of Spain, Ministry of Education (2023). *Economics - 'Specific Competences'.* Available at: https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/economia/desarrollo.html?_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en-US&_x_tr_pto=wapp [accessed July 2023]

SB economics also clearly evidences this DP theme, including various references to critical analysis and evaluation in its SCs; examples include: “Critically analyse market failures, evaluating their consequences”, and “analysing, with a critical sense, the impact caused by globalization”. The command verbs ‘analyse’ and ‘critically analyse’ are well aligned with the skills prompted by the DP theme, with the coupling of analysis and evaluation also being evident in how students will analyse market failures and then evaluate their consequences.

3. Be able to apply models, theories and tools to analyse complex economic data and test hypotheses

The SB also aligns well with this DP theme, as both subjects seek to ensure students are equipped with the skills needed to appropriately apply models, theories and tools to economic data. An example of this in SB economics can be seen where students are asked to analyse current economic problems by “using economic analysis tools and taking into account the factors that condition the decisions of economic agents”.[155] This theme is further emphasised in specific competence 4, where students will be expected to “analyse the elements that intervene in financial decisions”.

4. Formulate arguments and make recommendations through an understanding of real-world economics and economic theories

SB economics evidences this DP theme in statements such as “Propose initiatives that promote equity, justice and sustainability”, and further in the SB criteria for specific competence 2, where students reflect on possible solutions to market failures. The criteria for specific competence 6, too, evidence the theme further by requiring students to: “propose socio-economic solutions that respond to individual and collective needs”.

5. Critically study a range of economic, social, cultural and historical contexts and be aware of current economic situations and factors affecting them.

There is strong similarity between the DP and the SB economics subjects in this theme. The SB looks to ensure students are informed and able to critique both theoretical and real-world situations, either historical or current. This is evidenced in SB economics’ specific competence 5, where students are asked to analyse “with a critical sense, the impact of globalization, the new economy and the digital revolution on the economic and social well-being of citizens”.[156] Moreover, the theme is also present in specific competence 6, which asks students to “Analyse current economic problems through case studies”.

6. Be able to reflect on the human nature of economics and show an understanding of the uncertainty behind opinions and theories.

This theme is less prevalent in SB economics, being evidenced only sparsely in specific competence 2 of SB economics – “study the repercussion of these in the environment” – while DP economics places much greater emphasis on this. In contrast, the SB places more emphasis on critical thinking skills and the understanding of economic theories, and focuses less on understanding how opinions and theories of economics can be uncertain.

Other Themes in the SB

Overall, when looking at the learning outcomes of SB economics, there is little in the way of skills and knowledge demands that is not covered in the learning outcomes of DP economics.

[155] ibid
[156] ibid

Both subjects look to build similar skills, with importance given to technical knowledge and critical analysis and evaluation.

Summary

Overall, the DP and SB economics subjects show clear alignment in the skills and knowledge that they seek to develop in students, which include critical analysis and evaluation, development of recommendations, and the development of key knowledge of economic concepts and theories.

5.5.2 Content – Economics

This section compares and contrasts the content of the DP and SB curricula falling within the category of economics. In order to support visual comparison at-a-glance, the DP and SB economics curricula are presented below in diagrams which show the key topics and subtopics included in each.

Figure 23: DP economics content visualiser[157]

Unit 1: Introduction to economics	1.1 What is economics?	1.2 How do economists approach the world?					
Unit 2: Microeconomics	2.1 Demand *(SL + AHL)*	2.2 Supply *(SL + AHL)*	2.3 Competitive market equilibrium	2.4 Critique of the maximizing behaviour of consumers and producers *(HL only)*	2.5 Elasticity of demand *(SL + AHL)*	2.6 Elasticity of supply *(SL + AHL)*	
	2.7 Role of government in microeconomics *(SL + AHL)*	2.8 Market failure – externalities and common pool or common access resources *(SL + AHL)*	2.9 Market failure – public goods	2.10 Market failure – asymmetric information (*HL only)*	2.11 Market failure – market power *(HL only)*	2.12 The market's inability to achieve equity *(HL only)*	
Unit 3: Macroeconomics	3.1 Measuring economic activity and illustrating its variations	3.2 Variations in economic activity – aggregate demand and aggregate supply	3.3 Macroeconomic objectives *(SL + AHL)*	3.4 Economics of inequality and poverty *(SL + AHL)*	3.5 Demand management (demand side policies) – monetary policy *(SL + AHL)*	3.6 Demand management – fiscal policy *(SL + AHL)*	3.7 Supply-side policies
Unit 4: The global economy	4.1 Benefits of international trade *(SL + AHL)*	4.2 Types of trade protection *(SL + AHL)*	4.3 Arguments for and against trade control/protection	4.4 Economic integration	4.5 Exchange rates *(SL + AHL)*		
	4.6 Balance of payments *(SL + AHL)*	4.7 Sustainable development *(SL + AHL)*	4.8 Measuring development	4.9 Barriers to economic growth and/or economic development	4.10 Economic growth and/or development strategies		

[157] '(HL only)' and '(SL + AHL)' are used to flag, respectively, topics only taught at HL and topics taught at both SL and HL, but which also feature additional higher level content.

Figure 24: SB economics content visualiser

A. Economic decisions	1. The economy needs, goods and scarcity. The economic content of social relations.	2. The economic decision-making process, rationality.	3. Economic organization and economic systems; evaluation and comparison.	4. Planning and management of financial decision: investment, savings and consumption.	5. Behavioural economics. Deviations from economic rationality. Economic decisions and ethics.	6. Methods for the analysis of economic reality: the scientific method, modeling and experiments or economic tests.
B. The economic reality. Tools to understand the world through a microeconomic vision	1. Exchange and market. Types and functioning of the markets. Graphic representation.	2. Elasticity	3. Cost-benefit analysis	4. Market failures		
C. The economic reality. Tools to understand the world with a macroeconomic vision	1. Macroeconomics. Economic agents and the circular flow of income.	2. Economic growth and development.	3. Labour economics. The functioning and trends of labour markets.	4. International trade, economic integration processes and their effects.	5. The financial system, its operation and its effects. Evolution of the financial landscape.	
D. Economic policies	1. Positive economics and normative economics. State intervention and its justification.	2. Tax policy. The welfare state and its financing.				
E. The challenges of the Spanish economy in a globalized context	1. Globalisation: explanatory factors, opportunities and risks.	2. The new economy and the digital revolution.	3. Democracy and the welfare state.	4. Theories on economic decline	5. The Sustainable Development Goals (SDG) and current economic challenges.	

Structure

DP economics is studied over two years, whereas the SB economics is only studied over one year. Additionally, the DP offers the option to study economics at different levels – i.e. SL or HL – while the SB economics is offered only at one level.

When comparing SB and DP economics, the subjects are broadly structured in a similar way. DP economics is broken down into four overarching topic areas, each focused on a different theme. These topic areas are easily identified and referred to by short phrases or a common economics term, such as "Microeconomics" or "The Global Economy". SB economics is also divided into overarching topic areas – in this case, five – and also uses short phrases to distinguish its topics, such as "Economic Policies"; that said, it does also use longer phrases to describe some of the themes studied, such as "The challenges of the Spanish economy in a globalized context".

DP economics breaks each topic area down into subtopics that each deal with specific areas of economics knowledge, such as "exchange rates" or "supply side policies". SB economics approaches this differently, as each content theme is broken down into between two and five subtopics that may cover a number of content areas within them. For example, "The economy, needs, goods and scarcity", "The economic content of social relations" and "Modelling as a tool to understand economic interactions" are all areas studied within one single subtopic.

Content Alignment

The table below represents a simplified summary of SB economics content alignment, at topic-level, with DP economics (SL and HL).

Table 34: Summary of content alignment between the DP economics topics and SB economics

DP economics subtopics	Presence of SL content in SB economics	Presence of AHL content in SB economics
Unit 1: Introduction to economics		
1.1 What is economics?		N/A
1.2 How do economists approach the world?		N/A
Unit 2: Microeconomics		
2.1 Demand		
2.2 Supply		
2.3 Competitive market equilibrium		N/A
2.4 Critique of the maximising behaviour of consumers and producers	N/A	
2.5 Elasticity of Demand		
2.6 Elasticity of Supply		
2.7 Role of Government in microeconomics		
2.8 Market Failure – externalities and common pool or common access resources		
2.9 Market Failure – Public Goods		N/A
2.10 Market Failure – Asymmetric Information	N/A	
2.11 Market Failure – Market Power	N/A	
2.12 The market's inability to achieve equity	N/A	
Unit 3: Macroeconomics		
3.1 Measuring economic activity and illustrating its variations		N/A
3.2 Variations in economic activity—aggregate demand and aggregate supply		N/A

3.3 Macroeconomic objectives		
3.4 Economics of inequality and poverty		
3.5 Demand management (demand side policies)—monetary policy		
3.6 Demand management—fiscal policy		
3.7 Supply-side policies		N/A
Unit 4: The Global Economy		
4.1 Benefits of international trade		
4.2 Types of trade protection		
4.3 Arguments for and against trade control/protection		N/A
4.4 Economic integration		
4.5 Exchange rates		
4.6 Balance of payments		
4.7 Sustainable development		
4.8 Measuring development		N/A
4.9 Barriers to economic growth and/or economic development		N/A
4.10 Economic growth and/or economic development strategies		N/A

Key:

	Strong presence of this topic in the SB.		*Partial presence of this topic in the SB.*		*Little or no presence of this topic in the SB.*	N/A	*This topic does not exist at the respective level.*

As seen in the table above, SB economics includes many of the topic areas covered by DP economics, with only a small number of DP topic areas being entirely absent. Notably, given the considerably lower level of detail provided in the SB economics curriculum, various areas are shown to have partial, rather than full, alignment. This is due to it not being possible to ascertain the depth of the SB economics content covered from the documentation, particularly in relation to the mathematics requirements of the SB subject.

Relatively strong alignment between the two subjects is observed on the DP's unit 1. Both subjects cover most of the introductory economics content in the DP's 'Introduction to economics' unit. This includes concepts such as efficiency, rationality, choice, risk, uncertainty and sustainability, and both DP and SB economics cover the different types of economic systems, including free market economies and planned economies. SB economics does not overtly cover the history of economic thought, however, which is explicitly covered in the DP.

Regarding DP economics units 2 and 3 – microeconomics and macroeconomics, respectively – the SB generally evidences a relatively good coverage of DP SL topics, covering the concepts of demand, supply, the pricing mechanism, elasticity (of demand and supply), and reasons for government intervention from unit 2. In addition to this, the SB includes aggregate demand and supply, macroeconomic objectives, GDP and economic growth, and other indicators of social development and well-being from unit 3. The SB also includes coverage of some content on market failures, though it is unclear whether this matches the DP SL's coverage, as it includes no explicit mention of externalities and public goods. Although this content is likely to be covered as part of the SB topic of 'market failures' and/or topic area of 'D. Economic policies', there is not enough evidence of this in the SB documentation.

As to the SB's coverage of DP economics additional HL topics in these two units, this is far more limited. The SB does contain some content related to assumptions underlying the laws of supply and demand, and covers some behavioural economics content which, in the case of DP economics, is exclusive to HL. However, DP economics HL includes much more additional

content from units 2 and 3, including, but not limited to, profit maximisation, corporate social responsibility, market share, consumer nudges, asymmetric information and responses, and market competition from unit 2, and short-run and long-run Philips curve, average and marginal tax rates, determination of equilibrium interest rates, the Keynesian multiplier, or the crowding out effect in unit 3. There is also no reference in the SB to many of the mathematical and diagrammatical requirements covered in HL. Some examples of these include the calculation of the effect on GDP of a change in an injection in investment, and the amount of indirect tax paid from a given level/ amount of expenditure (given the indirect tax rate). Other examples of mathematical/diagrammatical DP economics HL requirements that are not present in the SB are the weighted price index (using a set of data provided), diagrams such as that representing determination of equilibrium interest rates, AD/AS curves, or showing the determination of equilibrium interest rates.

Finally, SB economics includes a generally strong coverage of the DP economics SL's content on 'The Global Economy' unit, covering the benefits and effects of international trade and economic integration, trade protectionism, economic integration and monetary union, as well as sustainable development and the sustainable development goals (SDGs). There is also a brief mention of exchange rates in the SB topic of 'B. Economic Reality. Tools to understand the world through a microeconomic vision', though the depth of content covered in this topic is unclear. The SB also does not explicitly cover any DP content on balance of payments.

As to comparison with HL, the overlap in content is more limited for this unit. While the SB does include some HL-only content on trade creation and trade diversion, unlike DP HL it does not cover absolute and comparative advantage, nor the limitations of comparative advantage theory. It also does not cover the HL-only content on balance of payments, such as the relationships between the current and financial accounts and the exchange rate, implications of a persistent current account deficit (and methods to correct it), and implications of a persistent current account surplus. Additionally, SB does not explicitly cover the advantages and disadvantages of monetary union, nor the relationship between sustainability and poverty, though the latter could be explored when addressing the SDGs. Finally, as with units 2 and 3, there is also no evidence that SB economics covers the DP HL-only calculations and diagrammatic requirements in this unit. These include the calculations of the effects of tariffs, quotas and subsidies on stakeholders (from diagrams), and the J-curve with reference to the Marshall Lerner condition.

As can be seen in the table below, there are also a few areas of content within the SB that are not explicitly referred to in the DP syllabus. In particular, the SB covers the new economy and digital revolution, as well as its impact on income distribution, which are not explicitly covered in the DP. The SB also includes a topic on economic decisions and ethics, which the DP does not do; however, consideration of the ethics of economic decisions is promoted through the TOK questions and linkages in the DP economics curriculum.

Table 35: SB economics content which is not covered in the DP

Significant SB economics content which is not included in the DP*
○ The new economy and the digital revolution. The ecological economy and the circular economy. The impact of the digital revolution on employment and income distribution. The adaptation of the active population to the challenges of the digital revolution.

- Economic decisions and ethics.

*Significant content mostly does not include topics which are typically studied *prior* to upper secondary.

Summary

Overall, there is a relatively high level of alignment between the content areas covered by DP economics and those covered by SB economics, with both covering introductory content on the nature of economics and economic principles, as well as content on microeconomics, macroeconomics and the global economy. The main difference between SB and DP economics is the depth of content covered; while the majority of the DP economics SL topics are covered in the SB, the latter's documentation suggests that there are a number of areas that are covered in less detail. Compared with DP economics HL, the SB subject covers only a few of the HL-only subtopics, calculations and diagrams; and where it does, it does so in less depth. There are also a couple of areas that the SB covers which are absent from the DP, namely the digital economy and the ethics behind economic decisions. Overall, however, SB economics is still smaller in size than DP economics SL, and considerably smaller than HL.

Notably, the comparisons above were based on the official Ministry of Education, Vocational Training and Sports' documentation on the SB economics subject. It is possible that the SB curriculum covers additional topics to those mentioned above or covers some of the topic areas referenced in further detail; this may just not have been explicitly evidenced in the documentation reviewed.

5.5.3 Demand – Economics

The DP and SB curricula were analysed using the same demand tool in order to create a demand profile for DP economics SL, DP economics HL and SB economics. These demand profiles are presented below in the form of radar diagrams, with the last diagram showing all profiles superimposed in one place, enabling immediate visual comparison.

Figure 25: Visual representations of subject demand

The panel of experts carried out a detailed analysis of each course and reached a consensus on the scores shown in the profiles above. The following points were particularly important within the panel discussion:

- Regarding the scores for **Bloom's Cognitive Skills**:
  - DP economics SL received a score of 2.5 for Bloom's cognitive skills, as although the subject has some presence of evaluation and synthesis skills in its learning outcomes, these were not a predominant enough focus to warrant a score of 3.
  - DP economics HL, in turn, received a score of 3 for Bloom's cognitive skills, as the latter places more explicit emphasis on higher order thinking skills in its HL-only assessment objectives, resulting in a concrete judgement of 3.
  - A score of 3 was awarded to SB economics, as the latter places critical analysis and critical evaluation at the centre of its learning outcomes. There is also a strong presence of synthesis and creation skills, with students being required to propose initiatives and socio-economic solutions, warranting a score of 3.

- Regarding the score for **Depth of Knowledge**:
  - DP economics SL was deemed to merit a score of 2 for depth of knowledge, as there is a substantial number of topics and most are covered in considerable detail, with students being required to engage with an average to high level of complexity.
  - DP economics HL was awarded a 3 for depth of knowledge as the latter shows strong evidence of extended thinking, with many topics being studied to a high level of detail and engaging with a high level of cognitive complexity, requiring information synthesis and interpretation of data for problem solving. In particular, the DP HL assessment objectives include the requirement for students to write policy recommendations, which necessitate a substantial amount of extended thinking time devoted to an in-depth task.
  - A score of 2 was given to SB economics as the subject covers a substantial number of topics to an average level of detail, though students are required to engage with an average to high level of complexity, with some evidence of extended thinking being present in the subject's evaluation criteria and specific competences. Therefore, a score of 2 was judged to best reflect the SB's depth of knowledge.

- Regarding the scores for **Volume of Work**:
  - DP economics SL was given a score of 3 for volume of work due to the high number of themes and skills covered within the relatively short time of 150 recommended teaching hours. This leads to a short time allocation per theme, and, thus, a heavy volume of work.
  - DP economics HL was also given a score of 3 for volume of work. The subject has a higher number of recommended teaching hours – i.e. 240, rather than 150 – but also includes some additional topics and subtopics, as well as significantly greater mathematical and diagrammatic requirements. As such, the time allocation per theme was still judged to be short, and the volume of work was judged to be heavy.
  - SB economics received a score of 2.5 for volume of work. The SB subject covers fewer topics and subtopics than the DP and covers some of these in less detail. However, the time allocation for the subject overall – a minimum of 87.5 teaching hours – was deemed to be low for the amount of content covered. As such, a score of 2.5 was deemed appropriate.

- Regarding the scores for **Outstanding Areas of Subject Demand**:
  - DP economics SL received a score of 1 for outstanding subject demand areas. Whilst no specific areas of content were considered to be of particular stretch, the internal assessment project – where students are asked to conduct research and prepare a portfolio of three commentaries on published (real-world) extracts from the news media – was deemed to constitute an area of stretch.
  - DP economics HL also received a score of 1 for outstanding demand areas. This was due to the internal assessment above mentioned, as well as the additional mathematical and diagrammatical requirements included in HL only, which, combined, were deemed to form an additional stretch area. As the score 1 descriptor encompasses both one and two stretch areas, the subject still received a score of 1, albeit at the higher end (rather than the lower end 1 awarded to SL).
  - SB economics also received a score of 1 for outstanding areas of subject demand. This was due to the SB's discussion of the ethics of economic decisions and the

requirement for students to develop innovative, sustainable solutions to respond to individual and collective needs 'by researching and exploring economic reality…and applying economics tools'.[158] Combined, these made up one area of stretch, warranting a score of 1.

5.6 Business Management

Below is the list of subjects used in the business subject comparative analysis.[159]

DP business management[160]
Business management is a offered at both SL and HL and has content that is common to both SL and HL, as well as AHL content delivered only to students studying the HL route. Thus, HL has greater breadth and depth than SL. This subject is designed to prepare students to be confident, creative and compassionate change agents for business in an increasingly interconnected global marketplace. Study of the interdisciplinary concepts of creativity, change, ethics, and sustainability aims to empower students to develop a deeper understanding of organisations and how business relates to the world around us.

SB business and business model design[161]
The business and business model design (BBMD) course is a one-year modality subject that students may opt to study on their second year of the Humanities and Social Sciences modality. It aims to give students the skills needed to understand the functioning of the economy as a whole and the interrelationship that exists between companies and their environments. The design of the BBMD subject is meant to develop students' entrepreneurial mindset and skills such as creativity, flexibility, initiative, teamwork, self-confidence and critical thinking.

5.6.1 Learning Outcomes – Business

This section compares and contrasts the learning outcomes of curricula falling within the category of business.

In the DP, learning outcomes were drawn from the Individuals and societies group aims, and DP business management aims and assessment objectives. For the SB, these were drawn from the SB BBMD's specific competences (SCs).

The following table demonstrates the learning outcome themes that were extracted from the DP learning outcomes and indicates if and where they were judged to have presence within the learning outcomes of the SB business curriculum.

[158] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d.), Economia Available at: https://educagob-educacionyfp-gob-es.translate.goog/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/economia/criterios-eval-primer-curso.html?_x_tr_sl=auto&_x_tr_tl=en&_x_tr_hl=en
[159] The term 'business' is used in this section as an umbrella term that encompasses both subjects – i.e. the DP business management subject and the SB BBMD subject.
[160] International Baccalaureate. (2022). *Business Management Guide*.
[161] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d.), Empresa y Diseño de Modelos de Negocio. Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/empresa-diseno-modelos/desarrollo.html

Table 36: Presence of the DP business learning outcome themes in the SB business curricula

Themes extracted from the learning outcomes of DP business management	Presence in the SB BBMD	
1. Develop and display knowledge of business management topics and the concepts that inform them		Present across many SCs
2. Develop skills in critical analysis and evaluation of business management topics and approaches to business management		Present across many SCs
3. Apply models, theories and tools to analyse complex data and test hypotheses		Present across many SCs
4. Assess companies and formulate recommendations that inform business strategies		'Assessing companies' aspect is present in the SCs, but the 'formulating recommendations' aspect is not explicit.
5. Show an understanding of how business management works within society and in real-world contexts		Present in SCs, though less explicitly than in the DP.

Key:

	This theme is well-evidenced in the competences of the SB		*This theme is partially evidenced in the competences of the SB*		*This theme is not evident in the competences of the SB.*

Presence of the DP's Learning Outcome Themes

As can be seen in the table above, all learning outcome themes extracted from the DP are present to some extent in the SB BBMD. The write-ups below summarise the extent to which each DP theme is present in the SB BBMD.

1. Develop and display knowledge of business management topics and the concepts that inform them

The first of the DP learning outcome themes involves the development and demonstration of knowledge of business management concepts and topics. This theme is also well evidenced within the SB BBMD subject. As stated in the evaluation criteria, SB students are required to know the different types of companies, their elements and functions, as well as the legal forms they adopt, with specific competence 3 also emphasising that they should be able to "recognize and understand current business models by comparing them with other traditional models".

2. Develop skills in critical analysis and evaluation of business management topics and approaches to business management

Another DP learning outcome theme that is well evidenced in SB BBMD is that of critical analysis and evaluation. Examples of this within SB can be found in the evaluation criteria for specific competences 2 and 3, which state that students should be able to "analyse the characteristics of the environment in which the company carries out its activity" and "analyse and make decisions about production processes from the perspective of efficiency and productivity". Additionally, critical analysis and evaluation are also present in specific competence 4, which requires students to "evaluate and select communication strategies applicable to the business world".

3. Apply models, theories and tools to analyse complex data and test hypotheses

The use of models, theories and tools to be able to test hypotheses and handle data is also well evidenced in the SB BBMD's SCs. Evaluation criterion 3.1 associated with specific competence 3 requires students to be able to compare different models and use "creative design strategies and tools", while specific competence 5 requires them "to carry out forecasting analysis of the designed business model, applying the necessary business analysis tools".

4. Assess companies and formulate recommendations that inform business strategies

While the DP theme of assessing companies and formulating recommendations to inform business strategies is also present in the SB BBMD's SCs, it is evidenced to a lesser extent than some of the other themes. It can be seen within the SB's evaluation criteria for specific competence 3, where students are asked to "propose a differentiated business or management model" and in the evaluation criteria of specific competence 2, where they are asked to "assess companies' ability to adapt quickly, responsibly and sustainably".

However, although the "assessing companies" element of the theme is present within the SB, the "formulating recommendations" aspect is not explicit in the SB BBMD's SCs. It can be somewhat implied from the evaluation criteria of specific competence 5, which requires students to be able to "prepare a basic business plan on a specific simulated scenario" but has an overall lesser emphasis than in DP business management.

5. Show an understanding of how business management works within society and in real-world contexts

The DP's theme of understanding of how business management works within society and in real-world contexts is less explicitly emphasised in the SB subject. That said, the theme is implied in some places, such as the specific competence 5's requirement for students to "validate the[ir] business model proposal designed within a specific context, defining it based on the key trends of the moment, the macroeconomic situation, the market and the competition", or the reference to "evaluate and select communication strategies applicable to the business world" in specific competence 4.

Other Themes in the SB

SB BBMD includes multiple references to the creation of proposals and business model proposals. Students are asked on multiple occasions to demonstrate these skills, for example, by "propos[ing] a differentiated business or management model that allows responding to current needs", or "carry[ing] out forecast analysis of the designed business model, applying the necessary business analysis tools to understand the entire process carried out and validate the business model proposal".[162] While DP business management does mention the "creation of recommendations for competing future strategies" at HL (see AO 3), explicit skills on the creation of business model proposals are more explicitly evidenced in the SB BBMD.

Summary

Overall, all the DP learning outcome themes are present in the SB BBMD to some extent, with the majority being well evidenced. Both subjects place emphasis on knowledge and understanding, application and analysis, while also significantly emphasising the skill of

[162] Government of Spain, Ministry of Education, Vocational Training and Sports (n.d.), Empresa y Diseño de Modelos de Negocio, 'Competencias específicas'. Available at: https://educagob.educacionyfp.gob.es/curriculo/curriculo-lomloe/menu-curriculos-basicos/bachillerato/materias/empresa-diseno-modelos/criterios-eval-segundo-curso.html

evaluation. As noted above, there are some differences in the way some of the skills are developed in each subject; however, overall, both aim to prepare students to understand and contribute towards the field of business by offering a good foundation of business theories, skills and tools.

5.6.2 Content – Business

This section compares and contrasts the content of the DP and SB curricula falling within the category of business. In order to support visual comparison at-a-glance, the DP business management and SB BBMD curricula are presented below in diagrams which show the key topics and subtopics included in each.

Figure 26: DP business management content visualiser[163]

Unit 1: Introduction to business management	1.1 What is a business?	1.2 Types of business entities	1.3 Business objectives	1.4 Stakeholders	1.5 Growth and Evolution	1.6 Multinational companies (MNCs)	
Unit 2: Human resource management	2.1 Introduction to human resource management	2.2 Organisational structure	2.3 Leadership and Management	2.4 Motivation and demotivation	2.5 Organisational (corporate) culture *(HL only)*	2.6 Communication	2.7 Industrial/ employee relations *(HL only)*
Unit 3: Finance and accounts	3.1 Introduction to finance	3.2 Sources of finance	3.3 Costs and revenues	3.4 Final accounts	3.5 Profitability and liquidity ratio analysis		
	3.6 Efficiency ratio analysis *(HL only)*	3.7 Cash flow	3.8 Investment appraisal	3.9 Budgets *(HL only)*			
Unit 4: Marketing	4.1 Introduction to marketing	4.2 Marketing planning	4.3 Sales forecasting *(HL only)*	4.4 Market research	4.5 The seven Ps of the marketing mix	4.6 International marketing *(HL only)*	
Unit 5: Operations management	5.1 Introduction to operations management	5.2 Operations methods	5.3 Lean production and quality management *(HL only)*	5.4 Location	5.5 Break-even analysis		
	5.6 Production planning *(HL only)*	5.7 Crisis management and contingency planning *(HL only)*	5.8 Research and development *(HL only)*	5.9 Management information systems *(HL only)*			
Business Management Toolkit	SWOT analysis, Ansoff matrix, STEEPLE analysis, Boston Consulting Group (BCG) matrix, Business plan, Decision trees, Descriptive Statistics (including mean mode, median, bar charts, pie charts, infographics, quartiles, standard deviation), Circular business models (including circular supply models, resource recovery models, product life extension models, sharing models, product service system models) *HL only:* Force field analysis, Gantt chart, Hofstede's cultural dimensions, Porter's generic strategies, Contribution (including make or buy analysis, contribution costing, absorption costing), Critical path analysis (including completion and analyses of a critical path diagram, identification off the critical path, calculation of free and total float), Simple linear regression (including scatter diagrams, line of best fit, and correlation/extrapolation).						

[163] '(HL only)' is used to flag topics only taught at HL.

Figure 27: SB business and business model design content visualiser

Unit A: The business and its environment	The businesspers on profiles	The classification of a company.	Business digitization and innovation						
Unit B: The business and management model	Business and the business model	The commercial function	The productive function	The management of human resources	The financial function	Information in the company: accounts, profit and loss			
Unit C: Tools to innovate in business management models	The business and management model canvas	The clients' point of view	The process of creativity – convergen ce and divergence	Competition and market niches	Ideas organization tools	Prototyping concept, utility and possibilities	The presentation of a project or idea	The scenarios: future and new business models	Innovation in business and management models
Unit D: Business strategy and business reality analysis methods: case study and simulation	Forecast, macro- and micro-economics	Evaluation of business models	Validation of business models	Protecting the idea, the product and the brand	Decision-making strategies	Analysis of market study results			

Structure

There are some similarities and differences between the structure of the DP business management subject and SB BBMD. For instance, DP business management is studied over two years, whereas the SB BBMD is studied over one year. Additionally, the DP business management offers the option to study business at different levels – i.e. SL or HL – while the SB BBMD is offered only at one level.

That said, both DP business management and SB BBMD split their content into a similar number of overarching topic areas, each of which is further divided into subtopics. More specifically, DP business management is split into five overarching units which are themselves subdivided into six to nine subtopics. In SB BBMD, content is divided into a similar number of overarching subject areas – in this case, four. Each topic area is also subdivided into a similar number of subtopics – i.e. four to nine subtopics. However, the nature of these subtopics differs between the two subjects; whilst each DP subtopic covers a well-defined business area, skill or tool, in the SB these are more broadly defined, at times encompassing content from different business areas.

Content Alignment

The table below represents a simplified summary of the SB's content alignment, at topic-level, with DP business management (SL and HL).

Table 37: Summary of content alignment between the DP business management topics and SB business and business model design

DP business management subtopics	Presence of SL content in SB BBMD	Presence of AHL content in SB BBMD
Unit 1: Introduction to business management		
1.1 What is a business		N/A
1.2 Types of business entities		N/A
1.3 Business Objectives		N/A
1.4 Stakeholders		N/A
1.5 Growth and Evolution		N/A
1.6 Multinational Companies (MNCs)		N/A
Unit 2: Human resource management		
2.1 Introduction to human resource management		N/A
2.2 Organizational structure		N/A
2.3 Leadership and Management		N/A
2.4 Motivation and Demotivation		N/A
2.5 Organizational (Corporate) Culture	N/A	
2.6 Communication		N/A
2.7 Industrial/Employee Relations	N/A	
Unit 3: Finance and Accounts		
3.1 Introduction to Finance		N/A
3.2 Sources of Finance		N/A
3.3 Costs and Revenue		N/A
3.4 Final Accounts		N/A
3.5 Profitability and Liquidity Ratio Analysis		N/A
3.6 Efficiency Ratio Analysis	N/A	
3.7 Cash Flow		N/A
3.8 Investment Appraisal		N/A
3.9 Budgets	N/A	
Unit 4: Marketing		
4.1 Introduction to Marketing		N/A

4.2 Marketing Planning		N/A
4.3 Sales Forecasting	N/A	
4.4 Market Research		N/A
4.5 The 7 Ps of the Marketing Mix		N/A
4.6 International Marketing	N/A	
Unit 5: Operations Management		
5.1 Introduction to Operations Management		N/A
5.2 Operations Methods		N/A
5.3 Lean Production and Quality Management	N/A	
5.4 Location		N/A
5.5 Break-even Analysis		N/A
5.6 Production Planning	N/A	
5.7 Crisis Management and Contingency Planning	N/A	
5.8 Research and Development	N/A	
5.9 Management Information Systems	N/A	

Comparing the topic areas covered by DP business management and SB BBMD respectively, there is generally a moderate level of alignment between the content covered by the two subjects. While some topic areas are present in both subjects, each subject covers some topic areas that the other does not.

One topic area where there is relatively strong content alignment between the subjects is that of human resources. The DP's 'Human Resource Management' unit contains multiple subtopics relating to different aspects of the subject, including introductory content on human resource management and content on 'organisational structure', 'leadership and management', 'motivation and demotivation', 'organizational (corporate) culture', 'communication', and 'industrial/employee relations'. From these areas, SB BBMD has content alignment with all SL topics but one – 'motivation and demotivation' – and also covers the team building aspect of the HL subtopic of 'organizational (corporate) culture', warranting a judgement of partial alignment.

Similarly, the SB also has a reasonable level of alignment with the DP content in its 'Finance and Accounts' unit. The SB covers the SL topics of 'final accounts' and 'investment appraisal', and partially covers the SL topics of 'costs and revenue' topic (i.e. it covers costs but not revenues), the 'profitability and liquidity ratio analysis' and 'cash flows' (i.e. concepts covered, but unclear to what extent). As to HL content, the SB covers efficiency ratios, though the extent to which it covers analysis of these is unclear from the documentation, so a partial alignment judgement was given. Moreover, the topic of 'budgets' was not found to be covered, meaning that alignment with HL 'Finance and Accounts' content overall is relatively limited.

SB BBMD also shows some alignment with the DP's 'Marketing' and 'Operations Management' units, particularly at SL. For Marketing, the SB curriculum mentions coverage of marketing strategies, though only briefly as part of the 'business and management models' topic. The topic of 'market research' is mentioned in the SB, though there is no evidence from the documentation that the topic is covered to the same depth as the DP, which includes coverage of various types of primary and secondary market research methods/techniques, the differences between qualitative and quantitative research, and sampling methods – none of which are explicitly mentioned in the SB curriculum. The SL topic of '7 Ps of the marketing mix' was also not found to be covered in the SB curriculum. As to HL coverage, the HL-only topic of 'sales forecasting' is covered in the SB, but 'international marketing' – the only other

HL-only topic in this unit – is not covered. For 'Operations Management', the SB covers all SL content to at least some extent, evidencing a clear coverage of the 'location' and 'break-even analysis' content. It does not, however, cover most of the HL-only topics in this area except for production planning, which is mentioned in the SB curriculum.

There are some DP content areas that the SB documentation does not explicitly reference. Some DP SL topics in the 'Introduction to business management' unit – i.e. 'business objectives', 'stakeholders', 'growth and evolution' and 'multinational companies' – are not explicitly mentioned in the SB BBMD, even though many constitute introductory content that would be expected to be covered at least to some extent in any business subject at this level.

Conversely, there are some areas of content covered in SB BBMD that cannot be explicitly found in the DB business management syllabus. This includes the content area of 'market niches', covered within the context of market competition, and study of the creative process, particularly the dynamics associated with generation of new business ideas. Additionally, SB BBMD also covers a number of specific tools that are not explicitly mentioned in the DP, including the use of 'empathy maps' to understand the positioning and point of view of potential clients; the use of visual thinking tools (such as diagrams and mind maps) to synthesise, idealise and communicate ideas; and specific techniques for presenting projects or business ideas, including storytelling methods and elevator pitches.

Table 38: SB BBMD content that is not covered in DP business management

Significant SB BBMD content which is not included in the DP*
○ Market niches ○ The creative process: generating new business ideas ○ Empathy maps ○ Visual thinking tools ○ Techniques for presenting projects and ideas, including storytelling methods and elevator pitches

*Significant content does not include topics which are typically studied *prior* to upper secondary.

Summary

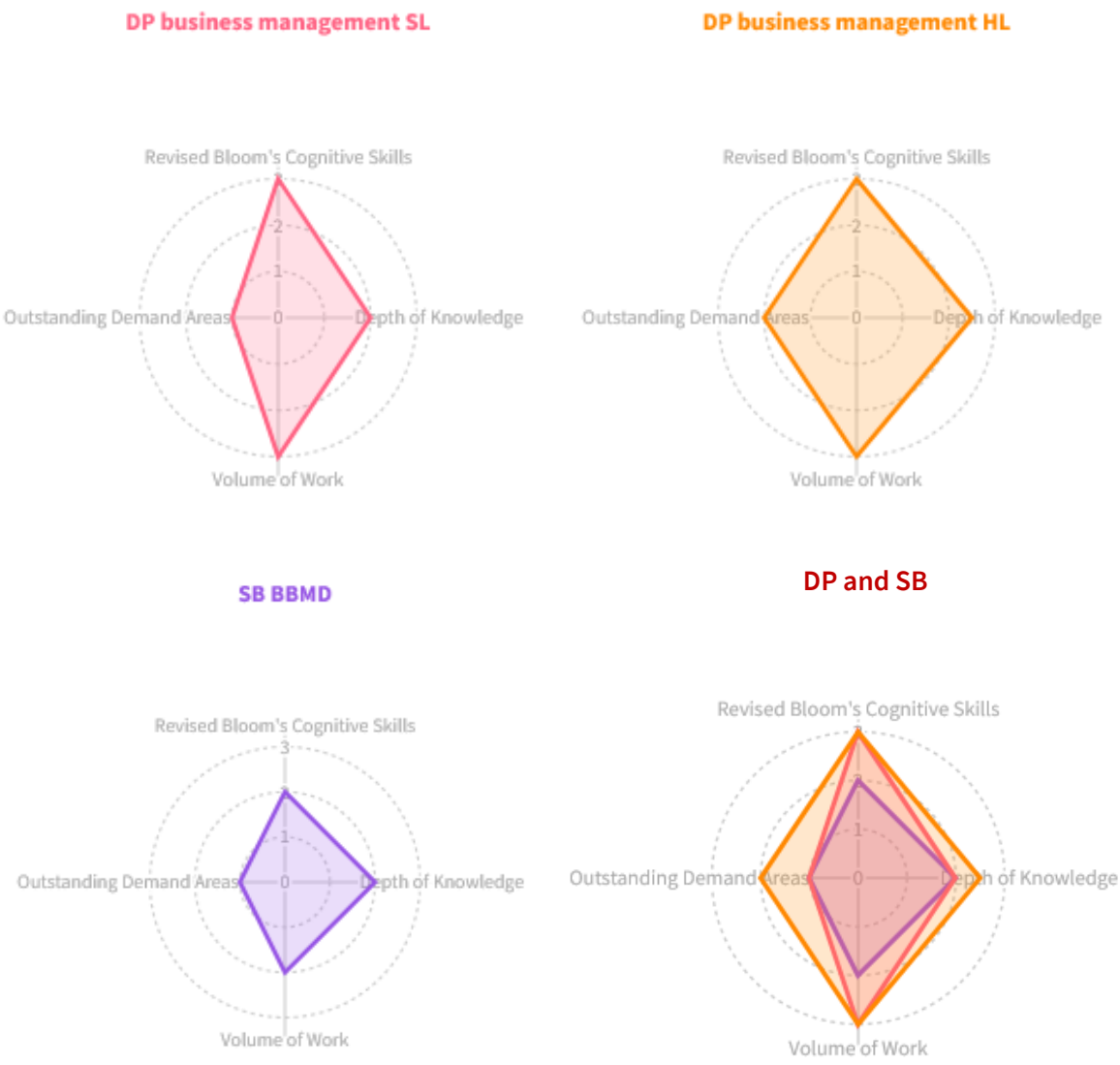
Overall, there is a moderate level of content alignment between the SB BBMD and the DP business management subjects. SB BBMD covers a substantial number of DP business management SL topic areas to at least some extent, though it shows less depth in some of these content areas. Compared to DP business management HL, SB BBMD generally evidences limited or no alignment with HL-only topics, with exception of sales forecasting and production planning content. Conversely, SB BBMD covers a number of business topics, tools and techniques that are not explicitly covered in the DP, including market niches, the creative process around generation of new business models, and tools such as empathy maps, visual thinking tools, and pitching business ideas.

5.6.3 Demand – Business

The DP and SB curricula were analysed using the same demand tool in order to create a demand profile for DP business management SL, DP business management HL and SB BBMD. These demand profiles are presented below in the form of radar diagrams, with the

last diagram showing all profiles superimposed in one place, enabling immediate visual comparison.

Figure 28: Visual representations of subject demand



The panel of experts carried out a detailed analysis of each course and reached a consensus on the scores shown in the profiles above. The following points were particularly important within the panel discussion:

- Regarding the scores for **Bloom's Cognitive Skills**:
  - DP business management, at both SL and HL, has been given a score of 3 for Bloom's cognitive skills. There is substantial evidence of synthesis and evaluation in the assessment objectives shared by SL and HL, with an additional reference to synthesis (in the form of recommendations for competing future strategic options) being present at HL.
  - A score of 2 was awarded to the SB BBMD due to a predominant focus on 'analysis' across the subject's learning outcomes. Although SB BBMD includes a

requirement for students to be able to produce a business plan, the word 'basic' precedes this task. Thus, although there is some evidence of synthesis in specific competences and evaluation criteria of the subject, enough evidence was not found to warrant a score of 3.

- Regarding the score for **Depth of Knowledge**:
  - DP business management SL was deemed to merit a score of 2 for depth of knowledge. Most topics are studied to a considerable level of detail, and both the subject's aims and assessment objectives go well beyond simple knowledge recall, often referring to analysis and evaluation, requiring strategic thinking. As such, as score of 2 was deemed appropriate.
  - DP business management HL received a score of 2.5 for depth of knowledge. This score was reached by taking into account not only the techniques and skills that students are required to use, but the level of autonomy and independence required of the student when determining which technique to use and when it is relevant. The increased emphasis on synthesis – visible, for example, in the requirement that students produce recommendations – requires some extended thinking, warranting a score of 2.5.
  - SB BBMD received a score of 2 for the depth of knowledge category. The documentation shows that there is a heavy emphasis on analysis, with some evidence of extended thinking and independent work. However, the documentation did not evidence that most topics were studied in considerable detail, preventing a score of 3.

- Regarding the scores for **Volume of Work**:
  - DP business management SL was judged to merit a score of 3 for the volume of work category. The subject covers a high number of topics, with students progressing from foundational topics and skills to critical analysis and application of their understanding of real-world scenarios. This results in a high volume of work, and a large proportion of time focused on issues beyond basic conceptual depth, warranting a score of 3.
  - DP business management HL also received a score of 3 for volume of work. DP HL has a higher number of recommended teaching hours – 240h, instead of 150h – but includes 11 additional subtopics and an additional assessment, making the volume of work equally heavy. As such, as a score of 3 was also deemed to be appropriate.
  - SB BBMD received a score of 2 for the volume of work. There is a high number of topics within the minimum allocated 87.5 hours, meaning there is a short time allocation per theme. However, a significant number of the themes covered were judged to be relatively simple, and the documentation reviewed did not indicate that a large proportion of time was spent on issues beyond basic conceptual depth. As such, a score of 2 was deemed appropriate.

- Regarding the scores for **Outstanding Areas of Subject Demand**:
  - DP business management SL received a score of 1 for outstanding demand areas. Students are required to complete an extended research project in which they apply appropriate business management tools and theories to a real-world problem

or issue within an organisation. Furthermore, the project must use one key concept, such as creativity, ethics, or sustainability. This project, combined with the business management toolkit which students apply throughout their DP business management studies, provides ample opportunity to challenge students and thus brings the judgement to a 1. Of particular relevance to the panel was the toolkit's discussion of the importance of applying understanding and knowledge to different contexts, as well as the fact that it highlights the importance of an interdisciplinary approach to learning.

- For DP HL, a score of 2 was given. This was due to the previously mentioned factors (i.e. the internal assessment and toolkit) and the additional challenge of the HL-only content in aspects such as management information systems and crisis management. These aspects added an additional area of stretch to HL, warranting a score of 2.
- A score of 1 was given to SB BBMD for outstanding demand areas due to the requirement for students to assess companies' ability to adapt quickly, responsibly and sustainably to their socio-economic and environmental context and market demands, particularly with a focus on different aspects of corporate social responsibility and equity, diversity and inclusion. This was deemed to amount to a stretch area, warranting a score of 1.

6. Key Findings

This section summarises the alignment and main similarities and differences found between the DP and Spain's upper-secondary programme (SB), both at programme level and subject level.

6.1 Programme Level

Philosophical Underpinnings

All the key themes within the IB's learner profile, ATL, and philosophy of international-mindedness are strongly present in the key curriculum competences of the SB. The main difference between both programmes lies in the SB's specific focus on the development of students' entrepreneurial and digital competences, which are not as explicitly emphasised in the DP. That said, students or teachers moving between the two qualifications would find a high level of consistency between the philosophical underpinnings of both programmes.

Programme Structure

There are various similarities between the two programmes' structures; for example, both take a baccalaureate-style approach to encourage breadth of study, and both require students to study subjects from broadly similar subject areas. Additionally, both programmes allow students to specialise in particular subjects – the DP by differentiating between SL and HL, and the SB by giving students the option to continue to study a particular subject in their second year.

There are also some differences between the programmes; for example, the SB offers four different modalities (i.e. streams) of study, whilst the DP is not split into different specialised streams, with each student typically studying a subject from each subject group. Additionally, SB subjects span one single year and students may choose to study different subjects in their first and second years; in contrast, DP students study each subject for the course of two years. Moreover, SB students study a slightly higher number of subjects than DP students, with each subject spanning only one year; in contrast, DP students take slightly fewer subjects, and each subject runs for the programme's two years. Finally, the SB does not require the completion of additional components to pass the qualification, while students in the DP must complete the TOK, CAS and the extended essay in order to obtain their diplomas.

Entry Requirements

Both the DP and the SB present a somewhat flexible approach to entry requirements at the start of their programmes. The IB encourages students and teachers to consult subject guides around expected prior learning but does not provide fixed entry requirements. For the SB, students are required to have completed one of the following qualifications in order to enrol in the first year: the Compulsory Secondary Education certificate; any vocational training qualifications; any plastic arts and design diplomas; or any diplomas in sports education.[164] As such, while the SB does specify particular entry requirements, these are flexible and allow students from different backgrounds to enrol.

[164] Government of Spain, Ministry of Education, Vocational Training and Sports. (2022) Royal Decree 243/2022. https://www.boe.es/buscar/act.php?id=BOE-A-2022-5521#dd

Notably, to take some specific subjects in their second year, SB students must have successfully completed certain subjects in their first year (e.g. to take SB physics in Grade 12, students must have successfully completed SB physics and chemistry in Grade 11). The DP does not stipulate a similar type of entry requirement for its subjects; instead, it simply states that, to study *some* subjects at HL, some prior study in the specific subject area is advisable.

Student Learning Pathways

Both programmes provide some level of optionality in relation to subjects studied and both require students to study subjects from a wide range of subject groupings. The approach to combining subject-specialisation with breadth is, therefore, somewhat similar. The main difference between the student learning pathways is that, depending on their choice of modality, students in the SB can choose to follow a pathway that exposes them to fewer subject areas than those experienced by DP students. For example, students in the Humanities and Social Sciences modality may complete their SB without taking any mathematics or sciences subjects, which is not possible for DP students to do.

Additionally, the two programmes also differ in the minimum total number of hours allocated to specialty subjects. Whilst DP students typically dedicate a combined total of 720h to the study of subjects at HL (which can go up to 960h if students choose to study four subjects HL, instead of three), SB students only dedicate a minimum of 525h to all their modality subjects (combined).

Assessment Methods

Due to the decentralised nature of the Spanish education system, it is challenging to meaningfully compare the assessment methods of the DP to those of the SB, as the latter varies from region to region. Nonetheless, some general trends can be noted. For instance, both the DP and the SB often feature both internal, school-designed assessment and externally-set, end-of-subject examinations, with both typically awarding more weighting to externally-set assessment overall (though information on the exact weighting awarded by each regional education authority could not be found). In both programmes, too, internal assessments can assume different forms, varying across subjects, and, in the SB, across autonomous regions and schools also. There are also some similarities between the subject-specific assessment objectives of the DP and the subject-specific competencies and evaluation criteria in the SB, with both programmes assessing similar skills.

That said, the overall approach to assessment differs between the two programmes; while the SB takes a decentralised approach, allowing regional educational authorities to make decisions about certain elements of subject selection and the specific weighting awarded to each assessment type, the DP follows a more homogenised approach, with both assessment types and weighting being set centrally.

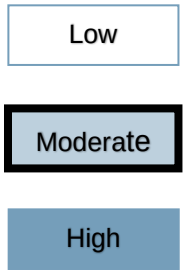
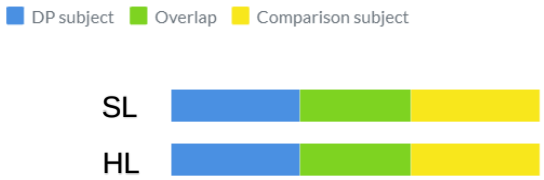
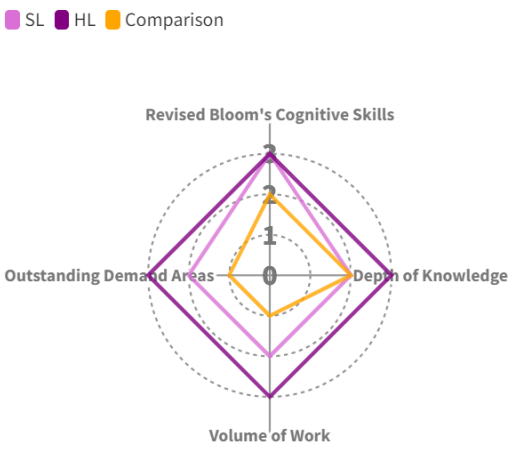
Summary

The philosophical underpinnings constitute the most significant point of similarity between the two programmes. In all other respects, there are some notable differences, though with points of clear alignment with regard to how students would be likely to experience the programmes in practice.

6.2 Subject Level

This section provides visual summaries of the subject-level alignment between specific subjects within the DP and the respective comparison points in the SB. The summaries include key findings on learning outcomes alignment, content alignment and demand alignment, as per the key below:

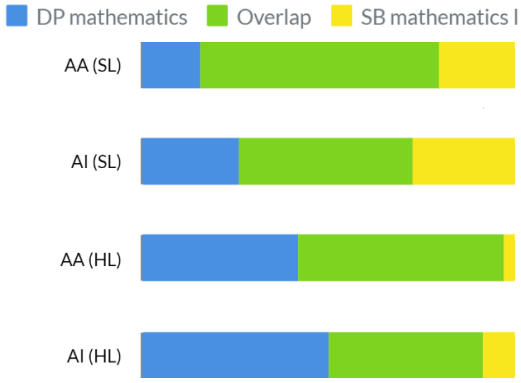
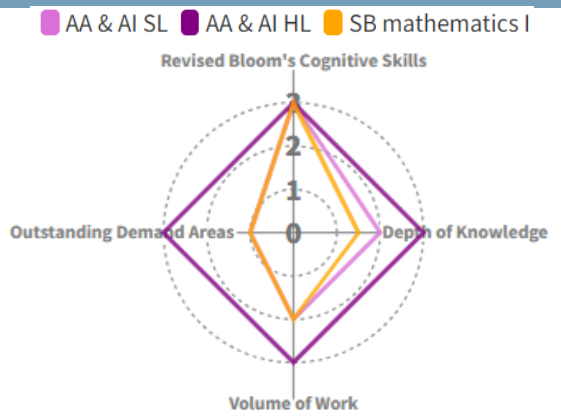
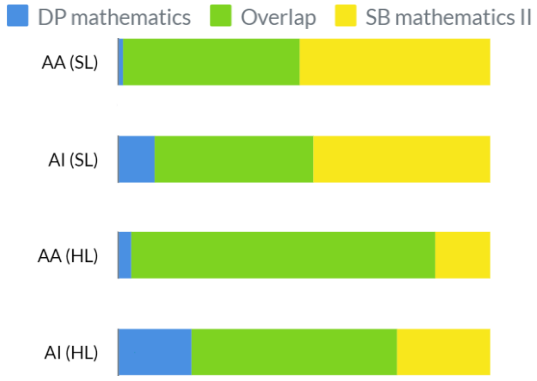
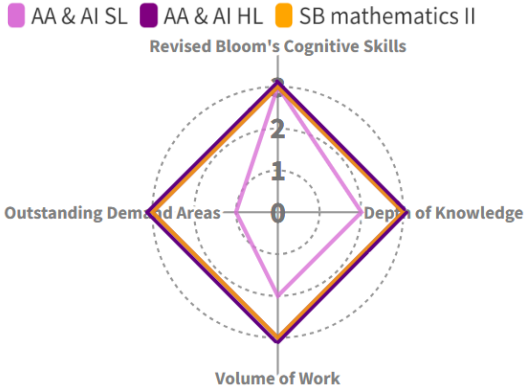
Key:

Subject name	Learning outcomes alignment	Content alignment	Demand alignment
Displays the name of the comparison subject	 This represents the learning outcome alignment between the DP subject and the comparison subject. A black border is placed around the selected judgement – 'Moderate' in this example.	 These bars represent the content alignment between the DP subject and the comparison. There is one bar showing alignment with SL content and another for HL content (inclusive of SL content). The **green** section of the bar represents the overlap of content between the subjects. The **blue** section represents content which was in the DP subject only. The **yellow** section represents content which was in the comparison subject only. Therefore, if, say, the blue section was longer than the yellow, this can be interpreted as DP subject having more content unique to itself than the comparison did. A large green bar would indicate that a substantial proportion of content overlaps between the DP and the comparison subject.	 This radar diagram displays the demand judgement scores for the comparison subject(s) and the DP subject – both SL and HL.

6.2.1 Mathematics Alignment

The subject level alignment between the DP and SB mathematics subjects is represented below:

Figure 29: Visual representations of subject-level alignment (mathematics subjects)

Subject name	Learning outcomes alignment	Content alignment	Demand alignment
Mathematics I	Low Moderate **High**		
Mathematics II	Low Moderate **High**		

- **Learning outcomes alignment**: the level of alignment between the learning outcomes of both DP mathematics subjects, at both SL and HL, and those of the SB mathematics subjects is high, as all DP learning outcome themes are present in the SB curricula.

- **Content alignment**: SB mathematics I is well aligned with DP AA SL content, as they share a considerable number of subtopics and are of similar breadth and depth. SB mathematics I has moderate alignment with DP AI SL, as it shares some, but slightly fewer, subtopics with this subject. SB mathematics II (which requires prior study of mathematics I) is strongly aligned with DP AA HL, as it shares a considerable amount of content and has similar breadth and depth. SB mathematics II has moderate, rather than strong, alignment with DP AI HL, as each subject features several areas which are not covered by the other.

- **Demand alignment**: the demand level of SB mathematics I and SB mathematics II strongly aligns with the demand of DP SL and HL mathematics subjects, respectively. Indeed, SB mathematics I scores the same as, or very similarly to, the DP's SL mathematics subjects for Bloom's cognitive skills, depth of knowledge, volume of work, and outstanding demand areas. Likewise, SB mathematics II scores the same as DP HL for all demand categories.

The **key similarities** identified were the following:

- **Similarities in learning outcomes**: similarly to the DP, the SB sets out general learning outcomes that are applicable to both years of mathematics study in the Science and Technology modality. Overall, the level of alignment between the SB courses mathematics' learning outcomes and the DP's is high. All eight themes extracted from the DP are well evidenced in the SB's Specific Competencies and corresponding Evaluation Criteria. Like the DP, the SB promotes critical thinking skills, consideration of global issues and contexts, transferable learning skills, clear communication, use of technology, making connections, and use of inquiry approaches. Thus, the SB takes a similarly holistic approach to the DP with regards to mathematics learning outcomes.

- **Similarities in content**: both the DP and SB's Science and Technology modality offer two levels of study, with the second course following directly on from the first. With regards to content alignment, SB mathematics I covers a significant number of subtopics from the DP's Number and Algebra and Geometry and Trigonometry topic areas, covering most SL and some AHL content. Overall, SB mathematics I has similar breadth and depth as DP SL, though has more depth in some topics and less in others. SB mathematics I has reasonable, though slightly less alignment, with DP AI SL, as the former's subtopics are more similar to those in DP AA SL. SB mathematics II has similarity to DP HL mathematics subjects in terms of the breadth and depth of content covered. With regards to content alignment, SB mathematics II strongly aligns with DP AA HL, as it covers most of the SL and AHL subtopics in every topic area. Furthermore, SB mathematics II also has moderate content alignment with DP AI HL, as it covers most subtopics from Number and Algebra, and a considerable number from Geometry

and Trigonometry and Calculus. Matrices is a key subtopic shared by DP AI HL and SSB mathematics II.

- **Similarities in demand**: SB mathematics I aligns very closely with DP SL mathematics subjects in all demand categories, with both evidencing higher order cognitive skills, similar depth of knowledge, a moderate-heavy volume of work, and a small number of outstanding demand areas. SB mathematics II aligns very closely with DP HL mathematics subjects for demand, scoring highly across all demand categories and similarly demonstrating higher order cognitive skills, considerable depth across topics, a heavy volume of work and a high number of areas that are considered challenging for upper-secondary mathematics.

The **key differences** identified were the following:

- **Differences in learning outcomes:** although there is strong alignment between DP and SP mathematics learning outcomes, a few small differences can be noted. Indeed, the SB more explicitly emphasises computational thinking, use of representations, making connections within mathematics, and personal and social skills.

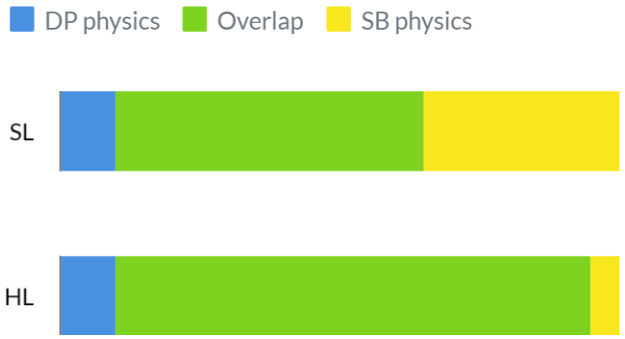
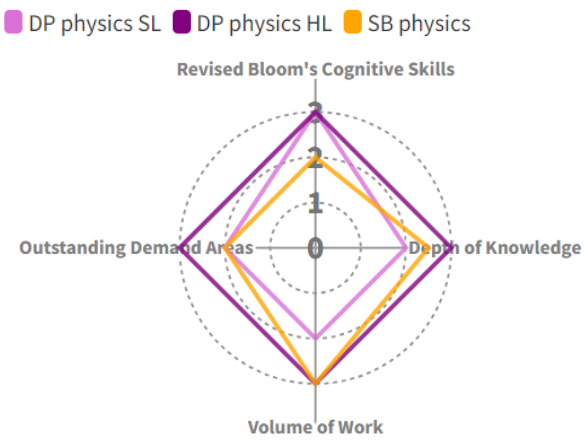
- **Differences in content:** whilst similar to DP SL subjects, SB mathematics I has less depth in statistics and calculus content and more depth in number and algebra and geometry and trigonometry content. With regards to SB mathematics II, there is only moderate content alignment with DP AI HL, due to content being more similar to DP AA HL. Indeed, SB mathematics II does not include the same emphasis on modelling or the subtopics relating to graph theory, decision mathematics, or any AHL Statistics and Probability content. Although, like the DP AI HL, matrices is a key topic in SB mathematics II, the areas within that topic that the two courses explore in significant depth differ. Furthermore, SB mathematics II contains a considerable amount of content which is not on the DP curriculum, particularly with regards to conics, vectors, and matrices.

- **Differences in demand:** there are no significant differences with regards to demand, as SB mathematics I aligns closely with DP SL subjects and SB mathematics II aligns closely with DP HL subjects.

6.2.2 Physics Alignment

The subject level alignment between the DP and SB physics is represented below:

Figure 30: Visual representations of subject-level alignment (physics)

Subject name	Learning outcomes alignment	Content alignment	Demand alignment
physics	Low Moderate High		

- **Learning outcomes alignment**: the level of alignment between the learning outcomes of DP and SB physics is significant, with all themes extracted from the DP learning outcomes being present in the SB's specific competences. There are some small differences in approach; for example, the SB's greater emphasis on the inter-connectedness of physics and chemistry, reflected in the combined teaching of the subjects in the first-year SB physics and chemistry course. Nevertheless, the level of overlap between the DP and SB is substantial.

- **Content alignment**: there is reasonable topic and subtopic overlap between DP and SB physics, for both SL and HL. The first-year SB physics and chemistry subject contains a lot less physics content than the DP at both SL and HL, due to the combined nature of the subject. The second-year physics-specific subject, in contrast, features a high level of content overlap with DP physics, both at SL and HL.

- **Demand alignment**: the DP demand scores exceed those of the SB physics and chemistry in all areas except volume of work. Some areas of SB physics received similar demand judgements as DP HL, while others fell short.

The **key similarities** identified were the following:

- **Similarities in learning outcomes:** all the seven general learning outcome themes extracted from DP physics are present to some extent in all SB specific competences. In terms of emphasis on those themes, the SB is especially similar in its focus on making connections and the use and application of techniques that characterise science. The theme of collaboration and communication is also heavily evident in both the DP and SB.

- **Similarities in content:** the SB physics and chemistry course shows strong alignment with the DP physics SL content across most of units A, B and D. Compared to HL, most of the DP content from units A and B is present in the SB physics and chemistry subject. Within the second-year SB physics subject, the DP and SB have strong levels of alignment in almost all areas of content, at both SL and HL.

- **Similarities in demand:** DP physics SL and SB physics and chemistry received the same score for the volume of work category, and the same score of 2 for the outstanding demand areas. DP physics HL and SB physics received similar scores for volume of work and depth of knowledge, thus they show alignment in these areas.

The **key differences** identified were the following:

- **Differences in learning outcomes:** although all DP learning outcome themes are present in the SB, and the latter includes no significant additional themes, the nature of the delivery of the SB results in some themes being more heavily emphasised than others. The combination of physics and chemistry taught together for the first year of study in the SB results in a great emphasis on the DP theme of making connections and links with other subjects. The collaboration and communication theme is also of a higher focus in the SB than in the DP. The second-year SB physics subject provides slightly greater specificity than the DP in the real-world contexts and problem-solving

theme, as it discusses the importance of the industrial, technological and biosanitation fields specifically.

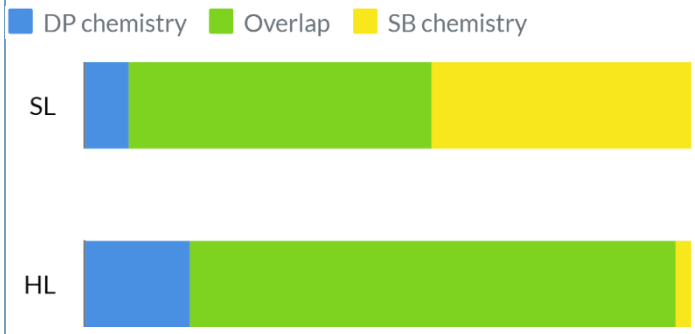
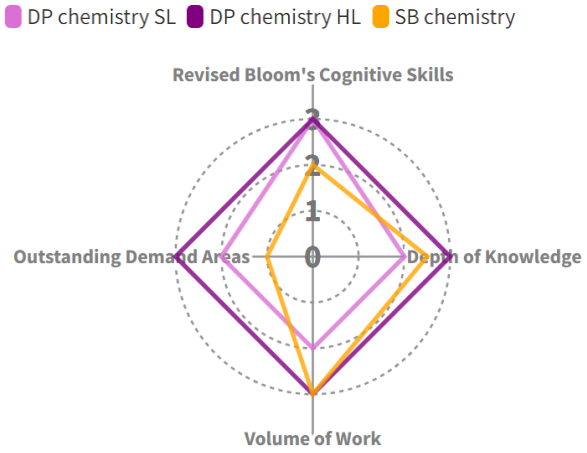
- **Differences in content:** the most apparent difference between the DP and SB physics content is that there is an overall deeper coverage of content in the DP. The combined teaching of physics and chemistry in the first-year SB physics and chemistry subject results in each of these subject areas being covered in less depth during that year. One DP content area that is absent from the SB, at both SL and HL, is the Doppler effect. This is the only DP physics content area that has little or no presence in the SB. In contrast, the SB includes some challenging mathematical aspects of physics that are not found in the DP, such as using modulus dot and cross products when dealing with vector notation and calculations. The SB also covers convex/concave lenses and concave mirrors, which are not covered in the DP.

- **Differences in demand:** the SB subjects have received various scores that differ from the DP at both SL and HL. Regarding Bloom's cognitive skills, both SB subjects have received lower scores than the DP SL and HL; thereby reflecting that the skills focused on and demonstrated by students in these courses are somewhat less demanding than those focused on in the DP. For the outstanding demand areas score, SB physics and chemistry falls short of the score achieved by DP SL, and SB physics as a whole scores less than DP HL.

6.2.3 Chemistry Alignment

The subject level alignment between the DP chemistry and SB chemistry is represented below:

Figure 31: Visual representations of subject-level alignment (chemistry)

Subject name	Learning outcomes alignment	Content alignment	Demand alignment
chemistry	Low Moderate High		

- **Learning outcomes alignment**: the level of alignment between the learning outcomes of DP and SB chemistry is high, as all themes extracted from the DP learning outcomes are present to some extent in the SB's specific competences. There are some small differences in approach; for example, the SB places greater emphasis on the inter-connectedness of chemistry and physics, reflected in the combined teaching of these subjects in the first-year SB physics and chemistry course. The SB also places less focus than the DP on developing technological skills. Nevertheless, the level of overlap between the DP and SB is substantial.

- **Content alignment**: there is a large amount of topic and subtopic overlap between DP and SB chemistry. While alignment with the DP is more limited for the first-year SB physics and chemistry course – which is unsurprising given that the latter covers both physics and chemistry – there is a substantial degree of content alignment between the second-year SB chemistry and the DP, both at SL and HL.

- **Demand alignment**: SB chemistry aligns with DP HL with regards to depth of knowledge and volume of work, however, it is surpassed by both DP SL and HL for Bloom's cognitive skills and outstanding demand areas.

The key similarities identified were the following:

- **Similarities in learning outcomes:** all learning outcome themes from the DP are present in the SB specific competences. There is strong alignment between the DP and the SB regarding the themes of conceptual understanding and making connections, techniques that categorise science, and creativity and critical thinking. The 'collaboration' aspect of the DP learning outcome theme on collaboration and communication is very prevalent in the SB, as is the awareness of global problems in the context of the environment and sustainability.

- **Similarities in content:** there is some level of content alignment between the first-year SB physics and chemistry subject and DP chemistry, with the former covering eleven DP chemistry subtopics at SL, ten of which are covered to a similar breadth and level of detail. As to the SB chemistry subject, the latter covers the vast majority of DP subtopics at both SL and HL, many of which to a similar depth and level of detail.

- **Similarities in demand:** SB physics and chemistry received the same score as the DP SL chemistry in only one area: volume of work. The SB chemistry subject, in turn, scored the same or similarly to DP HL for depth of knowledge and volume of work.

The **key differences** identified were the following:

- **Differences in learning outcomes:** from the DP learning outcome themes, some are more emphasised in the SB than others. The SB features less focus than the DP on investigative skills and the development of technological skills. These are briefly mentioned or can be inferred from the SB's specific competences but are less clearly defined than they are in the DP. Although 'collaboration' is heavily emphasised in the SB, the mention of the 'communication' component of this theme is much more subtle

than in the DP. Within the DP theme of awareness of global and local problems, although the global problems are strongly emphasised in the SB, there is less reference than in the DP to the ethical and cultural elements of this theme.

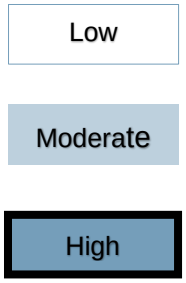
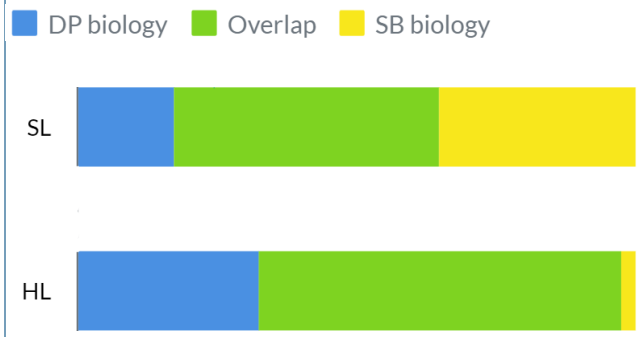
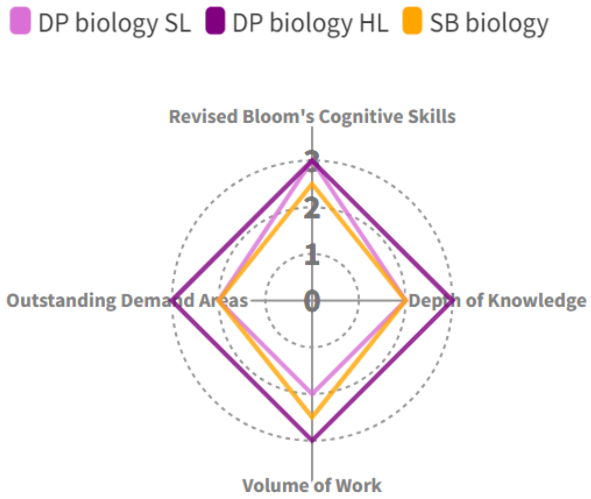
- **Differences in content:** although SB physics and chemistry has some alignment with the DP chemistry SL subject, ten DP SL subtopics were found to have little or no presence in SB physics and chemistry. SB chemistry also differs slightly from the DP in terms of depth of content covered. For example, unlike DP SL, SB does not cover the advantages and disadvantages of fossil fuels and biofuels, and free radical substitutions are also not referenced. The SB chemistry does not cover any large content that is not also found in the DP, though it does cover polymers in greater depth than the DP, by including their applications, properties and associated environmental risks.

- **Differences in demand:** SB physics and chemistry received lower scores than the DP SL, and therefore DP HL, for Bloom's cognitive skills, depth of knowledge and outstanding demand areas. SB chemistry exceeds the DP SL's scores in two categories (volume of work and depth of knowledge) but scored lower than both DP SL and HL for Bloom's cognitive skills and outstanding demand areas. This indicates that the DP, at both SL and HL, gives students the opportunity to develop a wider range of cognitive skills than the SB, and provides more opportunities to stretch and challenge students.

6.2.4 Biology Alignment

The subject level alignment between the DP biology and SB biology is represented below:

Figure 32: Visual representations of subject-level alignment (biology)

Subject name	Learning outcomes alignment	Content alignment	Demand alignment
biology			

- **Learning outcomes alignment**: all DP learning outcome themes were present in the SB specific competences (SCs) to some extent. Some themes, such as conceptual understanding, use of techniques that characterise science and creativity and critical thinking, were found to be strongly evident throughout the SCs. Others, such as technological skills. were inferred from the SCs and further descriptions, but not necessarily explicitly stated.

- **Content alignment**: there is a large amount of topic and subtopic overlap between the SB and DP biology at both SL and HL. There is less alignment between the DP and the first-year SB biology, geology and environmental sciences, partially due to the combined nature of the SB subject. All DP topics are present to some extent in the second-year SB biology subject; however, for many content areas, particularly those found in the DP at HL, the SB has only partial alignment with the DP.

- **Demand alignment**: as a whole, SB biology aligns strongly with DP biology SL, as it scores similarly in all demand categories. DP biology HL exceeds SB biology in all demand categories.

The **key similarities** identified were the following:

- **Similarities in learning outcomes:** all DP learning outcome themes are present in the SB SCs. The theme of conceptual understanding and making connections is highlighted throughout the SCs, as is the use of techniques that characterise science. The skill requiring creativity and critical thinking is also clearly evident throughout the SCs in references to evaluation and critically analysing research. Collaboration and communication skills are also highlighted as important within the SB; however, there is a greater emphasis on communicating; particularly the ability to debate and present an idea or project.

- **Similarities in content:** in the combined first-year SB biology, geology and environmental sciences subject, greater alignment is seen with DP SL than HL, with four topics strongly aligned at SL and one at HL. The second-year SB biology subject features a substantial overlap with DP biology content, particularly at SL. All content areas are present, with nine topics showing strong alignment at SL and three showing strong alignment at HL.

- **Similarities in demand:** as a whole, SB biology aligns strongly with DP SL, scoring the same for depth of knowledge and outstanding demand areas, and similarly for Bloom's cognitive skills and volume of work.

The **key differences** identified were the following:

- **Differences in learning outcomes:** whilst the SB contains all DP learning outcome themes, some are less emphasised than others. For example, the development of technological skills is not explicitly stated in its own right, though can be inferred from the wording of the SCs. For a student to use 'digital content' a level of competence in the use of technology is required. The analysis and evaluation of experimental data

also likely required the use of technology. The social, ethical and cultural impact of science within the DP theme of awareness of global and local problems is less apparent in the SB. Whilst there is mention of students understanding the constant evolution of science and how the political and social contexts may affect it, there is no explicit reference to the recognition of the social, ethical and cultural impact of science. Within the SB, there is a specific reference to students being able to highlight women's role in scientific research and discoveries. Whilst this is not necessarily missing from the DP, it is not expressed as overtly as it is in the SB.

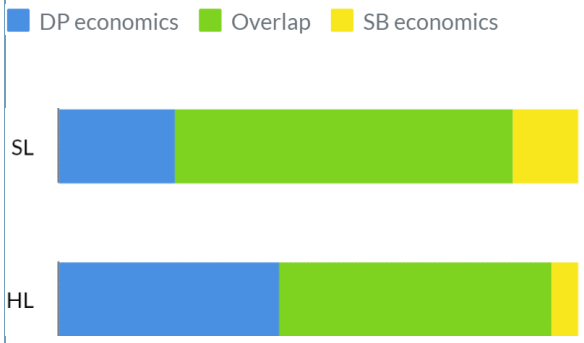
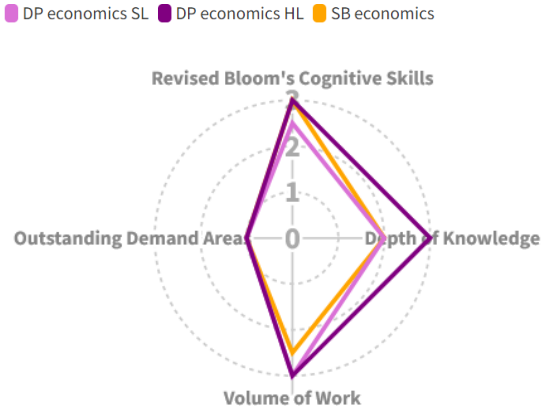
- **Differences in content:** the first-year SB biology, geology and environmental science subject does not cover a significant part of the DP biology's content, with four topics at SL and six topics at HL having little or no presence in the SB. This is possibly a consequence of the combined nature of the course, as some time will be spent on subject areas outside of biology – i.e. geology and environmental sciences. The second-year SB biology subject shows greater alignment with the DP at SL, though seven topics show only partial alignment. A higher number of topics (11) show partial alignment at HL. Overall, the SB biology surpasses the DP SL in breadth and depth of content, and although it meets the breadth of the DP HL subject, it does not feature the same depth of content.

- **Differences in demand:** SB biology, as a whole, is exceeded by DP biology HL in all demand areas, though only for depth of knowledge and outstanding demand areas is the difference in scores a notable one.

6.2.5 Economics Alignment

The subject level alignment between the DP and SB economics subjects is represented below:

Figure 33: Visual representations of subject-level alignment (economics subjects)

Subject name	Learning outcomes alignment	Content alignment	Demand alignment
economics			

- **Learning outcomes alignment**: the level of alignment between the learning outcomes for the DP and SB economics subjects is high. Indeed, all the DP economics' learning outcome themes are evidenced in SB economics, with the latter featuring no significant additional themes.

- **Content alignment**: SB economics has a good level of alignment with DP SL economics, as they share a significant number of subtopics and have comparable breadth and depth. There is less alignment between SB economics and DP HL economics, as the latter covers content in more depth.

- **Demand alignment**: there is a high level of alignment in demand between DP economics SL and SB economics. Indeed, both score very similarly with regards to Bloom's cognitive skills, depth of knowledge, volume of work and outstanding demand areas. SB economics is less aligned with DP HL, as it scores lower for depth of knowledge.

The **key similarities** identified were the following:

- **Similarities in learning outcomes**: of the six DP economics learning outcome themes, five of these are well-evidenced in SB economics and only one is partially evidenced, thus demonstrating a very high degree of alignment between the learning outcomes of both courses. Indeed, both subjects expect students to understand and apply critical thinking to economic issues, theories and concepts, as well as analyse data, formulate arguments, and make recommendations. Furthermore, both expect students to be informed of, and apply critical thinking to, social, cultural, and historical contexts and their related economic situations and factors.

- **Similarities in content**: SB economics includes some content from nearly all subtopics in DP economics, which span microeconomics, macroeconomics, and the global economy. SB economics often strongly aligns with the DP economics SL content in the subtopics of these areas and sometimes also has partial alignment with the AHL content. Overall, the breadth and depth of SB economics content is somewhat similar to that of DP SL.

- **Similarities in demand**: like DP economics, the learning outcomes of SB economics demonstrate higher order cognitive skills of analysis and evaluation, earning it the same high score as DP HL for Bloom's cognitive skills, which is slightly higher than DP SL. SB economics scores the same as DP SL for depth of knowledge, as both cover a substantial number of topics in good detail and sometimes require students to engage with a high level of complexity. SB economics scores the same as both DP subjects for outstanding demand areas – these being the internal assessment in the DP and the content regarding ethics of economics decisions in the SB. SB economics scores also very similarly to both DP subjects for volume of work, as it demonstrates a heavy workload. Overall, the demand of SB economics aligns very strongly with DP economics SL.

The **key differences** identified were the following:

- **Differences in learning outcomes:** there are no significant differences in the learning outcomes of DP and SB economics. However, it can be noted that SB economics features less emphasis than the DP on understanding the uncertainty behind economic opinions and theories.

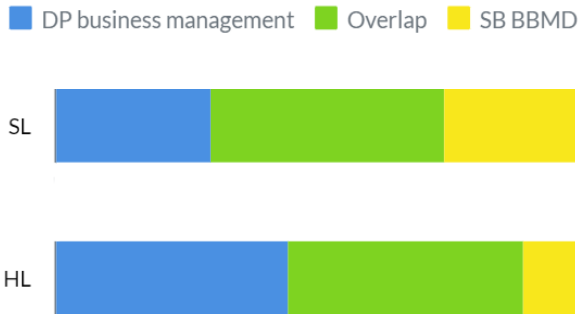
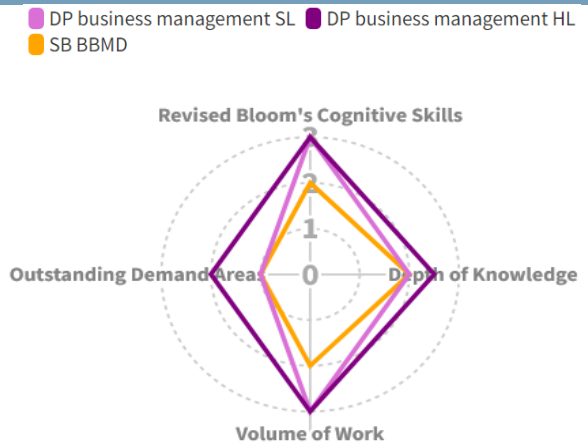
- **Differences in content:** SB economics is not offered at different levels, such as SL and HL in the DP, and is only studied over one year. As such, it is unsurprising that the SB economics syllabus has less depth in its content than DP HL. Indeed, SB economics only sometimes has partial alignment with AHL content and often does not have any alignment with the AHL content of certain subtopics, such as those relating to market failure, elasticity of supply and demand, and types of trade protection. Furthermore, there are a few DP subtopics with which SB economics has no alignment with, at either level – these being economics of inequality and poverty, and balance of payments. Furthermore, some SL content is covered in less detail in SB economics, though the level of depth of the latter is sometimes difficult to ascertain due to the content being described in broader terms in the SB curriculum. Finally, SB economics covers a few areas of content which are not explicit in the DP curriculum, such as the new economy and digital revolution.

- **Differences in demand:** generally, SB economics aligns closely with DP subjects in terms of demand, particularly DP economics SL. The most significant difference of note is that SB economics scores less than DP HL for depth of knowledge.

6.2.6 Business Alignment

The subject level alignment between the DP and SB business management subjects is represented below:

Figure 34: Visual representations of subject-level alignment (business management subjects)

Subject name	Learning outcomes alignment	Content alignment	Demand alignment
SB business and business model design	Low Moderate High		

- **Learning outcomes alignment**: the level of alignment between the learning outcomes for the DP business management and SB business and business model design (BBMD) subjects is high. Indeed, all the DP business's learning outcome themes are evidenced in SB BBMD, with the latter featuring only one significant additional theme.

- **Content alignment**: there is a moderate level of content alignment between DP SL business management and SB BBMD, as they share some subtopics and are similar in content size. However, SB BBMD and DP HL have limited content alignment due to the latter covering additional content areas and a significant number of subtopics in more depth.

- **Demand alignment**: SB BBMD has some alignment with DP SL, as it scores the same for depth of knowledge and outstanding demand areas, though less for Bloom's cognitive skills and volume of work. DP HL economics surpasses SB BBMD in all demand categories.

The **key similarities** identified were the following:

- **Similarities in learning outcomes**: of the five DP business management learning outcome themes, four are well-evidenced in SB BBMD and only one is partially evidenced, thus demonstrating a high level of alignment between the two subjects' learning outcomes. Indeed, both subjects expect students to demonstrate knowledge of business management topics and concepts, analyse complex data, and analyse and evaluate business approaches.

- **Similarities in content**: SB BBDM includes DP SL content from a good number of DP business management subtopics, sometimes strongly aligning in its coverage of these. SB BBMD has particularly good alignment with SL content from Unit 2: Human resource management. Occasionally, SB BBDM has some alignment with the AHL content of a DP subtopic, such as sales forecasting and production planning. Overall, SB BBDM has a moderate level of alignment with DP SL business management with regards to content.

- **Similarities in demand**: SB BBMD has some alignment with DP SL with regards to demand, as it scores the same in half of the categories. Indeed, although the content of both subjects may be somewhat different, SB BBMD was also deemed to cover a good number of topics in considerable detail, as well requiring some evidence of strategic and extended thinking, and thus scored the same for depth of knowledge. Moreover, both DP SL and SB BBMD score the same for outstanding areas of demand, as each had one area in their curricula.

The **key differences** identified were the following:

- **Differences in learning outcomes:** overall, there is a high level of alignment between the learning outcomes of DP business management and SB BBMD. However, it can be noted that the DP has a higher emphasis on real-world contexts and business management within society than SB BBMD. Conversely, the SB BBMD's learning

outcomes include creation of proposals and business model proposals, which is not explicitly described in the DP's learning outcomes.

- **Differences in content:** SB BBDM does not include a number of DP business management subtopics at SL, particularly those in Unit 1: Introduction to business management. Furthermore, SB BBDM often only partially aligns with SL content, particularly that in Unit 4: Marketing. With regards to DP HL, SB BBMD does not cover the AHL content of a significant number of subtopics, particularly those in Unit 5: Operations Management. Conversely, SB BBDM covers some content which is not present in DP business management, such as the creative process in generating business ideas, specific tools such as empathy maps, and specific techniques for presenting projects or business ideas.

- **Differences in demand:** SB BBMD scores lower than both DP subjects for Bloom's cognitive skills and volume of work. Indeed, the DP subjects score highly in these categories due their predominant presence of higher order cognitive skills and heavy workload. Furthermore, SB BBMD is not well aligned with DP HL, as it also scores less than the latter for depth of knowledge and outstanding demand areas.

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Appendix A

This Appendix provides further detail on the criteria utilised by Ecctis' experts and external panel members with subject expertise to measure demand for each of the subjects analysed in this study.

Demand Profile – Subject-level Judgement

- **Revised Bloom's Cognitive Skills** score (0-3): this is an overall score of course demand, based entirely on a review of learning outcomes. Levels have been defined based on increasing emphasis on Bloom's Higher Order Thinking Skills.

    - Level 0 – remembering and understanding: learning outcomes (as well as assessment and content) are primarily focused on recall and understanding, with limited or no evidence of higher order thinking skills.
    - Level 1 – applying: learning outcomes (as well as assessment and content) comprise a mix of recall-, understanding- and application-focused objectives, with only limited presence of higher order thinking skills.
    - Level 2 – analysing: learning outcomes (as well as assessment and content) comprise a mix of recall-, understanding and application-focused goals but also feature a substantial focus on analysis. Learning outcomes can also potentially feature some (though limited) evidence of evaluation and creation-focused goals.
    - Level 3 – evaluating and creating (or synthesising): learning outcomes (as well as assessment and content) feature a predominant focus on analysis-, evaluation- and creation/synthesis.

- **Depth of Knowledge** (adapted from Webb's) score (0-3): this is an overall score evaluating the depth of knowledge or complexity of knowledge required by curriculum standards and expectations. The score is focused on subject content and learning outcomes, complemented by assessment where relevant/possible. Levels have been defined based on the level of detail studied per topic, as well as the levels of thinking described in Webb's depth of knowledge framework.

    - Level 0 – All or most topics are studied in limited detail (pre-upper secondary level). Only basic pre-requisite knowledge is required in order to grasp ideas. The level of cognitive complexity of the information students are expected to know is low (e.g. many tasks may require recall and reproduction of information such as facts, definitions, terms, or simpler procedures – acquired knowledge).
    - Level 1 – Some topics are studied in considerable detail. Moderate levels of pre-requisite knowledge are required in order to grasp ideas in some topics. The level of cognitive complexity of the information students are expected to know is low to moderate (e.g. many tasks may require engagement of some mental processing beyond habitual responses, including comparison and basic reasoning – knowledge application).

  - Level 2 – Most topics are studied in considerable detail. Considerable pre-requisite knowledge is required in order to grasp ideas in some topics. The level of cognitive complexity of the information students are expected to know is average to high (e.g. some tasks require complex reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. The cognitive demands are often complex and abstract – analysis).
  - Level 3 – All or most topics are studied in very high detail. Considerable pre-requisite knowledge is required in order to grasp ideas in most topics. The level of cognitive complexity of information students are expected to know is mostly high (e.g. many tasks may require complex reasoning, planning, developing, information synthesis, interpretation of data for problem solving, and thinking most likely over an extended period – extended thinking).

- **Volume of Work** score (0-3): this is a trifactor score, considering breadth of content and depth of content, evaluated against the programme's specified timeframe. The three factors – breadth, depth, and time – were all considered in defining the levels.

  - Level 0 – light: small number of themes and sub-themes covered; a significant majority of time is spent on straightforward or basic themes; generous time allocation per theme.
  - Level 1 – moderate: typical number of themes and sub-themes covered; more time spent on conceptually complex themes compared to Level 1 (though majority of time still spent on themes of basic depth); standard time allocation per theme.
  - Level 2 – moderate heavy: typical to high number of themes and sub-themes covered; a significant proportion of time spent on issues beyond basic conceptual depth; standard to short time allocation per theme.
  - Level 3 – heavy: high number of themes and sub-themes covered; a large proportion of time spent on issues beyond basic conceptual depth; short time allocation per theme.

- **Outstanding Areas of Subject Demand** score (0-3): this score reflects the number of content areas typically viewed as more challenging and/or conducive to intellectual stretching of learners. Levels have been defined on a scale of increasing presence of 'stretch areas'.

  - Level 0 – no stretch areas (0)
  - Level 1 – few stretch areas (1-2)
  - Level 2 – a significant number of stretch areas (3-4)
  - Level 3 – a high number of stretch areas (>4)

Appendix B

Learner profile	Approaches to learning	Approaches to teaching	International-mindedness
Inquirers: We nurture our curiosity, developing skills for inquiry and research. We know how to learn independently and with others. We learn with enthusiasm and sustain our love of learning throughout life. **Knowledgeable**: We develop and use conceptual understanding, exploring knowledge across a range of disciplines. We engage with issues and ideas that have local and global significance. **Thinkers**: We use critical and creative thinking skills to analyse and take responsible action on complex problems. We exercise initiative in making reasoned, ethical decisions. **Communicators**: We express ourselves confidently and creatively in more than one language and in many ways. We collaborate effectively, listening carefully to the perspectives of other individuals and groups. **Principled**: We act with integrity and honesty, with a strong sense of fairness and justice, and with respect for the dignity and rights of people everywhere. We take responsibility for our actions and their consequences. **Open Minded**: We critically appreciate our own cultures and personal histories, as well as the values and traditions of others. We seek and evaluate a range of points of view, and we are willing to grow from the experience.	In all IB programmes, there are five categories of skills including: **Thinking skills:** including areas such as critical thinking, creative thinking, and ethical thinking **Research skills:** including skills such as comparing, contrasting, validating, and prioritizing information **Communication skills:** including skills such as written and oral communication, effective listening, and formulating arguments **Social skills:** including areas such as forming and maintaining positive relationships, listening	In all IB programmes, teaching is: **Based on inquiry:** A strong emphasis is placed on students finding their own information and constructing their own understandings. **Focused on conceptual understanding:** Concepts are explored in order to both deepen disciplinary understanding and to help students make connections and transfer learning to new contexts. **Developed in local and global contexts:** Teaching uses real-life contexts and examples, and students are encouraged to process new information by connecting it to their own experiences and to the world around them. **Focused on effective teamwork and collaboration:** This includes promoting teamwork and collaboration between students, but also refers to the collaborative relationship between teachers and students.	The aim of all IB programmes is to develop internationally minded people who recognize their common humanity and shared guardianship of the planet. Central to this aim is international-mindedness. International-mindedness is a multifaceted concept that captures a way of thinking, being and acting characterised by an openness to the world and a recognition of our deep interconnectedness to others. To be open to the world, we need to understand it. IB programmes therefore provide students with opportunities for sustained inquiry into a range of local and global issues and ideas. This willingness to see beyond immediate situations and boundaries is essential as globalization and emerging technologies continue to blur traditional distinctions between the local, national and international. An IB education fosters international-mindedness by helping students reflect on their own perspective, culture and identities, as well as those of others. By engaging with diverse beliefs, values and experiences, and by learning to think and collaborate across cultures and disciplines, IB learners gain the understanding necessary to make progress towards a more peaceful world.

Caring: We show empathy, compassion, and respect. We have a commitment to service, and we act to make a positive difference in the lives of others and in the world around us. **Risk-Takers**: We approach uncertainty with forethought and determination; we work independently and cooperatively to explore new ideas and innovative strategies. We are resourceful and resilient in the face of challenges and change. **Balanced**: We understand the importance of balancing different aspects of our lives – intellectual, physical, and emotional – to achieve well-being for ourselves and others. We recognize our interdependence with other people and with the world in which we live. **Reflective**: We thoughtfully consider the world and our own ideas and experience. We work to understand our strengths and weaknesses in order to support our learning and personal development.	skills, and conflict resolution **Self-management skills:** including both organizational skills, such as managing time and tasks, and affective skills, such as managing state of mind and motivation.	**Designed to remove barriers to learning:** Teaching is inclusive and values diversity. It affirms students' identities, and aims to create learning opportunities that enable every student to develop and pursue appropriate personal goals. **Informed by assessment:** Assessment plays a crucial role in supporting, as well as measuring, learning. This approach also recognizes the crucial role of providing students with effective feedback.	An IB education further enhances the development of international-mindedness through multilingualism. All IB programmes require students to study, or study in, more than one language. This is because we believe that communicating in more than one language helps students to appreciate that his or her own language, culture and world view are just one of many. In this way, it provides excellent opportunities to develop intercultural understanding and respect. International-mindedness is also encouraged through a focus on global engagement and meaningful service with the community. These elements challenge students to critically consider power and privilege, and to recognize that they hold this planet and its resources in trust for future generations. They also highlight the focus on action in all IB programmes: a focus on moving beyond awareness and understanding to engagement, action and bringing about meaningful change to make a more peaceful and sustainable world for everyone.

Appendix C

Task brief – Expert Demand Panel – [Subject]

For each subject, highlight in yellow the descriptor(s) deemed to best fit each demand category, using the following criteria (please refer to the demand tables for descriptors of the levels):

- **Revised Bloom's Cognitive Skills** score (0-3): this is an overall score of course demand, based entirely on a review of learning outcomes. Levels have been defined based on increasing emphasis on Bloom's Higher Order Thinking Skills.

- **Depth of Knowledge** (adapted from Webb's) score (0-3): this is an overall score evaluating the depth of knowledge or complexity of knowledge required by curriculum standards and expectations. The score is focused on subject content and learning outcomes, complemented by assessment where relevant/possible. Levels have been defined based on the level of detail studied per topic, as well as the levels of thinking described in Webb's depth of knowledge framework.

- **Volume of Work** score (0-3): this is a trifactor score, considering breadth of content and depth of content, evaluated against the programme's specified timeframe. The three factors – breadth, depth and time – were all taken into account in defining the levels.

- **Outstanding Areas of Subject Demand** score (0-3): this score reflects the number of content areas typically viewed as more challenging and/or conducive to intellectual stretching of learners. Levels have been defined on a scale of increasing presence of 'stretch areas'.

Demand Judgements – [Subject]

Table 40: [Subject]

Demand Judgement	Score Descriptors (highlight the best-fit descriptor)	Judgement and Key Evidence
Revised Bloom's Cognitive Skills[165]	Level 0 – remembering and understanding: learning outcomes are primarily focused on recall and understanding, with limited or no evidence of higher order thinking skills.	
	Level 1 – applying: learning outcomes (as well as assessment and content) comprise a mix of recall-, understanding- and application-focused objectives, with only limited presence of higher order thinking skills.	
	Level 2 – analysing: learning outcomes (as well as assessment and content) comprise a mix of recall-, understanding and application-focused goals but also feature a substantial focus on analysis. Learning outcomes can also potentially feature some (though limited) evidence of evaluation and creation-focused goals.	
	Level 3 – evaluating and creating (or synthesising): learning outcomes feature a predominant focus on analysis-, evaluation- and creation/synthesis.	
Depth of Knowledge[166]	Level 0 – All or most topics are studied in limited detail (pre-upper secondary level). Only basic pre-requisite knowledge is required in order to grasp ideas. The level of cognitive complexity of the information students are expected to know is low (e.g. many tasks may require recall and reproduction of information such as facts, definitions, terms, or simpler procedures – acquired knowledge).	
	Level 1 – Some topics are studied in considerable detail. Moderate levels of pre-requisite knowledge are required in order to grasp ideas in some topics. The level of cognitive complexity of the information students are expected to know is low to moderate (e.g. many tasks may require engagement of some mental processing beyond habitual responses, including comparison and basic reasoning – knowledge application).	

[165] Evidence pool: Learning outcomes
[166] Evidence pool: Learning outcomes, subject content, assessment types

Demand Judgement	Score Descriptors (highlight the best-fit descriptor)	Judgement and Key Evidence
	Level 2 – Most topics are studied in considerable detail. Considerable pre-requisite knowledge is required in order to grasp ideas in some topics. The level of cognitive complexity of the information students are expected to know is average to high (e.g. some tasks require complex reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. The cognitive demands are often complex and abstract – analysis).	
	Level 3 – All or most topics are studied in very high detail. Considerable pre-requisite knowledge is required in order to grasp ideas in most topics. The level of cognitive complexity of information students are expected to know is mostly high (e.g. many tasks may require complex reasoning, planning, developing, information synthesis, interpretation of data for problem solving, and thinking most likely over an extended period of time – extended thinking).	
Volume of work[167]	Level 0 – light: small number of themes and sub-themes covered; a significant majority of time is spent on straightforward or basic themes; generous time allocation per theme.	
	Level 1 – moderate: typical number of themes and sub-themes covered; more time spent on conceptually complex themes compared to Level 0 (though majority of time still spent on themes of basic depth); standard time allocation per theme.	
	Level 2 – moderate heavy: typical to high number of themes and sub-themes covered; a significant proportion of time spent on issues beyond basic conceptual depth; standard to short time allocation per theme.	
	Level 3 – heavy: high number of themes and sub-themes covered; a large proportion of time spent on issues beyond basic conceptual depth; short time allocation per theme.	
Outstanding Areas of Subject Demand[168]	Level 0 – no stretch areas (0)	
	Level 1 – few stretch areas (1-2)	
	Level 2 – a significant number of stretch areas (3-4)	

[167] Evidence pool: Subject content; assessment types and number; course duration; time allocated per topic/subtopic (where available).
[168] Evidence pool: Subject content.

Demand Judgement	Score Descriptors (highlight the best-fit descriptor)	Judgement and Key Evidence
	Level 3 – a high number of stretch areas (>4)	