Comparative Analysis of the International Baccalaureate Primary Years Programme (PYP) and Middle Years Programme (MYP) in the Context of the Indian Education System

Submitted to the International Baccalaureate by UK NARIC

The National Recognition Information Centre for the United Kingdom

The national agency responsible for providing information and expert opinion on qualifications and skills worldwide

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List of Acronyms

Term	Meaning
ATL	Approaches to learning
BTEC	Business and Technician Education Council
CBSE	Central Board of Secondary Education
CISCE	Council for Indian School Certificate Examinations
CP	Career-related Programme
DP	Diploma Programme
IB	International Baccalaureate
ICSE	The Indian Certificate of Secondary Education
MYP	Middle Years Programme
OCR National	Oxford, Cambridge and RSA (UK awarding body for general and vocational qualifications)
PYP	Primary Years Programme
NCERT	The National Council of Educational Research and Training
NCF	The Indian National Curriculum Framework
UK NARIC	The National Recognition Information Centre for the United Kingdom

Glossary

Key IB Terms	
Term	**Definition**
Aims	The "general statements about what teachers may expect to teach or do, what students may expect to experience or learn, and how students may be changed by the learning experience"[1].
Approaches to learning (ATL)	Skills that students develop that allow them to 'learn how to learn'[2].
Assessment Criterion	The assessment criteria align with the objectives and are used by teachers to judge the extent to which students have achieved the objectives. Teachers assess the criteria through summative tasks[3].
Global Contexts	Used in the IB MYP teaching and learning to understand concepts through a common language. These contexts allow for students to reflect on local, national, global communities, and real-life experiences.
IB MYP Guide	A subject level document that includes the aims, objectives, and prescribed concepts and assessment criteria. The document may also contain subject-specific guidance for teaching and learning[4].
IB PYP Scope and Sequences	Documents that provide examples of curriculum expectations for each subject area. Used as a tool by IB World Schools, they identify the role of the subject within the transdisciplinary programme and highlight the essential elements of that subject.
Interdisciplinary	Approach taken in the IB MYP in which "students come to understand bodies of knowledge and modes of thinking from two or more subject groups and integrate them to create new understanding"[5].
Key Concepts	These are "contributed from each subject group, provide interdisciplinary breadth to the programme. Key concepts are broad, organising, powerful ideas that have relevance within and across subjects and disciplines, providing connections that can transfer across time and culture"[6].
Objectives	A set of "statements which describe the skills, knowledge and understanding that will be addressed in the subject group"[7]. These are then addressed through teaching and learning.
Related Concepts	These are "grounded in specific disciplines, explore key concepts in greater detail, providing depth to the programme. They emerge from reflection on the nature of specific subjects and disciplines, providing a focus for inquiry into subject-specific content"[8].

[1] International Baccalaureate Organization, 2015. *Further Guidance for Developing MYP Assessed Curriculum.*
[2] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*
[3] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*
[4] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*
[5] International Baccalaureate Organization, 2010. *The Primary Years Programme as a model of transdisciplinary learning.*
[6] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*
[7] International Baccalaureate Organization, 2015. *Further Guidance for Developing MYP Assessed Curriculum.*
[8] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*

Strand	These are "aspects or elements of subject-group objectives or criteria; or put another way, strands are a detailed breakdown of what each objective or criterion encompasses or entails"[9]. Objective strands must be addressed and criteria strands assessed at least twice a year.
Transdisciplinary	Approach taken in the IB PYP "to convey learning that has relevance across the subject areas and more importantly, learning that transcends the confines of the subject areas to connect to what is real in the world"[10].
General Terms	
Term	**Definition**
Class	In the context of this report, "class" is used to refer to academic years in India, e.g. Class X (Grade/Year 10).
Cross-disciplinary	Of, relating to, or involving two or more disciplines[11].
Curriculum	The courses, classes, or content to be taught within a programme.
Learning outcomes	A learning outcome is the particular knowledge, skill or competency that a student is expected to exhibit after a period of study.
Spiral approach	A learning approach that begins with teaching simple facts first, then repeatedly re-visiting a topic with more details gradually introduced.
Syllabus	A document outlining the curriculum, topics to be taught, and assessment requirements.

[9] International Baccalaureate Organization, 2015. *Further Guidance for Developing MYP Assessed Curriculum.*
[10] International Baccalaureate Organization, 2010. *The Primary Years Programme as a model of transdisciplinary learning.*
[11] Merriam-Webster, 2015. *Dictionary.*

Executive Summary

The International Baccalaureate (IB) is a non-profit educational foundation offering four programmes internationally through authorised IB world schools. With over 120 of these world schools based in India[12], the IB commissioned UK NARIC to undertake a comparative analysis of two of its programmes, the Primary Years Programme (PYP) and Middle Years Programme (MYP), in the context of the Indian education system.

The purpose of the study is to compare both the underpinning philosophies, aims and principles of the IB and Indian school education systems, and in practice, how the resulting curricula compare. To this end, the comparative analysis reviews the PYP and MYP in relation to four reference points in the Indian education system:

- The Indian National Curriculum Framework (NCF, 2005)
- The National Council of Educational Research and Training (NCERT) primary and secondary education syllabi in three subjects
- The Indian Certificate of Secondary Education (ICSE – Class IX-X) from the Council for Indian School Certificate Examinations (CISCE) in three subjects: Mathematics, Science, and Social Studies.
- The Secondary School Examination (qualification: All India Secondary School Certificate) (Class IX-X) from the Central Board of Secondary Education (CBSE).

Methodology

To complete this study, UK NARIC undertook a desk-based document analysis, using materials available in the public domain, including published curriculum guides, syllabi and assessment framework documents.

A review of these documents from the IB and Indian reference points informed three levels of analysis: framework level, national level, and qualification and subject level analysis.

First, the framework level analysis looked at the philosophical underpinnings of the IB and Indian education systems, making particular reference to the IB Learner Profiles and the Indian NCF (2005) respectively. The analysis centred on the NCF's guiding principles; aims of education; its mission and goals regarding learning, development and teaching; and the concept of holistic education.

Second, the national curriculum level analysis examined the IB PYP and IB MYP against the primary and secondary syllabi in the NCERT for Mathematics, Science, and Social Studies. This comparison focussed on the key principles, themes, structure and content of the qualifications.

Next, the qualification and subject-level analysis examined the IB MYP in Mathematics, Science, and Social Studies in relation to Class IX and X syllabi in India, as prescribed by

[12] At the time of writing, the IB website lists 124 schools offering one or more of the four IB programmes, with 61 of those schools offering the PYP and/or MYP.

two of the central education boards, the ICSE and CBSE. The focus of this analysis was on identifying similarities and differences in the curriculum (in terms of aims, objectives and key topics covered) and assessment (in terms of format, typology of questions and/or assessment criteria): no judgement of quality has been made or intended on any of the programmes or awarding bodies reviewed.

In addition to the subject analysis of the CBSE and the IB MYP, the core components, curriculum mission and goals, core competences and outcomes for the CBSE were examined through a qualitative analysis. This comparison of the underpinning philosophies focussed on comparable values and accounted for cultural differences where applicable.

Key Findings

The study has found many similarities between the IB and Indian education, both in principle and in practice.

In terms of the underpinning philosophies and aims, it is evident from the framework level analysis and the examination of the CBSE core components that both the IB and Indian systems seek to:

- emphasise a holistic approach to education and development
- promote active and life-long learning
- develop students' ability to construct their own knowledge; encouraging and supporting them to make connections between what they learn in the classroom and the world outside it
- develop communicative and inquisitive learners who are knowledgeable in subjects they learn
- ensure appreciation for individuality and the individual differences of students
- support the development of open democratic classrooms
- focus, at this level of education, on using assessment primarily as a means to reflect on and improve the teaching-learning process.

The CBSE and IB also share many principles and components including the development of life-skills and global perspectives. Reflecting the national context, the CBSE includes a focus on teaching the values of the Indian constitution. Although the Indian constitution is not a part of the IB framework, the values that make up the constitution are similarly taught to IB learners and the framework would enable IB World Schools to incorporate specific content on the Constitution, as required. The CBSE and IB further focus on similar learning methods (i.e. value-based, collaborative, conceptual), skills (i.e. communication, problem-solving, language, and technological), and developing personal attributes (i.e. citizenship, empathy, creativity, open-mindedness of other cultures and opinions).

At subject level, the national curriculum level analysis at primary level (NCERT and IB PYP) found similar principles and content between the programmes in the three selected subjects. Both the NCERT and the IB PYP aim to develop competent users in Mathematics, investigative skills in Science, and an understanding of history, society, and the world around students in Social Studies. A comparison of the cross-curricula linkages also demonstrated

that both the IB and the Indian boards aim to connect the curriculum, and that the IB has a framework in place for ensuring these linkages are taught within the curriculum.

Some themes, principles and content of primary education (in the IB and NCERT) are similarly present in secondary education. For instance, in primary and secondary education both programmes highlight the importance of teaching to real-life contexts and applying the Mathematics syllabi to real-life experiences. Inquiry is a large focus of the primary and secondary Science syllabi for both the IB and NCERT. In Social Studies, the NCERT principles and content frequently focus on Indian contexts which would need to be adapted into the IB.

As previously noted, the CBSE and CISCE are developed based on the standards set in the NCERT. Therefore, comparisons of the IB PYP and MYP to syllabi prescribed by the NCERT, CBSE and CISCE resulted in similar key findings.

Differences noted can be largely categorised as structural and contextual. In India, the underpinning philosophy is stated in the NCF, while the NCERT develops and publishes the key themes and principles for the curriculum, textbooks and teaching along with the core topics to be covered. The CISCE and CBSE then use the NCERT syllabi to develop the syllabi and assessments for each subject. Through this process, the Indian NCF, NCERT, CBSE and CISCE are framed in the national context, with specific mention made to Indian history and heritage, the workings of the Indian democracy and the values of the Indian Constitution. Structurally, the IB defines a framework for the PYP and MYP respectively that is underpinned by the IB Learner Profile. As international awards, the IB programmes are not tied to any national context; instead the IB encourages development of common core skills, attributes and objectives for all learners. From this, each IB World School then develops the syllabi to reflect the local, regional or national context in which it is located.

These structural and contextual differences are demonstrated in the key findings from the curriculum comparison. For example, the NCERT syllabi, in the subjects and classes observed, are mostly knowledge-based, outlining the specific content to be taught and the teaching hours recommended for each major topic area. The IB PYP and MYP is outcomes-based where overall expectations for a topic are included as part of the framework, but specific content and teaching time is determined at school level. As such, some topics and sub-topics with the NCERT curriculum are not readily identifiable within the IB programmes, whilst a substantial number of similarities can be observed between the broader topic areas, indicating clear potential for the NCERT content to be adopted by IB World Schools under the IB framework.

Differences can also be observed in the assessment used by the IB and the two boards of education. All three employ internal and external assessment at secondary level, although the external assessment is optional in the case of the IB MYP. When comparing the IB MYP specimen eAssessments for the three subjects and the CBSE question design guidelines from the 2015/16 syllabus[13], clear differences could be seen both in the number of questions and the weighting assigned to the different question typologies; with the CBSE typically

[13] No examination papers or mark schemes have been reviewed within the scope of this study.

employing a higher number of questions, each designed to test a given typology (including but not limited to knowledge recall, understanding, application, and evaluation); whilst the IB MYP, though invariably testing across these typologies, would include a smaller number of questions that primarily testing application, evaluation and other higher order thinking skills.
When looking at the assessment criteria used in the ICSE and the IB MYP, the ICSE descriptors for the internal assessment in the three subjects are broad and focussed on the assessment task at hand. The IB MYP assessment criteria are used for multiple assessment tasks but are more descriptive and relevant to the objectives of the overall subject.

In the ICSE and IB, learning outcomes are developed by schools, however a comparison of sample learning outcomes demonstrates that both include statements for students to understand and apply their knowledge, and analyse or discuss ideas. In mathematics and science, the ICSE includes a sample outcome for students to apply their knowledge in other disciplines which is coherent with the IB MYP interdisciplinary approach.

Overall, the key findings from the three analyses demonstrate clear similarities between the IB PYP and MYP and the Indian education system, with many shared principles and aims as well as a framework that should enable IB World Schools in India to deliver the IB PYP and MYP in a way that is compatible with the aims, values and curriculum requirements of the national system.

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1. Introduction

1.1 Scope and Objectives of the Study

The International Baccalaureate (IB) is a non-profit educational foundation that offers four programmes internationally. One of the many countries in which the IB programmes are delivered is India. As of 2014, there were over 1.4 million elementary schools in India and over 200,000 secondary/higher secondary schools[14]. There are currently 60 IB World Schools in India that offer the IB PYP and 18 that offer the IB MYP[15].

This study, commissioned by the IB, intends to provide a holistic comparative analysis of two IB programmes, the Primary Years Programme (PYP) and Middle Years Programme (MYP), in the context of the Indian education system.

About UK NARIC

UK NARIC is the designated national agency in the United Kingdom for the recognition of international qualifications and professional skills. Since 1997, it has performed this official function on behalf of the UK Government.

UK NARIC provides informed advice and guidance on vocational, academic and professional qualifications from over 190 countries worldwide. The information provided enables international and UK organisations, institutions and government agencies to develop informed opinions when considering qualifications or training systems from overseas.

With the expertise and experience developed through running the National Agency, together with a number of other programmes on behalf of the UK Government and European Union, UK NARIC has been uniquely well placed to manage and support delivery of an extensive global research portfolio for:

- Ministries of Education and other government agencies
- Universities and other higher education institutions
- Secondary exam boards and awarding bodies
- Professional bodies

Specific areas of expertise include:

- International education systems and qualifications
- Comparative studies on curriculum and assessment
- Qualification benchmarking
- Grade comparisons
- Best practice in recognition
- Qualification framework development and/or referencing;
- Supporting the development and implementation of mutual recognition agreements.

[14] National University of Educational Planning and Administration, 2014. *Education For All Towards Quality with Equity: India*.
[15] International Baccalaureate Organization, 2015. *Find an IB World School.*

The study will therefore seek to identify similarities and differences not only in terms of the IB and Indian curriculum and assessment, but also the philosophies and aims which underpin them both. For this purpose, the IB will be compared with the following reference points:

- The Indian National Curriculum Framework (NCF, 2005)
- The National Council of Educational Research and Training (NCERT) primary and secondary education syllabi in three subjects (Mathematics, Science, and Social Studies)
- The Indian Certificate of Secondary Education (ICSE – Class IX-X) from the Council for Indian School Certificate Examinations (CISCE)
- The Secondary School Examination (qualification: All India Secondary School Certificate) (Class IX-X) from the Central Board of Secondary Education (CBSE).

1.2 Research Questions

The study is designed around the following research questions:

1) In what ways does the PYP and MYP align with the 'Guiding Principles', 'Aims of Education', and goals regarding learning, development and 'teaching for construction of knowledge' articulated by the NCF 2005?

2) To what degree are the attributes of the IB Learner Profile (e.g. 'caring', 'principled', 'open-minded', 'balanced' and 'reflective') congruent with NCF objectives concerning holistic education and the promotion of 'social and cultural vivacity' among learners?

3) To what extent do the PYP and MYP and NCERT primary and secondary syllabi align with regards to Mathematics, Science and Social Studies subject areas?

4) In what ways does the MYP align with the Central Board of Secondary Education 'Core Components', 'Curriculum Mission and Goals', 'Core Competence and Outcomes' and 'Main Pedagogical Outcomes for Curriculum Learning Areas' (CBSE 2015)?

5) To what degree does the MYP align with CBSE and ICSE Years IX and X Mathematics, Science and Social Studies subject areas and more broadly facilitate 'cross-curricula linkages'?

Structure of the Report

Section 2	includes the methodology used to complete the study
Section 3	provides an overview of the Indian school education system to contextualise the comparative analysis
Section 4	includes an overview of the IB and the four programmes it offers, with a more detailed overview of the PYP and MYP in line with the focus of this study
Section 5	considers the ways in and extent to which the IB education reflects the underpinning principles of the Indian NCF
Section 6	examines how the IB PYP and MYP compare to the Indian NCERT syllabi in selected subjects

Sections 7 and 8	more closely considers the Indian and IB curriculum frameworks in practice, conducting a comparative analysis of the IB MYP with the content and assessment format in three subjects, as designed by two Indian school education boards, the CBSE and the CISCE respectively
Section 9	summarises the key findings from the study
Section 10	includes a bibliography of the resources used for the study.

2. Methodology

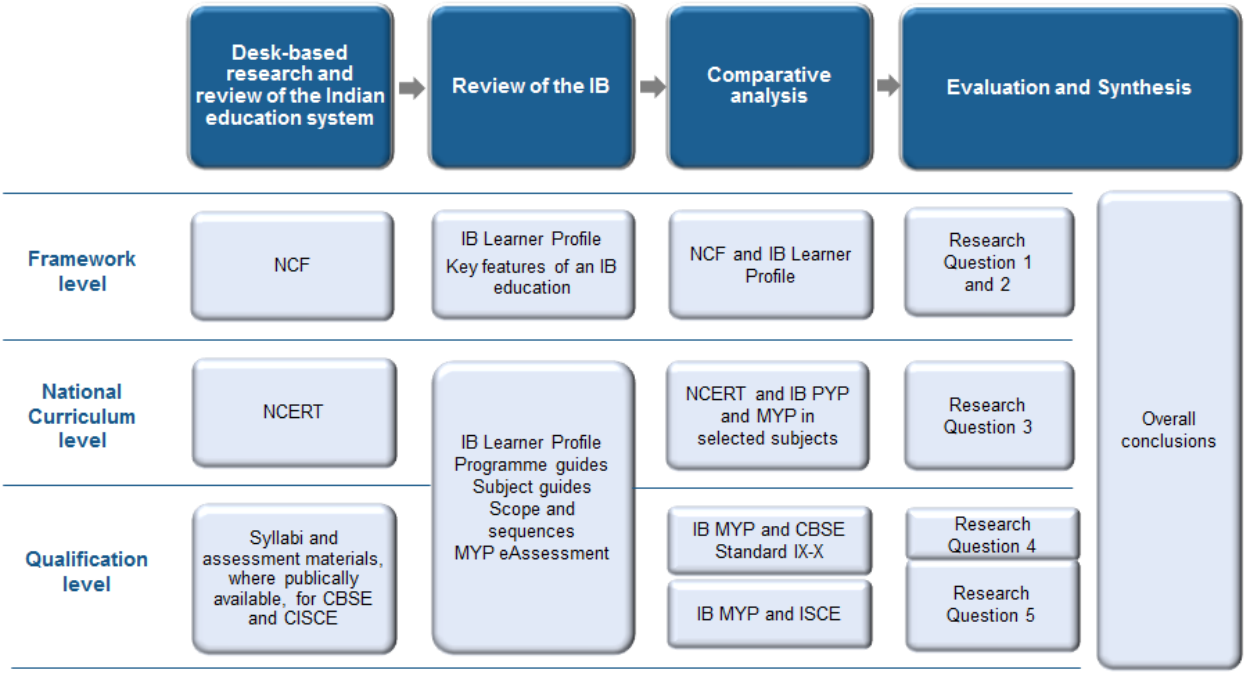
The methodology section outlines the process used to complete the comparative analysis and evaluation.

In order to conduct a reliable comparison of the IB qualifications against the focal points in the Indian education system and address the research questions, the study included the following key phases:

- Desk-based research and document review:
  - For the Indian school system – NCF, NCERT, CBSE and CISCE
  - For the IB – PYP and MYP
- Comparative analysis
- Evaluation and synthesis.

The process can be illustrated as follows:

Figure 1: Methodological process



2.1 Desk-based research and document review

As a first task, information pertaining to the IB PYP and MYP, including the programme content, and structure, assessment methods, learning outcomes and the philosophical underpinnings was collated. Similar information was also gathered from the public domain for the Indian NCF (2005), NCERT, CBSE and CISCE.

A full list of the sources can be found in Section 10.

First, a review of the frameworks, syllabi and programmes as a whole, was conducted to provide context to the review of the individual IB programmes and Indian syllabi and inform any methodological considerations. A second, comprehensive review was undertaken to discern the key principles, themes and components of the Indian framework, curriculum and assessment in preparation for the subsequent comparative analysis.

2.2 Comparative analysis

The second stage of the project, the comparative analysis, comprised three tiers as shown in Figure 1:

- Framework level analysis: comparison of the IB education and the Indian NCF
- National curriculum level analysis: comparison of the IB PYP and MYP syllabi to the Indian NCERT in Mathematics, Science and Social Studies in relevant years
- Qualification level analysis: comparison of the IB MYP curriculum and assessment, and as appropriate, other core components, with those of two Indian education boards, the CBSE and CISCE.

The key themes identified in the review were then searched for within the IB programmes, IB Learner Profile and other documentation where relevant, being mindful of inevitable variations in terminology. Using a tabular format, the report documents whether these themes could be similarly identified within the IB. Where sufficient evidence of similarity/alignment was found, a check mark (✓) was used. Where any aspect of the Indian system was not considered to be included within the IB, the cell was left blank and further explanation provided below the table. If there was evidence to show that the IB could be considered *partially* similar, a check mark with an asterisk was used (✓*). An example of the table format can be seen below:

Table 1: Example mapping table

[Reference Point in the Indian System]	Included in the IB
Key theme 1	✓*
Key theme 2	
Key theme 3	✓
Key theme 4	✓
Key theme 5	✓
Key theme 6	

The accompanying analysis for each table then provides both the evidence base for aspects UK NARIC considered to be covered by the IB as well as further explanation for areas which are not observed in the IB, including any areas which may be partially covered. Any relevant key features or components of the IB which were not similarly found within the Indian reference points were also identified within the text, where appropriate.

2.2.1 Framework level analysis [Research questions 1 and 2]

Since it could be reasonably expected that the national school curriculum and assessment would reflect the principles and aims established at a national level, the analysis began with the framework level analysis, comparing the philosophical underpinnings of the IB and Indian education.

The analysis centred on the Indian NCF (2005), and in particular its guiding principles; the aims of education; its mission and goals regarding learning, development and teaching; and the concept of holistic education.

Through this, the ways in which the PYP and the MYP align with the NCF could be clearly identified [Research Question 1].

2.2.2 National curriculum level analysis [Research question 3]

As outlined in the Introduction, analysis of the selected IB programmes against the NCERT centred on the three subject areas chosen by the IB: Mathematics, Science and Social Studies. The table below identifies the syllabi used as the basis for comparison.

Table 2: Syllabi reviewed in the IB-NCERT comparative analysis

Subject area	NCERT	IB PYP	IB MYP
Mathematics	Math I-V; Math VI-VIII	Mathematics	-
	Mathematics IX-X[II]	-	Mathematics
Science	Science VI-VIII	Science	-
	Science IX-X	-	Science
Social studies	Social Science VI-VIII	Social studies	-
	Social Science IX-X[II]		Individuals and Societies

The analysis identified and compared the NCERT and IB, for each subject area and level, in terms of key principles and themes; and structure and content.

The aims for each subject were also considered since these set out what the curriculum intends to achieve. It is important to highlight that the key information and level of detail provided in IB PYP, MYP and NCERT syllabi differ considerably in places. Each of the NCERT primary and secondary syllabi include different sections (e.g. introductions or general points for textbook writers, etc.) on the key principles for the curriculum and the textbook; likely accounting for the fact that specific aims of each subject will be further elaborated by the education boards that design the qualifications. The IB syllabi all include

introductory sections as well, but are focussed on the nature and philosophy of the subject. As such, the analysis has sought to identify the key principles and themes for the subjects in the NCERT syllabi, acknowledging that these may encompass aims for students to achieve, aims for teachers to achieve, and general themes to be addressed within the curriculum. These are listed in tabular format (outlined in Table 1), and are used as a point of reference against which the IB PYP / MYP can be compared.

The analysis had also sought to identify and compare recommended teaching time for each topic in the curriculum as a proportion of the teaching time for the overall subject. The data was not available in a comparable format meaning this comparison could not be made[16].

2.2.3 Qualification and subject-level analysis

Having considered the overarching national framework and curricula which underpin school education in India, the next stage of the analysis examined how the IB PYP and MYP compare in practice to similarly-focussed programmes in India; namely the Class IX and X curriculum and assessment as administered by two secondary education boards, the CISCE and the CBSE. No judgement of quality is made or intended on the programmes or awarding bodies.

As with the NCERT analysis, the comparison of curriculum and assessment between the IB and Indian programmes centred on three subjects selected by the IB: Mathematics, Science and Social Science. Again the most relevant modules and syllabi for these subjects were identified in the IB MYP, CBSE and ICSE during the review stage and the associated syllabi and assessment materials collated. These can be seen in the table below:

Table 3: Subjects examined in each programme

Subject area	CBSE	ICSE	IB MYP
Mathematics	Mathematics 041	Mathematics	Mathematics
Science	Science 086/090	Science	Science
Social Studies	Social Science 087	History, Civics, and Geography (50)[17]	Individuals and Societies

The subject-level analysis involved identification of the key aims, themes and principles that guide the syllabus for each subject, with consideration given to how and to what extent these could be similarly found within the IB programmes. Consideration was also given to the content in terms of range of topics as well as similarities in topics covered in the two syllabi[18].

[16] The NCERT Primary syllabi indicate the recommended number of periods or hours to be spent on topics within the Mathematics and Science but not in the Social Science. The IB PYP syllabus does not make recommendations for time spent on subjects, but similar to the NCERT, the teachers or schools set the hours for their classroom.
[17] The Economics (64) module has also been examined on a secondary basis.
[18] The CBSE has detailed subject level objectives and outcomes that are content specific. Therefore, a comparison of learning outcomes could not be completed.

The ICSE and CBSE syllabi all include descriptive sections on the topics, themes, and concepts that should be taught as part of the course. This differs from the IB in that key concepts and related concepts alongside objectives and/or strands are provided to schools to develop their own written and taught curriculum. The comparison of content was therefore based on the overarching themes, concepts and skills.

The IB MYP Guides and IB PYP Scope and Sequences documentation, outlining the suggested curriculum, assessment and skills taught (meant as examples for IB schools) were used as the principle source for the comparison against the ICSE and CBSE Class IX-X curricula.

Some consideration was also given to assessment in both systems, though within the scope of the study, this largely focussed on the assessment format and typology defined within the respective syllabi rather than a review of actual examination papers. As such, the analysis sought to identify similarities and differences in approaches to assessment rather than provide a value judgement on rigour or demand.

Both the IB and the two Indian programmes employ internal assessment so the analysis reflected on relevant guidelines for internal assessment where necessary. For example, the ICSE syllabi all include guidelines for marking the internal assessment with the criteria and range of grades that can be awarded. Although these are structured differently from the IB MYP, there was sufficient information to inform a comparative analysis with the IB MYP assessment criteria. Similarly both the ICSE and MYP provide suggestions for internal assessment tasks which were considered within the analysis.

Nevertheless, greater emphasis was placed on external assessment of the Indian programmes, taking in to consideration the method(s) of assessment employed, including the number, typology (types of skills assessed) and weighting of questions. This involved a comparative analysis of the IB MYP eAssessments in related subjects, though it should be acknowledged that unlike the CBSE and ICSE, the eAssessment is optional within the IB.

In addition to the subject analysis, consideration was given to the core components, principles and outcomes for the CBSE; namely the:

- Core components
- Curriculum mission and goals
- Core competence and outcomes
- Main pedagogical outcomes for curriculum learning areas.

As with the framework level analysis, which considered the underpinning philosophies and aims; the analysis of the CBSE components was qualitative in nature; applying a process of best fit and accounting for cultural and terminology differences where applicable. For example, it was accepted that no similar reference to the Indian constitution would be made in an international award and accordingly the analysis sought to identify evidence of comparable values integral to the IB education.

3. Overview of the Indian School Education System

3.1 Oversight and Administration

Responsibility for the national planning and policy of the overall education system lies with the Ministry of Human Resource Development (MHRD), part of the central government. Under this ministry are two education departments: the Department of Higher Education and Department of School Education and Literacy; with the latter holding responsibility for the development of school education and implementing the National Policy of Education (1992). State governments also share the responsibility of developing school education in each state.

The development of key educational policies and programmes, including the National Curriculum Framework, is done by the National Council of Education Research and Training (NCERT). The NCERT is further responsible for the implementation of government policy on education and developing the curricula, syllabi, textbooks and additional materials for school education and advising the central and state governments and boards.

Central and State Boards of Secondary/Senior Secondary Education use the national standard set by the NCERT to develop the curriculum, syllabi, and public examinations in their state or union territory. The CBSE and CISCE, two boards referenced in this study, are central (national) boards, alongside the National Institute of Open Schooling (NIOS)[19].

The CBSE

The CBSE sets the curriculum in affiliated schools and government schools and conducts examinations for the All India / Delhi Secondary School Certificate (after Class 10) and the All India / Delhi Senior School Certificate (after Class 12). The CBSE has more than 16,000 affiliated schools[20], and also conducts the Jawahar Navodaya Vidyalaya Selection Test (JNVST) for classes VI & IX. The CBSE also conducts a range of other assessments or entrance examinations for professional courses, including the Joint Entrance Examination (JEE-Main) for undergraduate Engineering programme and gateway for JEE (Advanced), Proficiency Test for Class X students, and the Central Teachers Eligibility Test (CTET)[21].

The CISCE

The CISCE was established in 1958 and since 1973 has set the curriculum and conducted public examinations in English for the Indian Certificate of Secondary Education (ICSE (after Class 10)), the Indian School Certificate (after Class 12), and the Certificate in Vocational Education (after Class 12 in the vocational stream). Students taking the CISCE examinations must be enrolled in an affiliated school[22], of which there are over 2,100[23]. The CISCE also

[19] International Comparisons, UK NARIC.
[20] Central Board of Secondary Education, 2014. *Annual Report 2014-2015.*
[21] Central Board of Secondary Education, 2014. *Annual Report 2014-2015.*
[22] Council for the Indian School Certificate Examinations, (n.d.). *Regulations Indian Certificate of Secondary Education Examination.*
[23] Council for the Indian School Certificate Examinations, 2013. *Locate a Council Affiliated School.*

conducts two national competitions: the Frank Anthony Memorial All-India Inter-School Debate and the Albert Barrow Memorial All-India Inter-School Creative Writing competitions.

3.2 Principles and Aims of School Education

The guiding principles and aims of school education in India are set out in the NCF (2005), which is designed and reviewed by the NCERT. The NCF principles and aims underpin the NCERT syllabi published for each subject. The NCERT publishes subject level textbooks based on the standards in the NCF (2005). The NCF also includes information such as the recommended school days in an academic year (i.e. 200) and that there should be a minimum of 180 instructional days with four hours of instruction a day at primary school, and five hours at upper primary school and above. The school year must fall between June / July to March / April. Further information on the principles and aims set out in the NCF is presented in Section 5 of the report.

3.3 Structure and curriculum

Education is compulsory and free for children between the ages of 6-14 under the Indian National Policy of Education (1992); however some states only require that children take five or six years of primary education. Overall, there are 12 years in the Indian school system with school years commonly referred to as ‘Standards’ or 'Classes', i.e. from Class 1 to Class 12. For clarity, the term ‘Class’ will be used throughout this report to relate to academic school years in India.

During the 12 years of education, the first ten years are delivered as part of the general school education, and the final two years as part of senior secondary school.

Table 4: Stages of the Indian education system[24]

Stage		Class / Grade	Class / Standard
Elementary	**Primary Stage**	1	I
		2	II
		3	III
		4	IV
		5	V
	Upper Primary Stage / Secondary School	6	VI
		7	VII[25]
		8	VIII
Secondary	**Lower Secondary**	9	IX
		10	X
Higher Secondary	**Senior Secondary**	11	XI
		12	XII

[24] International Comparisons. UK NARIC.
[25] In some States upper primary ends at this year.

At elementary stage, the NCERT develops syllabi for the following subjects:

- English
- Environmental Studies
- Hindi
- Mathematics
- Sanskrit
- Science
- Social Science
- Urdu[26].

For secondary and higher secondary classes, the NCERT provides subject syllabi and textbooks across a large range of subjects, from which central and state education boards can develop their syllabi and assessments. The medium of instruction is Hindi or the regional language; however a second language, often English (or Hindi) is required starting at Class VI. Compulsory subjects are determined by the board.

At the end of general school education (Class 10 of lower secondary) students sit public examinations conducted by either a state board or national board (i.e. All-India examining bodies). Upon successful completion of Class 10 students receive a secondary school certificate (the title of the award depends on the awarding body)[27].

Senior secondary school can be academic, and prepare for higher education; or vocational in order to prepare for higher vocational education. At the end of senior secondary school (Class 12), students sit public examinations, and on successful completion receive a senior secondary certificate (again, the title of the award depends on the awarding body).

CBSE Curriculum

Within the CBSE secondary curriculum, students would be expected to study:

- Two languages
- Art education
- Mathematics
- Physical education
- Science
- Social sciences
- Work education or pre-vocational education[28].

They may also undertake additional subjects.

[26] National Council of Educational Research and Training, 2006. *Syllabus for Classes at the Elementary Level - Volume 1.*
[27] International Comparisons. UK NARIC.
[28] Central Board of Secondary Education, 2015. *Secondary School Curriculum 2015-2016 - Volume 1 Main Subjects.*

CISCE Curriculum

Students taking the ICSE examinations undertake Socially Useful Productive Work (compulsory for all students) and sit six subjects, which for the external examinations include:

Table 5: ICSE Subjects for external assessment[29]

Subject Group	Subjects
I	Compulsory subjects: • English (compulsory) • A second language (compulsory) • History, civics and geography (compulsory)
II	Two of the following: • A Classical Language • A Modern Foreign Language • Commercial Studies • Economics • Environmental Science • Mathematics • Science (Physics, Chemistry, Biology)
III	One of the following: • A Modern Foreign Language • Art • Commercial Applications • Computer Applications • Cookery • Economic Applications • Environmental Applications • Fashion Designing • Home Science • Performing Arts • Physical Education • Technical Drawing Applications • Yoga

[29] Council for the Indian School Certificate Examinations, (n.d.). *Regulations Indian Certificate of Secondary Education Examination.*

4. Overview of the International Baccalaureate

The International Baccalaureate (IB) is a non-profit educational foundation founded in 1968. The IB is run internationally by three Global Centres in The Hague, Bethesda, and Singapore. A Foundation Office is located in Geneva, the Assessment Centre is in Cardiff, and a final office is in Buenos Aires.

4.1 IB Philosophy and Learner Profile

The IB programmes are developed, delivered, and maintained by the IB's philosophy to focus not only on academics, but also on personal, emotional, and social skills. This is further demonstrated in the IB's mission statement as follows:

> "The International Baccalaureate® aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect.
>
> To this end the organization works with schools, governments and international organizations to develop challenging programmes of international education and rigorous assessment.
>
> These programmes encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right"[30].

All of the IB programmes hold a philosophy to develop their learner's academic and non-academic attributes. These ideals and descriptors are defined in the IB Learner Profile. The profile describes the types of learner the IB intends to develop, namely:

- Inquirers
- Knowledgeable
- Thinkers
- Communicators
- Principled
- Open-minded
- Caring
- Risk-takers
- Balanced
- Reflective.

Schools offering the programmes are expected to assist students in becoming an IB Learner. The Learner Profile attributes are discussed and compared to the key themes and underpinning philosophies of the Indian education system in the comparative analysis[31].

[30] The International Baccalaureate (n.d.). *Mission.*

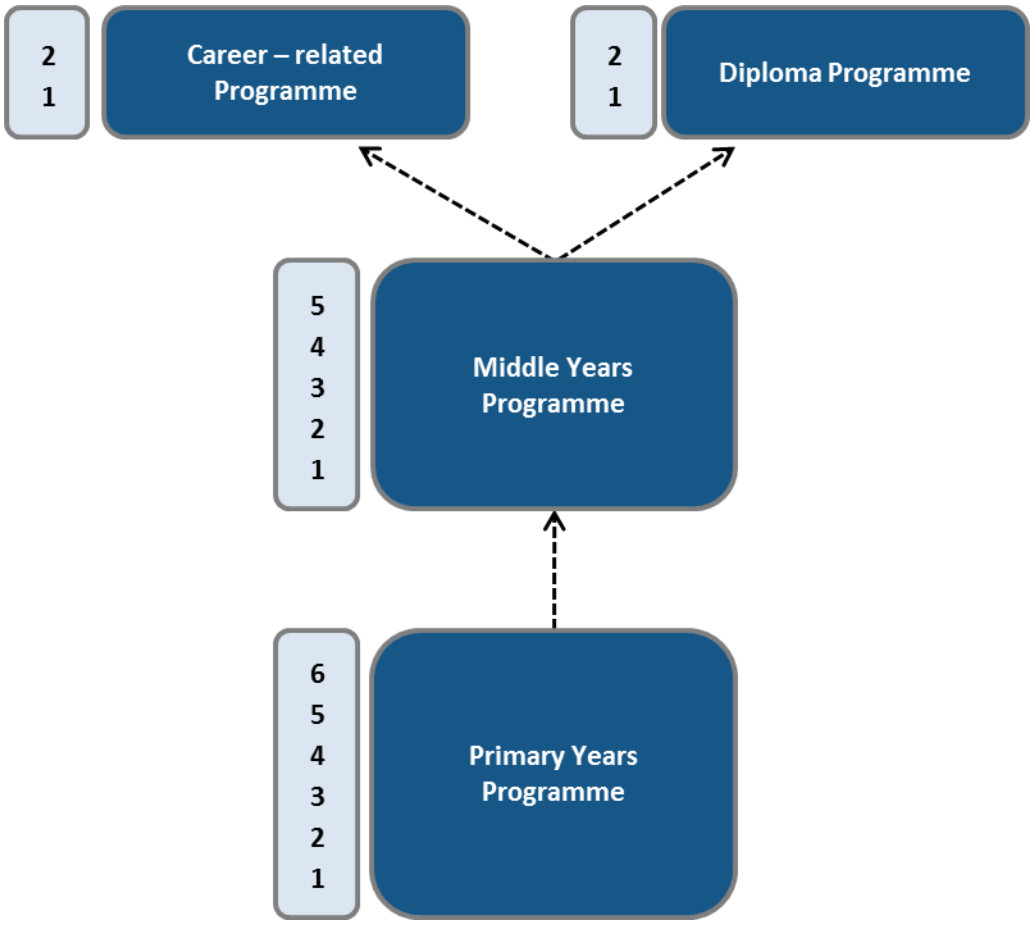
[31] For the full IB Learner Profile, please visit http://www.ibo.org/globalassets/digital-tookit/flyers-and-artworks/learner-profile-en.pdf

4.2 Programmes

Four programmes are offered globally by the IB including the Primary Years Programme (PYP), Middle Years Programme (MYP), Diploma Programme (DP) and Career-related Programme (CP). All four programmes are delivered internationally in authorised schools, referred to as IB World Schools. The IB World Schools can deliver individual IB programmes or offer them as a continuum. Additionally, the programmes can be taught and assessed in three languages: English, French, and Spanish.

In terms of duration, the IB PYP is generally run by schools as a five to six year programme[32] and the IB MYP as a two to five year programme. Both the IB DP and CP are two year programmes. The progression of the IB programmes, when taken in continuum, can be seen in the figure below. Equally, students can enter any of the below IB programmes without previous experience in an IB programme.

Figure 2: Progression of the IB programmes



[32] The PYP may be begin at age three and often concludes at grade 6 (however some schools run till grade 7).

4.2.1 IB Primary Years Programme

The IB PYP is a primary level programme offered to students between the ages of 3-12. The intention of the programme is to expand beyond the academic curriculum and focus on the child as a whole. Specifically, the IB PYP aims to develop active, caring, lifelong learners 'who demonstrate respect for themselves and others and have the capacity to participate in the world around them'[33].

The IB PYP curriculum itself is split into three sections: what students should learn (written curriculum), how students should learn (taught curriculum), and how to determine what students have learned (assessed curriculum).

What Students Should Learn

As part of the written curriculum framework, schools teach five essential elements regarding the knowledge, concepts, skills, attitudes and actions the IB considers students to need in order to lead successful lives. The written curriculum is referred to as a programme of inquiry. This programme includes multiple units of inquiry that combine global issues and central ideas that are relevant to a transdisciplinary theme[34]. The six transdisciplinary themes in the programme of inquiry include:

Table 6: Underpinning themes of the Primary Years Programme

The Six Transdisciplinary Themes of PYP[35]
• Who we are • Where we are in place and time • How we express ourselves • How the world works • How we organise ourselves • Sharing the planet.

Linked to each of the above themes is a description, a central idea, key concepts, related concepts, and lines of inquiry.

The IB PYP is a concept-driven curriculum, using key concepts and related concepts that have significance within and across disciplines. The concept-driven curriculum is also used to support inquiry, which the PYP believes is key to promoting meaning and understanding. A set of eight key concepts is then applied to each of the subjects.

[33] The International Baccalaureate (n.d.). *Primary Years Programme*.
[34] International Baccalaureate Organization, 2012. *Developing a transdisciplinary programme of inquiry*
[35] The International Baccalaureate (n.d.). *How the PYP works*.

A sample programme of inquiry for the written curriculum is provided within the IB's *Developing a transdisciplinary programme of inquiry (2008)*[36]. IB PYP schools can either adopt and adapt an existing transdisciplinary sample programme of inquiry or develop their own. Schools can determine the content to include and can adapt the programme to reflect national, regional or local requirements within the units of inquiry.

The Science and Social Studies Scopes and Sequences documents are organised by age-banded stages, whereas Mathematics is organised by 'phases' which are an alternative to demonstrate the developmental process that is not age-related[37]. These phase or age-banded stages are then organised in a continuum which emphasises the construction of meaning and deeper understanding of concepts. Conceptual understanding is then developed at each phase or age-banded stage with learning outcomes associated with these.

How Students Should Learn

The taught curriculum defines the pedagogical approach for the programme and demonstrates how schools should teach the written curriculum. This includes supporting students by:

- Drawing on their prior knowledge
- Providing provocation through new experiences
- Providing opportunities for reflection and consolidation.

Assessment

The IB PYP assessment curriculum explains that teachers are required to observe student performance and promote learning. Teachers can use assessment to measure students understanding of what has been taught (summative assessment) and to measure what they already know in order to plan the next stage of learning (formative assessment)[38]. In the final year of the IB PYP, all students engage in a collaborative project known as the IB PYP exhibition.

[36] International Baccalaureate Organization, 2012. *Developing a transdisciplinary programme of inquiry.*
[37] International Baccalaureate Organization, 2009. *Introduction to the PYP Scope and Sequences.*
[38] International Baccalaureate Organization, 2009. *Making the PYP happen: A curriculum framework for international primary education.*

4.2.2 IB Middle Years Programme

The IB MYP is offered to students aged 11-16 and consists of eight subject groups from which students choose courses.

Table 7: IB Middle Years Programme Subject Groups

MYP Subject Groups
• Language acquisition • Language and literature • Individuals and societies • Sciences • Mathematics • Arts • Physical and health education • Design.

IB World Schools offering the MYP must teach at least one subject from each of the eight subject groups through to year 3. For both years 4 and 5, students have subject-group flexibility and can choose a minimum of six out of the eight subjects to study. The six must include Language Acquisition, Language and Literature, Mathematics, Sciences, and Individuals and Societies, and one course from the additional subjects (Arts, Design, or Physical and Health Education).

Each subject group has a minimum of 50 hours' teaching time required per year of the programme. The final two years of the programme are more flexible depending on the requirements set by the school and a student's learning goals (i.e. 70 teaching hours per subject in the last two years of the programme are recommended for those taking the eAssessment).

As well as the above subjects, students take an interdisciplinary unit each year of the programme that combines two or more of the eight subject groups. Additionally, students complete a long-term project.

Principles and Philosophy of the IB MYP Curriculum

Inquiry is key to the written, taught and assessed curriculum across the IB programmes and is at the heart of the MYP structure. The IB uses inquiry to promote deeper levels of understanding in students. IB MYP Mathematics, Science, and Individuals and Societies all sustain inquiry by "developing **conceptual understanding** in **global contexts**. Teachers and students develop a **statement of inquiry** and use **inquiry questions** to explore the subject. Through their inquiry, students develop specific interdisciplinary and disciplinary **approaches to learning** skills"[39].

[39] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics guide.*

The conceptual understanding is framed by key concepts and related concepts within each subject. These are prescribed in the MYP Guides[40] for teachers to use when developing the curriculum. Schools are able to develop additional concepts as needed to meet local requirements[41]. The key concepts are used to develop the broad curriculum and create connections between and among courses within the subject and other subject groups. Related concepts promote the deeper learning and are subject-specific.

Global contexts are used in teaching and learning to create a common ground to build on and provide context to the concepts discussed above. Students encounter all of the six global contexts over the course of their study. Teachers must identify one of the following global contexts to use and explore in each unit of a course:

- Identities and relationships
- Orientation in space and time
- Personal and cultural expression
- Scientific and technical innovation
- Globalisation and sustainability
- Fairness and development.

Statements of inquiry are then used to 'set conceptual understanding in a global context in order to frame classroom inquiry and direct purposeful learning'[42]. Each IB MYP Guide provides examples of possible statements of inquiry for units or projects within the curriculum. These then lead to inquiry questions that can be factual, conceptual and debateable[43].

Through the above inquisitive learning, IB MYP students develop approaches to learning (ATL) skills that help meet the aims and objectives of the curriculum. The ATL skills are grouped into five categories shared across the IB MYP programme:

- Thinking skills
- Social skills
- Communication skills
- Self-management skills
- Research skills[44].

For each of these categories, teachers develop subject related skill indicators.

[40] A subject level document that includes the aims, objectives, and prescribed concepts and assessment criteria. The document may also contain subject-specific guidance for teaching and learning.
[41] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics guide.*
[42] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics guide.*
[43] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics guide.*
[44] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics guide.*

Although the IB MYP Guides include a 'framework' for the concepts and skills that should be taught within the curriculum, schools are responsible for developing their own set of documents on what will be taught in each subject at each age group. Therefore, schools are responsible for determining the subject-level content that will be taught, and can do so based on national curriculum requirements. It is expected that the written and taught curriculum should be developed with the following IB components in mind:[45]

- Key concepts
- Related concepts
- Global contexts
- Subject-group objectives.

The framework for teachers focusses on students becoming creative, critical, and reflective thinkers. Similar to the IB PYP, IB MYP students are taught to make connections between their studies and the real world.

Further prescribed sections within the MYP Guides include aims, objectives, criteria and strands. These key terms are defined by the IB as follows:

Table 8: Key terms in the IB MYP

Key Terms in the IB MYP	
Aims	The 'general statements about what teachers may expect to teach or do, what students may expect to experience or learn, and how students may be changed by the learning experience'[46].
Objectives	A set of 'statements which describe the skills, knowledge and understanding that will be addressed in the subject group'[47]. These are then addressed through teaching and learning.
Criteria	The assessment criteria align with the objectives and are used by teachers to judge the extent to which students have achieved the objectives. Teacher assesses the criteria through formative and summative tasks.
Strands	These are 'aspects or elements of subject-group objectives or criteria; or put another way, strands are a detailed breakdown of what each objective or criterion encompasses or entails'[48] Objective strands must be addressed and criteria strands assessed at least twice a year.

[45] International Baccalaureate Organization, (n.d.). *Further Guidance for Developing MYP Written Curriculum.*
[46] International Baccalaureate Organization, 2015. *Further Guidance for Developing MYP Assessed Curriculum.*
[47] International Baccalaureate Organization, 2015. *Further Guidance for Developing MYP Assessed Curriculum.*
[48] International Baccalaureate Organization, 2015. *Further Guidance for Developing MYP Assessed Curriculum.*

Interdisciplinary teaching / learning (Cross-curricular linkages)

Each MYP school is required to engage students in at least one interdisciplinary unit for each year of the programme. All subjects must have interdisciplinary teaching and learning opportunities. The IB uses this learning to allow students to expand on their disciplinary understanding in two ways:[49]

- Integrative: bringing together concepts, methods, or modes of communication from two or more subject groups, disciplines, or established areas of expertise to develop new perspectives
- Purposeful: connecting disciplines to solve real-world problems create products or address complex issues in ways that would have been unlikely through a single approach.

Each subject Guide includes interdisciplinary inquiries that could be included.

Assessment

The IB MYP is currently in a transition period between assessment regulations and practices. From May 2016 onward, the IB MYP Certificate will be awarded to students who complete the following:

- Two hour on-screen examination in five subjects (Language and Literature, Individuals and Society, Sciences, Mathematics, Interdisciplinary Learning)
- ePortfolio for Language Acquisition (or on-screen examination for a second language)
- ePortfolio in one subject (including Art, Physical and Health Education, or Design)
- The personal project
- Participation in community service to meet school requirements[50].

A grade of 3 or higher (where 7 is the highest) must be achieved in each eAssessment (online examinations, ePortfolio, and personal project) with a total of at least 28 (out of 56) points in order for students to receive the IB MYP Certificate.

Students who do not wish to achieve the IB MYP Certificate can receive an MYP Course Results document by completing study in individual subjects and the personal project. Students may also receive an IB MYP Record of Participation by meeting the following requirements:

- Complete two years of the programme (including requirements in year 3 and year 4)
- Study a minimum of six subjects in year 4, and eight subjects in year 3
- Complete school-based community project[51].

Grading of the internal assessment, including the community project and personal project, is based on assessment criteria. The assessment criteria are developed in line with the objectives, and the strands underneath. The strands are turned into level descriptors that demonstrate the increasing demands for student performance at the higher achievement

[49] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics guide.*
[50] International Baccalaureate Organization, 2014. *General Regulations: Middle Years Programme.*
[51] International Baccalaureate Organization, 2014. *General Regulations: Middle Years Programme.*

levels[52]. Each strand and assessment criteria must be assessed at least twice a year for each year of the MYP. These required assessment criteria and strands are provided at subject level for years 1, 3 and 5 of the MYP in each of the syllabi. Schools can add criteria or additional modes of assessment to meet any local or national requirements.

4.2.3 Other IB Programmes

The Diploma Programme

The IB DP is a two-year programme offered to students between the ages of 16-19 and is widely accepted for admission to higher education. The programme consists of the DP core and six courses chosen from the following subject groups: studies in language and literature; Language Acquisition; Individuals and Societies; Sciences; Mathematics; and the Arts. Students may opt to study an additional Sciences, Individuals and Societies, or languages course, instead of a course in the Arts.

All IB DP courses are assessed through a combination of external and internal assessment. Most subjects are offered at both higher level and standard level, and students must take a combination of both (three or four at higher level).

The Career-related Programme

The IB CP is a two-year programme also offered to students between the ages of 16-19 and intends to provide students with transferable and lifelong skills and competences in preparation for further or higher education, apprenticeships or employment. As part of the curriculum, students take a minimum of two IB DP courses, a core (with four components) and engage in career-related study (i.e. a vocational qualification offered by BTEC, or OCR National[53]). All IB DP courses are externally examined, while the CP core is internally assessed.

[52] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics guide*.
[53] International Baccalaureate Organization, 2014. *The IB Career-related Programme: A Guide for Employers.*

5. Comparing the Philosophical Underpinnings of an IB and Indian Education

Key findings

Overall clear similarities could be seen between the underpinning principles and overarching aims of the IB and the Indian school systems.

Differences, where they exist, reflect the different contexts within which the IB and Indian education systems operate. The NCF, as a national framework, must address the specific needs and values of society in the national context whereas the IB education, being international in nature, is not designed or prescribed in line with any single system; rather the IB provides a framework from which the content can be adapted to national or local systems. Nevertheless, the IB and Indian school systems share many key principles and aims, in particular:

- That both systems adopt a holistic approach to education and intend that education support the overall development of learners
- That curriculum and teaching should highlight the connections between what's learned in the classroom and what students experience outside of it
- That curriculum and teaching should both value individuals and enable open, democratic classrooms
- That students should be considered active learners, with the capacity to construct their own knowledge
- That assessment serves to reflect on and improve the teaching-learning process and that assessment *for* rather than *of* learning is of greater importance at the levels of schooling reviewed in this study.

The NCF (2005) was designed to support the modernisation of the education system, making it "more relevant, meaningful"[54], by providing a single guide for schooling in India. The NCF thus sets out the philosophies and key principles that should underpin education; the ideals to which school curriculum and teaching should be aligned.

The NCF firstly discusses "perspectives" on the Indian education system, specifically the historical backdrop and rationale for the NCF, the concerns the NCF sought to address and the associated guiding principles and aims of education.

Drawing on the guiding principles and aims for education, the NCF further elaborates on the implications and goals for learning and development. This section discusses these goals alongside the guiding principles and/or aims to which they relate, considering the extent to which the IB PYP and MYP address these goals.

[54] World Bank, (n.d.). *India National Curriculum Framework 2005*.

5.1 Comparing the IB PYP and MYP to the NCF

5.1.1 Guiding Principles

The NCF 2005 sets out the guiding principles for curriculum development, all of which are well reflected in both the IB PYP and MYP programmes.

A clear connection between the knowledge acquired in the classroom to life outside the classroom, and a move away from rote learning

The first two guiding principles of the NCF propose that i) learning and knowledge should be connected to life outside the school and ii) that the learning process should be shifted away from rote methods and textbook based instruction. The NCF includes a chapter on development and learning which touches on this theme, stating that teaching should deepen students' understanding and encourage them to engage with concepts so that learning is not simply tied to what's needed to pass their exams, with knowledge forgotten thereafter[55].

The IB PYP and MYP draw upon empirical research to explain the importance of moving away from rote learning methods towards deeper understanding of subject matter stating that "research in student learning has shown that when students simply accumulate new information in their minds they may be able to retain it for a test or an exam but be unable to recall such information when a new situation emerges that requires them to bring their knowledge to bear"[56].

The importance of relating factual knowledge to situations and scenarios encountered outside of the classroom highlighted in the NCF is similarly reflected in IB programmes generally, and is clearly evident within the IB PYP and MYP. The figure below shows how, at an overarching level, it is intended that teaching and learning in the IB will relate to the idea of "Global Contexts".

Figure 3: The IB education[57]

[55] National Council of Educational Research and Training, 2005. *National Curriculum Framework 2005.*
[56] International Baccalaureate Organization, 2010. *Middle Years Programme: MYP guide to interdisciplinary teaching and learning.*
[57] International Baccalaureate Organization, 2015. *What is an IB Education?.*

At programme level, the PYP and MYP are transdisciplinary which has two main aims including "to convey learning that has relevance across the subject areas and more importantly, learning that transcends the confines of the subject areas to connect to what is real in the world"[58]. The PYP model shows how the different strands of learning should combine and enable connections both across subjects and with the wider world, outside the classroom.

Figure 4: The PYP Model

Source: International Baccalaureate

The PYP also emphasises real world application of subject knowledge in practice, as shown for example in a unit related to the transdisciplinary theme "How the world works", in which students aged 8 and 9 inquire into the central idea, that "Human survival is connected to understanding the continual changing nature of the Earth"[59].

The MYP model also brings together different subjects, with students encouraged to make connections between them; whilst for example the community project supports connections between the real world and knowledge acquired in the classroom.

[58] International Baccalaureate Organization, 2010. *The Primary Years Programme as a model of transdisciplinary learning.*
[59] International Baccalaureate Organization, 2009. *The Primary Years Programme: A basis for practice.*

Figure 5: The MYP Model

Source: International Baccalaureate

The NCF approach to building subject knowledge closely reflects the constructivist approach, which is elaborated further in the "teaching for construction of knowledge" (section 2.4 of the NCF). In line with this approach, the IB programmes also acknowledge the idea that learning builds on previously learned beliefs, models and constructs by revisiting and revising these constructs in light of new learning, thereby creating a cyclical process. The construction of knowledge is mainly promoted in the IB programmes through structured inquiry, whereby students continue to question what they have learned, a method which is also heavily endorsed by the NCF in extending breadth and depth of knowledge.

Education should support the overall development of learners

The next NCF guiding principle, providing for the overall development of children, covers cognitive, social, emotional and physical development of children. This is reflected both in the IB Learner Profile (as discussed further in section 5.2) but also in the IB PYP and MYP programmes which reflect this holistic view of child development, stating that "along with cognitive development, IB programmes and qualifications address students' social, emotional and physical well-being"[60].

[60] International Baccalaureate Organization, 2015. *What is an IB Education?.*

Examinations should be more flexible, integrated into classroom life

The third NCF guiding principle "making examinations more flexible, integrated into classroom life" can be seen to reflect both the idea of "Learning without Burden"[61] and a view of assessment as a tool to measure student progress, to gauge how far aims have been achieved and areas for further development and modification of the learning process where applicable. Both the IB PYP and the MYP encompass the aim that assessment should be flexible and intended for objective feedback, corresponding with the underlying purpose of assessment highlighted in the NCF. The IB programmes place additional emphasis on reflexivity, with student self-assessment and the involvement of both the teacher and the student in the assessment process.

A competency-based assessment framework is the key feature of flexible assessment as outlined in the NCF. Competency-based testing places emphasis on what the student can demonstrate in terms of skills and competencies and less on the knowledge he/she can memorise, which also underpins the nature of assessment in the IB PYP and MYP. A further element of flexible assessment in the NCF is the varied range of assessment methods, which incorporate oral testing and group work evaluation in the classroom as well as written tests, the IB programmes similarly adopt a variety of assessment methods across subjects.

Supporting development of own identity and an inclusive environment

The development of personal identity is promoted by PYP and MYP programmes through building self-esteem and recognising individual learning styles through differentiation. In contrast to the NCF which encourages development of civic identity within the Indian polity, the IB does not promote identity based on the national citizenship of any particular country. As globally-oriented programmes, the IB PYP and MYP intend to further develop personal identity through global citizenship and building intercultural awareness. However, whilst the IB is politically neutral, the NCF endorses the ideals of democracy and citizenship specifically as outlined in the Indian constitution.

The final guiding principle which is designed to foster an inclusive approach to education is one that is also shared by the IB MYP and PYP programmes. The IB PYP and MYP programmes are both designed to "promote integrity and honesty, as well as a strong sense of fairness that respects the dignity of individuals and groups"[62].

The NCF also articulates the goal of retaining students in school in the NCF which is not mentioned as an aim of the IB programmes, but it should be similarly acknowledged that the IB programmes operate in different national contexts and at different levels, whilst the NCF is designed as an overall guide for national education from entry to upper secondary level.

[61] The NCF, reiterating the findings from a 1993 report, *Learning without Burden*, that external assessment which focusses heavily on knowledge recall does not support independent thinking but rather encourages rote learning and memorisation.
[62] International Baccalaureate Organization, 2015. *What is an IB Education? IB Learner Profile.*

5.1.2 Aims of Education

Acknowledging challenges in several aspects of the education system and practice, the NCF sought to draw on the vision and values set out in the Indian constitution to define the broad aims of education that will support this vision. In this context, the aims set out the ideals to which curriculum and teaching should move towards; namely:

Table 9: The Aims of Education, NCF 2005

NCF Aims of Education[63]
Curriculum and teaching should be designed so as to develop students' commitment to the following:
• Democracy and values of equality, freedom and justice
• Concern for others' well-being
• Secularism
• Respect for human dignity and rights

In practice this should mean that the curriculum allows sufficient scope and space for teachers to build in activities that support the development of these aims. As reflected later in the NCF, this also means that promoting independent thought and the ability to make value-based decisions, alone and with others, should be integral to the curriculum and teaching. Supporting students to develop a wider understanding of the world should be a key consideration in developing the curriculum, given the importance of this to several further educational aims, specifically that students should be sensitive to others' feelings and well-being; and that students should want to contribute to society.

The NCF further emphasises the importance of integrating work with education: specifically that work-related aspects in the curriculum should both support the development of skills and mindset/values; for example that learners will be able to work in cooperation with others.

The IB PYP and MYP align closely to the NCF "Aims of Education" overall. The majority of NCF aims relate to skills and attributes students develop as they progress through the Indian education system. Many of these skills and attributes can be observed within the IB Learner Profile which defines key characteristics IB programmes should develop in their students

The IB Learner Profile, for instance, highlights that "all members of the IB community are expected to be principled, to act with integrity and honesty, with a strong sense of fairness and justice and with respect for the dignity and rights of people everywhere"[64], mirroring two of the NCF aims: that of having respect for human dignity and rights; and of valuing equality and justice[65]. Furthermore, the NCF indicates that Indian school children should similarly be able to empathise with others while the IB Learner Profile encourages pupils to be *Caring*, which involves showing "empathy, compassion and respect towards the needs and feelings of others"[66].

[63] National Council of Educational Research and Training, 2005. *National Curriculum Framework 2005.*
[64] International Baccalaureate Organization, 2015. *What is an IB Education? IB Learner Profile.*
[65] National Council of Educational Research and Training, 2005. *National Curriculum Framework 2005.*
[66] International Baccalaureate Organization, 2015. *What is an IB Education? IB Learner Profile.*

The NCF "Aims of Education" also propose that "space should be made for dialogue and discourse, so that students can ask questions freely, engaging in a discussion with the teacher as well as their peers, during an ongoing lesson"[67]. This emphasis on promoting dialogue and debate is also promoted in both the PYP and in particular the MYP programmes. In practice, IB MYP teachers are expected to incorporate debates and discussions into lesson plans, and are provided guidance on the characteristics of factual, conceptual and debatable questions. In the IB programmes, debate and discussion is often practiced through pair and group work; which is viewed as "a collaborative strategy and should engage students as co-learners and co-constructors of meaning through dialogue"[68].

The ability to make value-based decisions, both independently and collectively, expressed in the NCF as an integral component to democratic functioning, is similarly reflected in the IB Learner Profile. In the IB Learner Profile, reference is also made to developing the ability to use critical thinking skills in making ethical decisions, while the NCF does not specifically mention the role of critical thinking in the context of decision making.

A further key aim of the Indian education system indicated in the NCF is that it promotes secularism and inclusion of all faiths. The IB similarly is secular in that it does not subscribe to any one religious doctrine, but does promote acceptance of diversity and acceptance of varying religious beliefs in line with its global orientation. The IB PYP and MYP handbooks do not specifically make reference to integrating work with education, although it is assumed this may be given more attention in the IB Diploma programme given its aim to prepare for entry into employment or higher education.

Encouraging flexibility and creativity in responding to new situations is presented as an integral in the teaching for construction of knowledge method endorsed by the NCF. This method of knowledge acquisition is encouraged in different ways across both IB programmes. The IB MYP interdisciplinary teaching model, for instance, includes performances of understanding. Performances of understanding are employed as a particular kind of learning experience, one that encourages flexible thinking with knowledge in novel situations[69].

The IB programmes also incorporate "developing community awareness and concern, a sense of responsibility, and the skills and attitudes needed to make an effective contribution to society"[70], which fits well with a further key aim of education highlighted in the NCF.

5.2 The Relevance of the IB Learner Profile to the Indian Context

It is firstly important to note broad differences between the IB Learner Profile and the NCF objectives in terms of their purpose and expression. The IB Learner Profile defines the attributes specifically developed by students; the NCF predominantly focusses on objectives for the development of skills and attributes, which are facilitated by teachers. These personal

[67] National Council of Educational Research and Training, 2005. *National Curriculum Framework 2005.*
[68] International Baccalaureate Organization, 2010. *The Primary Years Programme as a model of transdisciplinary learning.*
[69] International Baccalaureate Organization, 2010. *Middle Years Programme: MYP guide to interdisciplinary teaching and learning.*
[70] International Baccalaureate Organization, 2015. *What is an IB Education? IB Learner Profile.*

attributes are therefore not defined in the form of a student profile in the NCF but are encapsulated within the guiding principles and "Aims of Education" which should be incorporated within school curricula developed by the main examination boards. The IB Learner Profile attributes are nonetheless congruent overall with the objectives concerning holistic education outlined in the NCF, some areas of divergence related to coverage are noted in the following analysis.

IB students are expected to be *Inquirers* who think autonomously, reflecting the NCF aim that curriculum and teaching should develop students' independence of thought. The IB Learner Profile encourages students to develop curiosity, which can be likewise found in the NCF which specifies that the curriculum must "enable children to find their voices, nurture their curiosity—to do things, to ask questions and to pursue investigations, sharing and integrating their experiences with school knowledge"[71].

In terms of the approach to knowledge acquisition, the NCF objectives propose that students should "question received knowledge critically, whether it is found in a 'biased' textbook, or other literary sources in their own environments, can be built by encouraging learners to comment, compare and think about elements that exist in their own environment"[72]. There is a degree of emphasis on acquiring knowledge in the local context and to some extent the global context, although the intention to develop and apply global knowledge is not expressed as a defined aim or objective in the NCF.

Although the NCF aims do make reference to promoting novel thinking and approaches in students, there is no specific reference to calculated risk taking as an attribute, as is the case in the IB Learner Profile which encourages students to adopt a courageous and resilient attitude in the face of challenges and change.

The NCF plan for holistic education promotes a caring approach; curricula are specifically intended to encourage sensitivity to others' well-being and feelings, a key guiding principle for the Indian Education system. Developing students to have a service oriented attitude and who can make a contribution to the community are also mentioned in the NCF "Aims of Education".

Communication is a key area of interest in the NCF 2005, with Chapter 3, Section 3.1 describing the main principles involved in language teaching. Students receive a multi-lingual education which fits well with the IB expectation that children should be able to operate in more than one language. The importance of being able to communicate in a variety of forms (including verbally, in writing, mathematically, and visually) is emphasised.

Reflective learning is not explicitly mentioned in the NCF aims of education, although under learning and development, the NCF does outline the key characteristics that learners should practice, including the ability to reflect "Children learn in a variety of ways – through experience, making and doing things, experimentation, reading, discussion, asking, listening, thinking and reflecting, and expressing oneself in speech, movement or writing"[73].

[71] National Council of Educational Research and Training, 2005. *National Curriculum Framework 2005.*
[72] National Council of Educational Research and Training, 2005. *National Curriculum Framework 2005.*
[73] National Council of Educational Research and Training, 2005. *National Curriculum Framework 2005.*

Developing students' personal ability to self-reflect and manage limitations is not expressed as clearly as a desired attribute in the NCF, although Indian teachers are encouraged to implement reflective learning practices in Chapter 5, *Vision for Teachers*.

Under the NCF guiding principles, the ideas of integrity, justice and fairness are expressed as key components of the democratic ideals the Indian education system espouses in its key objectives. These ideals correspond well with the IB Learner Profile attributes which foster a principled outlook among IB students, a sense of individual responsibility and integrity.

The open-minded approach to learning described in the IB Learner Profile appears to be congruent with the NCF holistic education model. Chapter 2.8 on *Learning and Development* includes mention of developing students' understanding of local traditions and customs, whilst appreciating the plurality of peoples and ways of life represented in textbooks. Chapter 2 also includes a section on the persistence of stereotypes associated with marginalised groups, and suggests ways in which teacher and student engagement can overcome these.

The NCF intends that the education system, and specifically teachers, create a balance between physical, emotional and cognitive development in children. Although the idea of reflective learning is apparent in the NCF "Aims of Education", it is unclear how much personal responsibility students are expected to take and how far they are expected to develop their own understanding of how development in different domains (physical, emotional and cognitive) may progress and interact, as is expected of the IB student from the IB Learner Profile.

6. Comparing the Syllabi of the IB and the NCERT

6.1 Overview of the NCERT

The NCERT and IB PYP and MYP both offer a wide range of subjects. The subjects offered, and the name of the course (where it differs from the subject name) can be seen in the table below:

Table 10: Subjects in the NCERT and IB PYP and MYP

Subject	NCERT Primary		NCERT Secondary	PYP[74]	MYP
	I – V	VI - VIII	IX – X		
Languages	• Hindi • Urdu (I-VIII)	• Sanskrit VI - VIII	• Hindi • Sanskrit • Urdu	Language	• Language acquisition • Language and literature
English	English	English	English	Language (English can be taught)	• Language acquisition (English can be taught) • Language and literature (English can be taught)
Mathematics	Mathematics	Mathematics	Mathematics	Mathematics	Mathematics
Science	Environmental Studies	Science	Science	Science	Science
Social Studies	Environmental Studies	Social Science	Social Science (History, Geography, Political Science, Economics)	Social Studies	Individuals and Societies
Arts	Arts Education	Arts Education	Arts Education	Arts	Arts
Physical Education	Health and Physical Education (I-X)	Health and Physical Education (I-X)	Health and Physical Education (I-X)	Personal, social, and physical education	Physical and health education
Design	Visual Arts (in Art Education)	Visual Arts (in Art Education)	Visual Arts (in Art Education)	-	Design
Media Studies	Media Studies	Media Studies	Media Studies	-	Arts (includes visual arts)

In line with the research questions, the study will focus on the courses offered for three subjects: Mathematics, Science, and Social Studies.

[74] The PYP does not prescribe set subject modules in the same way the MYP does. There are instead five essential elements of the PYP: knowledge, concepts, skills, attitudes, and action.

6.2 Comparative Analysis of the IB PYP and the NCERT Primary Syllabi: Selected Subjects

6.2.1 Mathematics

Key findings – NCERT and IB primary Mathematics

Both the Indian primary school curriculum and IB PYP seek to develop competent users of mathematics, with students able to understand and apply mathematical language and symbols. Both programmes place emphasis on linking teaching to real-life contexts and intend that Mathematics should be a transdisciplinary programme.

The IB PYP attaches learning outcomes to "phases of development", which may or may not be linear. The NCERT, though defining curriculum content in a linear manner, encourage a spiral approach in delivering the course (Classes I-V)*.

Where they differ is in the extent to which the structure and content are prescribed. In particular:

- the NCERT syllabus document is largely knowledge-based, defining the mathematical processes to be covered by all students; the topics and sub-topics to be taught, and the expected teaching hours by academic year (class) assigned to each.
- The PYP instead is largely outcomes-based, defining content in terms of overall expectations for a topic: what students will be expected to know and be able to do.

Key Themes and Principles

Whilst the NCERT Mathematics syllabi for Classes I-V and Classes VI-VIII do not explicitly define aims for Mathematics, they do set out some underlying principles and objectives in relation to the course and textbooks within the introduction and *General Points for Textbook Writers*[75]. The key principles drawn from the NCERT are included below, providing the reference point against which the IB PYP Mathematics can be compared to relevant sections.

* A spiral approach to learning begins with teaching simple facts, then repeatedly re-visiting a topic with more details gradually introduced. Alternatively, a linear approach visits one topic at a time, in sequence.

[75] National Council of Educational Research and Training, 2006. *Syllabus for Classes at the Elementary Level - Volume 1.*

Table 11: Key themes and principles underpinning NCERT Classes I-V and IB PYP Mathematics

NCERT: Key themes and principles for curriculum and teaching	Included in the IB PYP
Classes I-V	
Association with real-life experiences	✓
Multiple streams of mathematics covered simultaneously	✓
Mathematics should be interesting	✓
The focus should be on thinking and reasoning	✓
Teach children to provide reasoning behind mathematical solutions	✓
Spiral approach to sequencing encouraged	
There are multiple solutions to mathematical problems	✓
Focus on mathematical concepts and ideas (i.e. rather than definitions)	✓
Classes VI-VIII	
Focus on logic and notion of proof rather than facts	✓
Mathematics language and symbols	✓
Generalise and identify patterns	✓
Forming and solving problems	✓
Enjoyment of mathematics	✓
Developing understanding from concepts	✓
Topics that build understanding of abstract mathematics	✓
To develop a confident, competent, and engaged mathematics student	✓

As seen in the table above, the IB PYP Mathematics Scope and Sequence include many similar themes to the NCERT Classes I-V. The IB PYP emphasises the use of realistic contexts, real-world situations and 'real-life' when teaching topics: both programmes introduce the subject topics using real-life situations and objects that will already be familiar to the child. It is likely that IB schools will teach multiple streams of mathematics at the same time, as the learning continuums are each taught simultaneously over the four phases. The IB PYP further aims to teach children to enjoy mathematics, and use that enjoyment to encourage learning. This is evident in the introduction that states "a school's programme should also provide students with the opportunity to see themselves as 'mathematicians', where they enjoy and are enthusiastic when exploring and learning about mathematics"[76].

Similar to the NCERT, the IB PYP focusses on thinking and reasoning within the three stages of learning mathematics: *Constructing meaning*, *transferring meaning*, and *applying with understanding*. Both teachers and students are expected to use mathematical reasoning during these stages. They also provide their reasoning or "justify their answers and the processes by which they arrive at solutions"[77] which compares to the aim within the NCERT. In determining solutions, IB MYP students are similarly encouraged to use a range of strategies, and their conceptual understanding.

[76] International Baccalaureate Organization, 2009. *Primary Years Programme Mathematics Scope and Sequence.*
[77] International Baccalaureate Organization, 2009. *Primary Years Programme Mathematics Scope and Sequence.*

Focussing on the key principles and themes for the upper primary syllabus (NCERT Classes VI-VIII), all could be observed within the IB PYP. They both aim for learners to increase their understanding of abstract mathematics and logical thinking. Additionally the IB PYP aims to teach students to become "competent users of the language of mathematics"[78]. Like the NCERT, the IB PYP aims to develop understanding from concepts as seen within the learning stage *constructing meaning about mathematics*[79] where students are expected to interpret new ideas to fit with their current understanding or create new understanding from their observations.

As well as the introduction section, the Mathematics for Classes VI-VIII syllabus has a section titled *General Points in Designing Textbook for Upper Primary Stage Mathematics*[80]. Many of the key themes and principles identified are similar to those from the NCERT I-V; with a few new themes added including the use of accessible language and an appropriate level of understanding for children. These themes are also included within the IB PYP. Both programmes aim for children to develop their own definitions and understanding in mathematics from their observations.

In addition to the principles in the table above, the NCERT Class VI-VIII includes some textbook specific themes that are not evident within the IB PYP including: continuity between topics in the textbook chapters, and creative and explorative mathematics. Further, the NCERT aims for children to create their own mathematical problems, and for teachers to create mathematical problems that are of an appropriate level and context for students[81].

Content

The NCERT Mathematics syllabi for both Classes I-V and VI-VIII include a breakdown of the main topics taught across the years, and the specific information that should be taught in progression for each class year. Similar information is provided in the IB PYP Mathematics Scope and Sequence document. The recommended hours, which demonstrate the weight of each topic toward the overall course, are also included in the NCERT syllabus.

The breakdown of the topics and overall teaching hours are included in the table below. The teaching hours for the NCERT course are an approximation on the amount of time that would be spent, and the number of periods for each topic area is a recommendation and not a prescribed amount. No hours are prescribed or recommended for the PYP.

[78] International Baccalaureate Organization, 2009. *Primary Years Programme Mathematics Scope and Sequence.*
[79] International Baccalaureate Organization, 2009. *Primary Years Programme Mathematics Scope and Sequence.*
[80] National Council of Educational Research and Training, 2006. *Syllabus for Classes at the Elementary Level - Volume 1.*
[81] National Council of Educational Research and Training, 2006. *Syllabus for Classes at the Elementary Level - Volume 1.*

Table 12: Content in the NCERT I-V and IB PYP Mathematics

	NCERT Mathematics		PYP
	I-V	VI-VIII	
Topics	Data handling Geometry Measurement Numbers Money Patterns	Data handling Geometry Mensuration Number system Ratio and proportion Algebra Introduction to graphs (Class VIII only)	Data handling Shape and space Measurement Number Pattern and function
Number of topics	6 main topics	7 main topics	5 main mathematics topics
Recommended Teaching hours	140 periods per year (70-94 hours per year)	180 hours per year (540 total)	n/a

As seen in the table above, the NCERT includes a similar number and range of mathematical topics as the IB MYP. Many of the topics included in the NCERT Classes I-V are further developed within the NCERT Classes VI-VII. The IB PYP also demonstrates a learning continuum within the advancement between the four phases of learning in each strand of mathematics.

The table below presents a broad comparison of content, in terms of how the IB PYP compares to core topics and sub-topics included in the NCERT Mathematics I-V syllabus:

Table 13: Content comparison of the NCERT I-V and IB PYP Mathematics

NCERT Topics	Sub-topics	Included in the IB PYP
Geometry	Shapes and spatial understanding	✓
	Solids (class1)	✓
Numbers	Counting and operations of numbers 1 - 9 and zero	✓
	Number sequence up to 1000	✓
	Numbers and operations	✓
	Addition and subtraction	✓
	Preparation for multiplication and division	
	Multiplication and division	✓
	Mental arithmetic	✓
	Fractions	✓
Money		✓
Measurement	Length	✓
	Weight	✓*

	Time	✓
	Capacity (volume)	✓
	Volume	✓
Data Handling		✓
Patterns		✓

The NCERT topic of *Geometry* includes two sub-topics that are both identified within the IB PYP strands, as seen the table above. Similar progression on *Shapes and Space* can also be seen between the two programmes. The *Numbers* topic has many sub-topics within the NCERT, but is similarly covered within the IB PYP *Number* strand. There is very similar progression of *Mental Arithmetic* during the NCERT years and the IB PYP phases. The only difference is that the NCERT identifies a specific section on *Preparing to Learn Multiplication and Division*, a topic that the IB PYP also includes, but not as a standalone preparation stage, with the assumption being that preparatory content would be integrated as needed within the main strand.

The NCERT topic *Money* can be identified within the IB PYP *Number* strand. Both provide a similar focus on addition and subtraction with money; with the minor difference that the NCERT topic includes identifying and converting Indian currency, which are relevant to the national context and would understandably not be found in an international qualification, such as the IB PYP.

Most of the sub-topics within the NCERT topic of *Measurement* are similarly included within the IB PYP strand *Measurement*. In terms of the NCERT *Weight* sub-topic, the IB PYP includes the topic of *Mass* and comparisons using standard and non-standard units, but without explicitly covering the use a balance or conservation of weight, as is discussed in the NCERT. The last two topics, *Data Handling* and *Patterns* can be easily identified within the IB PYP strands *Data Handling* and *Patterns and Functions*. The IB PYP phases include similar progression of these topics to the NCERT.

A similar comparison can be made for the five IB PYP strands of mathematics against NCERT Mathematics VI-VIII below:

Table 14: Content comparison of the NCERT VI-VIII and IB PYP Mathematics

NCERT topic	Sub-topic	Included in the IB PYP
Number System	Knowing our numbers (intro)	✓
	Integers / negative numbers	✓
	Fractions and rational numbers	✓
	Powers / squares/cubes	✓
	Whole Numbers	✓
Algebra	Introduction to Algebra	✓
	Algebraic expressions	✓*
Ratio and Proportion	N/A	✓
Geometry	Basic geometrical ideas	✓
	Understanding shapes	✓
	Properties of triangles	✓
	2D and 3D	✓
	Symmetry	✓
	Congruence	✓
	Constructions	✓
Mensuration		✓
Data Handling		✓
Introduction to graphs (Class VIII only)		✓

The majority of the NCERT topics can be identified within the IB PYP strands. The IB PYP *Number* strand includes similar content to that within the NCERT topic of *Number Systems*, with the exception of the NCERT section on *Rational Numbers*.

The NCERT *Algebra* topic can be partially identified within the IB PYP. Specifically, the introduction sub-topic includes similar content to that in the IB PYP *Pattern and Function* strand which "builds a foundation for the later study of algebra"[82]. From the materials, it is unclear whether this refers to later teaching in the IB MYP. *Algebraic Expressions* are included in phase 4 of the IB PYP learning continuum for the *Patterns and Function* strand[83]; but the NCERT syllabus document defines the content for the sub-topic in greater detail[84]. The IB, as with all subjects, defines concepts and the branches of mathematics, rather than prescribed content. It should be noted though that the IB PYP phase in the learning continuum would provide scope for IB World Schools to incorporate the NCERT content on *Algebraic Expressions.*

[82] International Baccalaureate Organization, 2009. *Primary Years Programme Mathematics Scope and Sequence.*
[83] International Baccalaureate Organization, 2009. *Primary Years Programme Mathematics Scope and Sequence*, p. 18.
[84] National Council of Educational Research and Training, 2006. *Syllabus for Classes at the Elementary Level - Volume 1,* p. 84.

Ratio and Proportion, *Mensuration*, and *Data Handling* can be found within both the NCERT syllabus and the IB PYP. The NCERT topic of *Geometry* can also identified within the IB PYP *Shape and Space* strand.

6.2.2 Science

Key findings – NCERT and IB primary Science

The key themes and principles between the NCERT and IB PYP Science syllabi are mostly similar, with both valuing:

- Engagement with experiments to develop investigative skills
- Cross-disciplinarily and a curriculum based on inquiry developed with the student perspective in mind.

In terms of the content taught within the course, the IB PYP Science strands include similar concepts and topics to the NCERT. The NCERT syllabus document describes the science topics in detail, whereas the IB focusses on overarching science strands to be adapted by IB schools. Both programmes include topics on energy, materials, plants and living things.

As similarly found within the Mathematics analysis, differences where noted largely reflect the ways in and levels to which the NCERT and IB PYP prescribe the Science curriculum: the NCERT details specific scientific content to be covered by all students, the IB PYP instead defines overall expectations for a topic in terms of the knowledge and skills to be developed by all students.

Key Themes and Principles

The NCERT syllabus includes general themes on the revision of the previous Science syllabus[85]. The key themes and principles identified in the NCERT syllabus' introductory sections are used as the point of reference in comparing the IB PYP in the table below:

Table 15: Key themes and principles underpinning NCERT VI-VIII and IB PYP Science

NCERT Classes VI-VIII: Key themes and principles for curriculum and teaching	Included in the IB PYP
Participation and inquiry-based syllabus related to a childs own experiences	✓
Focus on childrens perspective	✓
Focus on activities, discussion, and reflection	✓
Provision of space and time for scientific inquiry	✓
Content includes cross-disciplinary themes	✓
Syllabus themes should advance through the Classes	
Experiments are a focus	✓

[85] National Council of Educational Research and Training, 2006. *Syllabus for Classes at the Elementary Level - Volume 1.*

Provides opportunity to engage with science, observing, recording, drawing and plotting graphs, drawing conclusions	✓
Introduction to non-mathematical quantitative understanding of the world	
Inclusion of low-cost materials (e.g. magnets, lenses and microscopes)	✓*
Children are encouraged to become autonomous learners	✓

As seen in the table above, many of the NCERT key topics can be identified within the IB PYP. As the IB PYP is structured by units of inquiry rather than content it closely reflects the NCERT aim for an inquiry-based syllabus. The IB PYP students explore science content that is relevant to them, and engage in discussions and reflection (with discussion about science activities).

The NCERT Science syllabus states that cross-disciplinary themes should be included whilst the IB PYP is intended as a transdisciplinary programme, with the identified transdisciplinary themes, therefore meeting the NCERT aim and potentially expanding upon.

One of the IB PYP Science specific skills is to "plan and carry out systematic investigations, manipulating variables as necessary" [86]. This would likely include engagement with experiments. Another IB skill, to observe carefully in order to gather data, would include similar activities to those referenced in the NCERT such as observation and recording.

The NCERT also aims for children to become independent learners, a focus shared by the IB PYP as part of the IB Learner Profile. Students are expected to "acquire the skills necessary to conduct inquiry and research and show independence in learning. They actively enjoy learning and this love of learning will be sustained throughout their lives"[87].

The NCERT Science principles and themes not identified within the IB PYP may be addressed by other areas of the IB curriculum developed by IB World Schools. There is evidence to show that the IB does advance the skills expected of students and the possible learning outcomes. It is also likely that students engage in quantitative understanding, especially within the transdisciplinary aspects of the programme; however this is not stated within the IB Scope and Sequence.

The NCERT Science also aims to include usage of low-cost materials. This is not an explicit aim of the IB PYP; although they do aim to use instruments and tools when developing scientific skills. Since the schools have flexibility in designing the course activities, it can be reasonably assumed that IB World Schools would similarly have flexibility in the materials they use, as relevant to their national, local or individual contexts.

[86] International Baccalaureate Organization, 2008. *Primary Years Programme Science Scope and Sequence.*
[87] International Baccalaureate Organization, 2008. *Primary Years Programme Science Scope and Sequence.*

Content

Table 16: Content in the NCERT and the IB PYP Science

	NCERT Science	IB PYP
Topics taught	Food Materials The World of the Living Moving things, people and ideas How things work Natural Phenomenon Natural resources	Living things Earth and Space Materials and Matter Forces and Energy
Number of topics	7 main topics	4 main topics
Recommended teaching periods	• Class VI: 148 • Class VII: 142 • Class VIII: 132 Overall 422 periods	n/a

The above table lists the topics taught within both the NCERT and IB PYP Science courses. Although the NCERT appears to have a larger number of main topic headings than the IB PYP, both include a similar range of sub-topics within these.

The NCERT also specifies teaching hours for each of the three academic years (Class VI-VIII). Alternatively, the IB PYP does not prescribe teaching hours; rather the schools set these themselves.

Table 17: Content comparison of the NCERT and the IB PYP Science

NCERT Topics	IB PYP Science strand
Food	✓
Materials	✓
The World of the Living	✓
Moving things, people and ideas	✓
How things work	✓
Natural Phenomenon	✓
Natural resources	✓

As summarised in the table above, all of the NCERT topics are covered by the IB PYP Science strands. The NCERT topic on *How things work* includes content related to electricity and magnetics. These sub-topics are similar to the IB PYP strand *Forces and Energy*; however the NCERT goes into more depth on topics such as how torches work.

Many similarities between the IB and NCERT can be found including the IB strand in *Materials and Matter* (ages 9-12) where the central idea is that "material can undergo permanent or temporary changes poses challenges and provides benefits for society and the environment"[88]. This corresponds well to the NCERT Class VIII topic for *Materials in daily life* where IB students are required to consider the properties and use of materials and the implications of changing materials (including plastics). IB students are also required to consider the ethical dilemmas associated with manufacturing processes and by-products.

Other NCERT topics similarly covered in the IB PYP include:

- Plant form and function
- Properties of air
- Night and day cycles
- Daily habits and routines
- Reducing waste
- Sources of water, water as a resource, distribution and usage, responsibilities
- Reproduction of living things
- Changing nature of the earth
- Adaptation of living things
- Needs of living beings, processes and responses to change.

6.2.3 Social Studies

Key findings – NCERT and IB primary Social Studies

The structure of Social Studies in the primary syllabi is different; the NCERT progresses from Environmental Studies into Social Science whereas the IB PYP syllabus encompasses all of primary Social Studies.

The key general themes and principles identified from the NCERT syllabus document can all be similarly found within the IB PYP with the exception of those relating to Indian history and society.

The NCERT syllabus further defines for Classes VI-VIII, principles and objectives specific to History, Geography, and Social Sciences. Whilst the IB PYP does not prescribe objectives to this level of detail, many of the key concepts in History, Geography, Social and Political life are included even if the specific contexts may differ.

In terms of content, the IB PYP provides partial coverage of the NCERT Social Sciences content, reflecting the specific nature of the NCERT content in contrast to the broader concepts and strands defined by the IB.

Both the NCERT and IB PYP Social Studies similarly seek to develop in students:

- Understanding of history and its significance
- Comprehension skills
- Engagement with the world around them and an understanding of society
- Awareness of and sensitivity to social problems.

[88] International Baccalaureate Organization, 2008. *Primary Years Programme Science Scope and Sequence*.

Key Themes and Principles

A few overarching themes for the NCERT Social Studies students from I-X are provided in the NCERT Social Science (VI-VIII)[89] and reiterated in the syllabus for NCERT Social Science (IX-XII)[90]. The IB PYP principles and themes are compared to the NCERT in the table below:

Table 18: Key themes and principles underpinning NCERT Social Studies I-X and IB PYP

NCERT Social Sciences I-X: Key themes and principles for curriculum and teaching	Included in the IB PYP
The curriculum should be interesting and challenging for students and promote self-understanding	✓
Curriculum and teaching should ensure students develop understanding of:	
Society and the world students live in	✓
Socio-economics in time and space	✓
Shape and functions of society	✓
Country and urban life; the nature of the problems of everyday life	✓*
Diversity of the world and conflict resolution	✓
India's history and the context in which the country has and continues to develop	✓*
Social sensitivity and social problems	✓
Key features of human existence, democracy, equality and social justice	✓*
Curriculum and teaching should support development of:	
Comprehension skills	✓
World engagement	✓

As seen in the table above, all of the NCERT Class I-X key principles and themes are considered included within the IB PYP – whether fully or partially covered. Many similarities can be found to the IB PYP related concepts, part of the rationale and introduction for the programme, or the overall expectations for an age group within the programme. For instance, the NCERT key themes on understanding and having a healthy engagement with the world, and to have social sensitivity are included within the IB PYP overall expectation for 5-7 years to "increase their understanding of their world"[91]. This reflects the philosophy of the programme that "learning should influence their willingness and ability to take action and make a difference in the world"[92], and that students will be given opportunities to "look at and

[89] National Council of Educational Research and Training, 2006. *Syllabus for Classes at the Elementary Level - Volume 1.*
[90] National Council of Educational Research and Training, 2005. *Syllabus for Secondary and Higher Secondary Classes - Volume 2.*
[91] International Baccalaureate Organization, 2008. *Primary Years Programme Social studies Scope and Sequence.*
[92] International Baccalaureate Organization, 2009. *Making the PYP happen: A curriculum framework for international primary education.*

think about human behaviour and activity realistically, objectively, and with sensitivity"[93]. A few of the NCERT themes are included within strands from the IB PYP including *Human systems and economic activities*, *Continuity and change through time*, and *Individuals and groups and the way they interact with each other*[94].

Four of the above key themes are similar to the IB PYP related concepts, including the NCERT themes relating to country, urban, and everyday life; India's history; values of democracy; and the diversity of the world. These first three themes are partially included within the IB PYP related concepts of *lifestyle, history and government or governance*, but they are broader categories than in the NCERT. The NCERT theme on *diversity* is similar to the IB PYP related concept of *diversity* and the inquiry on *conflict resolution* and is also included within the transdisciplinary theme on *Sharing the planet* which discusses peace and conflict resolution[95].

The importance of developing comprehension skills, acknowledged in the NCERT syllabus, is clearly evidenced within the IB PYP Social Studies, as an integral component of the Scope and Sequence. For instance, the sample learning outcomes are intended to "focus on the conceptual understanding of a particular central idea"[96]. Further, the IB Learner Profile aims for learners to be *Knowledgeable* and develop broad and balanced understanding[97].

The NCERT theme regarding self-understanding and fulfilment can be found within the IB PYP Learner Profile attribute *Reflective*, which encourages students to "achieve the personal well-being for themselves and others"[98].

The NCERT Environmental Studies syllabus for Classes III-V[99] includes objectives from the NCF which combine Science and Social Studies related themes and principles. Many of these are repeated with the NCERT primary Science syllabus or the themes presented in Table 18. Some of the additional aims include identifying relationships between different environments and developing a child's curiosity and creativity along with an understanding of environmental issues and design. The IB PYP similarly aims to develop *Inquirers* who understand key concepts regarding environments. The topic of *design* is also found within both programmes, in addition to *people,* and *families.*

In the NCERT Environmental Studies syllabus the subjects of Social Studies and Science are integrated at this primary stage. This is similarly reflected within the IB PYP as there are no boundaries or barriers on when topics are taught. The PYP encourages transdisciplinary learning.

[93] International Baccalaureate Organization, 2008. *Primary Years Programme Social studies Scope and Sequence.*
[94] International Baccalaureate Organization, 2008. *Primary Years Programme Social studies Scope and Sequence.*
[95] International Baccalaureate Organization, 2008. *Primary Years Programme Social studies Scope and Sequence.*
[96] International Baccalaureate Organization, 2008. *Primary Years Programme Social studies Scope and Sequence.*
[97] International Baccalaureate Organization, 2008. *Primary Years Programme Social studies Scope and Sequence.*
[98] International Baccalaureate Organization, 2008. *Primary Years Programme Social studies Scope and Sequence.*
[99] National Council of Educational Research and Training, 2006. *Syllabus for Classes at the Elementary Level - Volume 1.*

The NCERT Social Sciences for Classes VI-VIII also includes themes and principles for each of the three overarching themes: *History*, *Geography*, and *Social and Political life*. The key themes from these, for each subject, is provided in the below table.

Table 19: Key themes and principles underpinning NCERT VI-VIII and IB PYP Social Studies

NCERT Social Sciences VI-VIII: Key themes and principles for curriculum and teaching[100]	Included in the IB PYP
History *Curriculum and teaching should support students to:*	
Understand the significance of history and develop 'historical sensibility'	✓
Learn beyond the facts, to learn to think historically. In this context, students should be encouraged to imagine what it would be like to be a child during the period under discussion	✓*
Draw connections between processes and events	✓*
Learn about Indian history whilst also learning about a diverse range of historical events (from across multiple regions)	✓*
Be familiar with developments within periods of history	✓*
Understand how historians learn about the past. (i.e. sources, reflection)	✓*
Be familiar with timelines and historical maps, as a means of contextualising events/case studies	✓
Geography *Curriculum and teaching should enable students to develop an understanding of:*	
The world	✓
Contemporary issues (an introduction)	✓*
The environment, resources and development as local, regional/national and international levels	✓
The earth as the habitat of humankind and other forms of life	✓*
The students' own region, state and country in the global context	✓
The global distribution of economic resources and the ongoing process of globalisation	✓*
The interdependence of various regions and countries	✓*
Social and Political Life *Curriculum and teaching should:*	
Focus on certain key concepts that enable students to understand the functioning of Indian democracy, including its institutions and processes	✓*
Focus on the real-life functioning of institutions	✓
Enable students to make connections between their everyday lives and the issues discussed in their textbooks. This may include the use of imaginary narratives to support students in drawing their own connections	✓

[100] National Council of Educational Research and Training, 2006. *Syllabus for Classes at the Elementary Level - Volume 1*, p. 162-187.

Embed the ideals of the Indian Constitution	
Enable students to comprehend the interlinkages between political, social and economic issues	✓*
Enable students to recognise the gendered nature of all of the issues raised	
Develop student skills in critical analysis and interpretation, from the point of view of the marginalised, of political, social and economic developments	✓*
Help students to understand how politics affects their daily lives	✓*

As seen in the table above, the IB PYP more closely reflects the key principles of the *History* and *Geography* components, with less of a link to the *Social and Political life* themes of the NCERT which are more specific to the national context.

Key themes and principles from NCERT can be similarly found within the IB PYP key concepts, related concepts, and introduction section of the IB PYP syllabus. For instance, the NCERT history theme to develop 'historical sensibility' and awareness is similar to the IB principle to develop understanding of the related concept *history*. The NCERT theme to know the development within periods of history can be partially included within the IB *history* concept and the strand *Continuity and change through time*[101].

Another example of a NCERT theme that is partially included in the IB PYP is the introduction of contemporary issues within the *Geography* section. As the IB PYP includes discussion on various issues, such as resources, this could be considered a contemporary issue.

Content

The NCERT Environmental Studies III-V syllabus covers six main in the curriculum. The NCERT Social Sciences VI-VIII syllabus is more complex in that there are three subject themes, with each theme including sub-topics for each year. For the ease of the comparison, the below table only examines the over-arching main topics. Similarly, the five strands from the IB PYP represent the main concepts or topics in the curriculum.

[101] International Baccalaureate Organization, 2008. *Primary Years Programme Social studies Scope and Sequence*.

Table 20: Content in the NCERT IB PYP Social Studies

	NCERT Environmental Studies III-V	NCERT Social Sciences VI-VIII	IB PYP
Topics taught	• Family and friends • Food • Shelter • Water • Travel • Things we make and do	• History • Geography • Social and Political life	• Human systems and economic activities • Social organisation and culture • Continuity and change through time • Human and natural environments • Resources and the environment
Number of topics	6 main topics	3 main topics (many sub-topics)	5 main topics
Teaching hours	n/a	n/a	n/a

The table above shows the topics taught within the NCERT Environmental Studies Class III-V and Social Sciences Class VI-VIII. As Environmental Studies reflects both the topics in Social Sciences and the NCERT Science course in lower primary, the transition to Social Sciences in upper primary is clear. Overall the NCERT courses cover a similar number and range of topics as the IB PYP. The NCERT Social Sciences VI-VIII course has three main topics but includes many sub-topics within it.

None of the courses have prescribed teaching hours in the syllabi.

The topics taught in NCERT Environmental Studies III-V are included in the table below:

Table 21: Content comparison of the NCERT III-V and IB PYP Social Studies

NCERT Topics	Included in the IB PYP
Family and Friends • Relationships • Work and Play • Animals • Plants	✓
Food	
Shelter	✓
Water	✓
Travel	✓
Things we make and do	

As seen in the table above, four out of the six topics in the NCERT syllabus can be identified within the IB PYP Scope and Sequence. The NCERT topic *Family and Friends* is similar to the related IB concepts of *family* and *employment* which includes an idea regarding work

and play; however, the topics of *Animals* and *Plants* are not directly mentioned within the IB PYP.

The last three NCERT topics found within the IB PYP (*Shelter, Water*, and *Travel*) are included within various sections of the IB PYP sample units of inquiry as either part of the lines of inquiry or the central ideas. For instance, the IB PYP includes lines of inquiry on the different types of homes or circumstances that determine where people live. It also includes *sources of water and how water is used* and other similar water-related sections. For *Travel* the IB PYP has lines of inquiry and a central idea about the transportation system.

The NCERT topic of *Food* is not found within the IB PYP Social Studies specifically; however the related concept of *diversity* could be used to discuss the diversity in food. Additionally, the topic of *Food* could be included within the IB PYP Science Scope and Sequence as part of the discussions on how to sustain life and stay healthy.

Another topic not covered by the IB PYP is *Things We Make and Do*. Although the IB PYP includes a central idea on *the design of buildings and structures* and materials, similar to one section within the NCERT, it does not detail some of the further topics the NCERT covers related to food or pottery.

The NCERT Social Sciences for Classes VI-VIII includes topics under each of the subject themes.

Table 22: Content comparison of the NCERT VI-VIII and IB PYP Social Studies

NCERT Topics	Included in the IB PYP
History	
Our Pasts – I	✓*
Our Pasts – II	✓*
Our Pasts – III	✓*
Geography	
Class VI: the Earth – Our Habitat	
Class VII: Our Environment	✓*
Class VIII Resources and Development	✓*
Social and Political Life	
Class VI: Diversity and Interdependence	✓*
Class VII: Democracy and Equality	✓*
Class VIII: Rule of Law and Social Justice	✓*

Each of the key topics of the NCERT Social Sciences syllabus, and the sub-topics within them has been compared to the IB PYP Social Studies Scope and Sequences[102]. The first topic, *History: Our Pasts*, is split by the three years of programme. Each year focusses on

[102] International Baccalaureate Organization, 2008. *Primary Years Programme Social studies Scope and Sequence.*

key points in Indian history, and therefore can only be partially identified within the IB PYP which provides a broader sample of inquiry. Although the specific aspects of Indian history and culture are not present within the IB PYP syllabus, there are some similarities. For instance the related concepts include *history, government or governance*, and *change*. There is also a central idea in a unit of inquiry that "governmental systems and decisions can promote or deny equal opportunities and social justice"[103]. The strand *Social organisation and culture* also ties to the NCERT topics.

The NCERT overall topic area on *Geography* has three topics taught over the three class years. The first, *The Earth – Our Habitat* is not included in the IB PYP. Although the IB PYP does discuss the earth, it is in relation to the practices to sustain and maintain the earth resources. This differs from the NCERT that focusses on the geographical elements of the earth (i.e. solar system, maps, and realms). The second two topics, *Our Environment* and *Resources and Development*, can be partially identified within the IB PYP. The IB PYP includes the strands *Human and Natural Environment* and *Resources and the Environment* which touch on similar content to that in the NCERT; however the NCERT focusses more on factual and geographical content.

The NCERT topic on *Social and Political Life* is split into the three years, with each year covering a different topic. The first year, *Diversity and Interdependence*, includes content found within the IB PYP, such as diversity, government, and interdependence. The NCERT unit on *Making a Living*[104] is not covered within the IB PYP although the second two sections/years under this topic can be partially identified: the topics related to the government and social systems are included in the IB PYP, but are prescribed in more detail within the NCERT and centred on India.

[103] International Baccalaureate Organization, 2008. *Primary Years Programme Social Studies Scope and Sequence.*
[104] National Council of Educational Research and Training, 2006. *Syllabus for Classes at the Elementary Level - Volume 1.*

6.3 Comparative Analysis of the IB MYP and the NCERT Secondary Syllabi: Selected Subjects

6.3.1 Mathematics

Key findings – NCERT and IB secondary Mathematics

The NCERT and IB MYP share similar aims and themes overall including the aim for students to know and understand mathematics while applying it to real-life experiences. Both also emphasise that secondary Mathematics should build on what was learned in primary Mathematics.

The main mathematical topics taught in the NCERT are similarly present in the IB MYP four branches of mathematical study, including: number, algebra, geometry, trigonometry, and statistics and probability.

In terms of differences, the NCERT includes quadrilaterals which is not explicitly found within the IB MYP branches of mathematics, but could be built into the IB programme by Indian schools.

Key Themes and Principles

The key points from the NCERT salient features of the syllabus and the general guidelines[105] are included in the table below as the reference point for comparing the IB MYP Mathematics.

Table 23: Key themes and principles underpinning NCERT and IB MYP Mathematics

NCERT: Key themes and principles for curriculum and teaching	Included in the IB MYP
Room for students to develop understanding of mathematics	✓
Abstraction; moving between concepts, ideas, and processes	✓
Application to real-life experiences and whole curriculum	✓
Connections to primary math studies. Beginning of 'formal mathematics'	✓
Examples should be used to demonstrate mathematics concepts	✓
Clear and simple language, particularly in word –problems	✓
Non-didactic proofs presented, and where possible, more than one proof	✓*
Emphasis on correct solutions to problems, and providing clear arguments	✓
Ruler and compass construction and analysis used to encourage reasoning	✓

As seen in the table above, the majority of the key principles and themes from the NCERT are included within the IB MYP. The IB MYP objectives on knowing and understanding

[105] National Council of Educational Research and Training, 2005. *Syllabus for Secondary and Higher Secondary Classes - Volume 2*, p. 57.

mathematics and applying mathematics in real-life contexts[106] and the strands within them are similar to the NCERT aims for students to have room to understand mathematics (including abstraction, and moving between concepts) and apply it to real-life experiences.

IB MYP strands also demonstrate similar aims for the student to be able to solve problems with correct and clear answers, and to "communicate complete, coherent and concise mathematical lines of reasoning"[107] which may include ruler and compass construction.

The NCERT aim to present 'non-didactic proofs' can be partially included within the IB MYP as part of its wider objective, investigative patterns.

Content

The table below summarises the main mathematical topics included in the NCERT syllabus and the four branches of mathematics in the IB MYP Guide.

Table 24: Content in the NCERT and IB MYP Mathematics

	NCERT		IB MYP
	IX	**X**	
Topics	Algebra Coordinate Geometry Geometry Mensuration Number Systems Statistics and Probability Appendix: 1. Proofs in Mathematics, 2. Introduction to Mathematical Modelling	Algebra Coordinate Geometry Geometry Mensuration Number Systems Statistics and Probability Trigonometry Appendix: 1. Proofs in Mathematics 2. Mathematical Modelling	Algebra Geometry and trigonometry Number Statistics and probability
Number of topics	9 main topics		4 main mathematics topics
Teaching hours	180 periods each year (360 overall)		50 required per year (250 required overall, 290 recommended for those taking the eAssessment)

[106] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics guide.*
[107] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics guide.*

The NCERT and IB MYP both include similar mathematics topics within the secondary course, with the number and range being broadly the same. The NCERT includes two topics that are in the textbook appendices, as they are only introductory topics for class IX and X and students are not required to be aware of these topics fully until class XI and XII.

A comparison of the NCERT content, including the sub-content, to the IB MYP branches of mathematical study is seen in the table below:

Table 25: Content comparison of the NCERT and IB MYP Mathematics

NCERT Topics	Sub-topics	Included in the IB MYP standard[108]
Number Systems	Real Numbers	✓
Algebra	Polynomials	✓
	Linear Equations in Two Variables	✓
	Quadratic Equations	✓
	Arithmetic Progressions (AP)	✓
Trigonometry	Intro to Trig	✓
	Heights and Distances	✓
Coordinate Geometry	IX -	✓
	Lines (In two-dimensions)	✓
Geometry	IX Introduction to Euclid's Geometry	✓
	Lines and Angles	✓
	Triangles	✓
	Quadrilaterals	
	Area	✓
	Circles	✓
	Constructions	✓*
Mensuration	Areas	✓
	Surface areas and volumes	✓
	Areas related to circles	✓
Statistics and Probability	Statistics	✓
	Probability	✓
Proofs in Mathematics		
Introduction to Mathematical Modelling		
Mathematical Modelling		

[108] Where the IB programme includes multiple pathways (i.e. standard vs extended in MYP Mathematics year 4 and 5) the standard programme was examined, on the basis that this reflected the minimum content that all IB students would have covered.

The majority of the topics presented in the NCERT are included in the IB MYP as seen in the table above. The NCERT sub-topic, *Quadrilaterals*, cannot be identified within the IB MYP; however the other *Geometry* sub-topics are similar to the IB MYP topics and overall both programmes cover *Geometry to* a similar breadth and depth.

For the NCERT topic *Statistics and Probability* the IB MYP in comparison covers more types of probability. The NCERT primarily focusses on empirical probability whereas the IB MYP suggests that students should learn to "estimate parameters, discover empirical laws, test hypotheses and predict the occurrence of events"[109].

The last three topics seen in Table 25 are included as 'appendix' subjects within the NCERT. Although these are not immediately identifiable within the IB MYP mathematics branches, it is possible that they may be covered within the course. The IB MYP includes *models* as a related concept, although *proof* can only be found in the glossary of the IB MYP Guide as one of the key terms. This suggests that the topics may be included within the curriculum when developed by IB schools.

6.3.2 Science

Key findings – NCERT and IB secondary Science

The principles and aims of the NCERT Science are similar to those found within the IB MYP, with a shared focus on inquiry (including scientific inquiry) and connecting the curriculum to real life. Both syllabi also value practical skills development, with experiments intended to be a focus for each.

Comparing content proved more difficult owing to differences in the extent to which content is prescribed within the two syllabi: the NCERT syllabi define core topics and sub-topics whereas the IB MYP focusses on conceptual understanding of science. Both the NCERT and MYP Science cover chemistry, physics, and biology however owing to the aforementioned differences in the syllabus documentation, the majority of the NCERT prescribed content for Science could not be directly found within the defined IB MYP key concepts.

Key Themes and Principles

The key themes from the introductory sections of the NCERT syllabus (rationale, themes and format, and approach)[110] have been compared to the IB MYP. Some of the aims and themes identified are repeated from the NCERT primary syllabus. These key themes have been compared to the IB MYP, in addition to the a few key themes specific to the NCERT secondary syllabus.

[109] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics guide.*
[110] National Council of Educational Research and Training, 2005. *Syllabus for Secondary and Higher Secondary Classes - Volume 2.*

Table 26: Key themes and principles underpinning NCERT and IB MYP Science

NCERT: Key themes and principles for curriculum and teaching	Included in the IB MYP
Participation and inquiry-based syllabus related to a childs own experiences	✓
Focus on childrens perspective	✓
Focus on activities, discussion, and reflection	✓
Provision of space and time for scientific inquiry	✓
Content includes cross-disciplinary themes	✓
Syllabus themes should advance through the Classes	✓
Experiments are a focus	✓
Inclusion of abstraction and quantitative reasoning	✓
Acquire factual knowledge through processes	✓
Exposure to experiences and modes of reasoning	✓
Help students learn to become autonomous learners	✓

As seen in the table above, all of the key themes identified in the NCERT are included within the IB MYP. One clear theme mentioned within the introduction of the NCERT is that students should learn to become autonomous learners[111]. This aim is also present in the NCERT primary syllabus. Similarly, the IB MYP promotes independent learning for students, through inquiry. The focus on inquiry is clearly evident in the IB MYP Guide[112], and therefore matches to the NCERT first key theme in the table above. The IB MYP also focusses on providing similar 'space and time' for scientific inquiry as the NCERT, and for experiments.

The two NCERT aims to focus on the student's perspective and experiences are similarly included in the IB MYP as emphasis on everyday life and real-life contexts. The NCERT also aims for the content to be cross-disciplinary, a key theme included within the IB MYP through the mention of interdisciplinary learning and connections across the curriculum. Both programmes further demonstrate an increase in difficulty through the class years.

Three of the key themes identified in Table 26 are specific to the NCERT secondary Science syllabus. The first, regarding abstraction and quantitative reasoning, is included within the IB MYP curriculum (*interpretation of quantitative data and summarisation* - a key word that means 'to abstract' in the IB[113]). The second NCERT aim, to acquire factual knowledge through processes rather than learning the facts themselves, can be found within the IB MYP strands on *explaining and applying scientific knowledge*. The last NCERT aim is on exposing students to experiences and modes of reasoning. Similarly, the IB MYP focusses heavily on learning experiences and additionally includes the aim to "reflect on learning experiences and make informed choices"[114]. IB MYP students are exposed to modes of

[111]National Council of Educational Research and Training, 2005. *Syllabus for Secondary and Higher Secondary Classes - Volume 2. Secondary Science IX-X.*
[112] International Baccalaureate Organization, 2014. *Middle Years Programme: Sciences guide.*
[113] International Baccalaureate Organization, 2014. *Middle Years Programme: Sciences guide.*
[114] International Baccalaureate Organization, 2014. *Middle Years Programme: Sciences guide.*

reasoning in a science setting, as identified within the strand to "formulate a testable hypothesis and explain it using scientific reasoning"[115].

Content

The table below summarises the main topics included in the NCERT syllabus and the key concepts from the IB MYP Guide.

Table 27: Content in the NCERT and IB MYP Science

	NCERT Science		IB MYP
	IX	**X**	
Topics	Materials Natural Phenomenon The World of the Living Food Moving things, people and ideas	Materials Natural Phenomenon The World of the Living Natural resources How things work	**Key Concepts** • Change • Relationships • Systems **Related Concepts in:** Biology Chemistry Physics
Number of topics	7 main topics		n/a
Teaching hours	154 periods each year (308 overall)		50 required per year (250 required overall, 290 recommended for those taking the eAssessment)

The NCERT and IB MYP have a similar breadth and depth in terms of the number and range of topics studied. The IB MYP Guide outlines the key concepts and related concepts to be included within the curriculum[116]. The IB MYP has fewer main topics, as seen in the table above; there are multiple sub-topics (related concepts).

Both programmes provide the recommended teaching hours or periods per year.

[115] International Baccalaureate Organization, 2014. *Middle Years Programme: Sciences guide.*
[116] International Baccalaureate Organization, 2014. *Middle Years Programme: Sciences guide.*

Table 28: Content comparison of the NCERT and the IB MYP Science

NCERT Topics	Included in the IB MYP
Food	
Materials	✓*
The World of the living	✓*
Moving things, people and ideas	✓*
How things work	✓*
Natural phenomenon	✓*
Natural resources	✓*

The NCERT topic of *Food* includes detailed sub-topics on higher yields and concepts on plant and animal breeding, sub-topics not found in the IB. A topic list for the IB eAssessment includes 'food chains' but is not comparable to the NCERT *Food* topic. Within the IB MYP Guide, rather than prescribing detailed sub-topics, the IB provides broader key concepts and science specific related concepts. These concepts are used by IB World Schools to draw connections across the curriculum and can include various scientific principles and ideas. Thus, depending on how they are adapted, the curriculum may or may not include similar content to the NCERT. For the purposes of this comparison, neither the IB MYP Guide nor the topic lists include food in the study of Science, so a check mark has not been included for this in the table.

The other NCERT topics are partially included in the IB MYP. For instance, the NCERT topic *The world of the living* includes a sub-topic on the environment and another on the movement of cells. These are similar to the IB MYP Biology specific related concepts *environment* and *transformation*. For the NCERT topic *Moving things, people and ideas* the sub-topic on motion relates to the IB MYP related concept *movement*. Both also discuss energy and transformation (a change of state). The last key topic, *Natural resources*, discusses 'balance in nature' which corresponds to the IB MYP Biology related concept *balance*. The related concepts of *consequences* and *energy* could be similar to the NCERT sub-topics on *sources of energy and conservation*. All three of these NCERT topics can also be identified within the IB MYP eAssessment topic lists.

Unlike the above NCERT topics, *Materials*, *How things work*, and *Natural phenomenon* are not similar to the IB MYP concepts. Alternatively, they are partially similar to the topic lists for the IB MYP optional eAssessments. For instance, the IB MYP Physics eAssessment could include 'heat, light and sound' and 'properties of matter', and the Chemistry eAssessment could include 'matter', 'bonding' and the 'periodic table', all topics under the NCERT *Materials*. Similar to the *How things work* topic, the IB MYP Physics or Integrated Sciences eAssessment could include 'electromagnetism'. Lastly, both programmes also include some similar topics on *Natural phenomenon* such as light and waves, which could be assessed in the IB MYP optional Physics eAssessment.

6.3.3 Social Studies

Key findings – NCERT and IB secondary Social Studies

Most of the NCERT key principles and objectives can be similarly found in the IB MYP with the extent of coverage varying. However, these principles and objectives are organised by subject (History, Geography, etc.) and best compare to the IB key concepts which cover the broad topics, and the IB related concepts which cover the subject-specific topics. The IB focusses on broader topics.

- In the NCERT, History, Geography, Political Science, and Economics have separate syllabi content outlines, whereas the IB allows for schools to organise the course in one of three ways: discrete course with individual disciplines, modular course with all disciplines studied at the same time, or an integrated course that includes multiple disciplinary perspectives.
- The NCERT principles are subject-specific and knowledge-based whereas the IB MYP is concept-based. This can also be found with the content outlines.
- The NCERT content is all partially included within the IB MYP. Although the general topics are shared between the programmes, the NCERT provides more subject-specific topics and some specific to India.

The NCERT Secondary syllabus for Social Science[117] includes a detailed introduction to Social Science for all of primary, secondary, and higher secondary education, and a second introduction specifically for the secondary stage of Social Sciences. The syllabi for History, Geography, Political Science, and Economics are included separately with each section explaining the rationale and objectives for the overall course. History and Geography have overall objectives in addition to objectives provided alongside the curriculum themes and units. Political Science differs in that learning objectives are provided alongside the themes. Economics is similar with objectives next to each of the themes. In some, but not all, cases the number of periods per theme are provided.

The IB MYP Individuals and Societies Guide is structured in a similar way to the other guides in that it includes the general missions and aims of the IB, the MYP, and the IB Learner Profile. It also includes the aims for this subject group, objectives, strands, key concepts, related concepts and information for teachers on developing the written and taught curriculum.

The IB MYP Individuals and Societies course can be offered in one of three different ways:

- Separate courses focussed on the individual disciplines
- Modular courses where the disciplines would be studied one at a time
- Integrated courses with multiple disciplines offering a perspective[118].

[117] National Council of Educational Research and Training, 2005. *Syllabus for Secondary and Higher Secondary Classes - Volume 2.*
[118] International Baccalaureate Organization, 2014. *Middle Years Programme: Individuals and Societies Guide.*

For the IB MYP assessment, required assessment criteria are provided for years 1, 3 and 5. For two of the criteria, investigating and communicating, the Guide includes information on the assessment tasks.

Key Themes and Principles

Key themes and principles for NCERT Social Studies students from Classes I-X are identified and examined in section 6.2.3 of this report. Further themes and principles for the individual subjects in the NCERT can also be identified (often from the *Objectives* section) and used as a reference point for comparing the IB MYP individuals and Societies.

Table 29: Key themes and principles underpinning NCERT and IB MYP Social Studies

NCERT: Key themes and principles for curriculum and teaching	Included in the IB MYP
History *The course objectives state that students will:*[119]	
Study the contemporary world, and understand the key forces that shape / have shaped it. Included within this is the awareness of political concepts and ideologies	✓
Understand how different social groups respond to and influence economic changes, typically in relation to a give region and selected national case studies (India and one other country)	✓*
Appreciate that history is everywhere (that everything 'has a history') and that everything – from books to clothing, food, leisure or sport – can reflect changes in culture and politics and be linked to identity and power issues	✓*
Be able to critically engage with and interpret different media and literature (used in the course to supplement textbooks)	✓
Be encouraged to interpret and make connections in what they're learning (in terms of space and time) through the use of maps and timelines	✓
Geography *The course objectives state that students will:*[120]	
Appreciate diversity in India in terms of land and people and understand their own place in the wider context	✓*
Understand economic and social change and development in their own milieu and be able to relates these processes more widely to contemporary India	✓*
Understand the relationship between the world economy and changes and developments in India	✓*
Recognise the importance of using resources carefully and of environmental conservation, and with an instilled appreciation of environmental concerns	✓*
Have respect for local communities' rights regarding their environment	✓

[119] From the History (Classes IX-X) syllabi in the National Council of Educational Research and Training, 2005. *Syllabus for Secondary and Higher Secondary Classes - Volume 2,* p. 77.
[120] From the Geography (Classes IX-X) syllabi in the National Council of Educational Research and Training, 2005. *Syllabus for Secondary and Higher Secondary Classes - Volume 2,* p. 81-82.

Political Science *The course objectives state that students will:* [121]	
Be introduced to the Indian Constitution	
Be given the opportunity for reflection and debate, drawing on own experiences and values compared with the Indian national constitutional and democratic values	✓*
Develop skills in connecting personal and political	✓*
Economics *The course objectives state that students will:*[122]	
Be taught that changes occur frequently in the institutional framework of the economy	✓*
Be party to discussions on resources (ownership and usage) and inequalities, with emphasis on the normative nature of economics and the role of economic policies	✓*
Be aware that different perspective should be used to view economics problems	✓*

Most of the key themes and principles in the *History* section of the NCERT syllabus are included within the IB MYP. Instead of subject-specific themes, the IB MYP prescribes key concepts (including: *change* and *time*, *place and space*) and related concepts (*culture, identity,* and *causality*) which contain similarities to the broader aspects of the NCERT principles. The fourth NCERT topic about critically engaging with sources and literature can be found within the IB MYP strand to "analyse and evaluate a range of sources/data in terms of origin and purpose, examining value and limitations"[123].

Similarly, the NCERT section for *Geography* includes themes regarding understanding or appreciating elements of geography. These are similar to the IB MYP key concepts of *change*, and the related concept of *power*, allowing for the NCERT theme to be identified within them. The first theme for Geography is also similar to the IB MYP aim to "appreciate human and environmental commonalities and diversity"[124]. Two of the geography themes are only partially identified within the IB MYP due to their similarity with the aim to "identify and develop concern for the well-being of human communities and the natural environment"[125]; however the NCERT is focussed on conservation.

For *Political Science and Economics*, the main principles of the courses have been included in the table. These are less similar to the IB MYP as they are subject-specific and focus on the content to be taught. As the IB MYP does not focus on the Indian Constitution, these are not found within the IB MYP Scope and Sequence. The rest of the key rationale points are partially identified, as they match key concepts (*global interactions*, and *change*), related concepts (*for Economics: resources*), and the strand to "interpret different perspectives and their implications"[126].

[121] From the Political Science (Classes IX-X) syllabi in the National Council of Educational Research and Training, 2005. *Syllabus for Secondary and Higher Secondary Classes - Volume 2,* p. 85.
[122] From the Economics (Classes IX-X) syllabi in the National Council of Educational Research and Training, 2005. *Syllabus for Secondary and Higher Secondary Classes - Volume 2,* p. 88-89.
[123] International Baccalaureate Organization, 2014. *Middle Years Programme: Individuals and Societies Guide.*
[124] International Baccalaureate Organization, 2014. *Middle Years Programme: Individuals and Societies Guide.*
[125] International Baccalaureate Organization, 2014. *Middle Years Programme: Individuals and Societies Guide.*
[126] International Baccalaureate Organization, 2014. *Middle Years Programme: Individuals and Societies Guide.*

Content

The table below summarises the main topics included in the NCERT syllabus and the IB MYP Guide.

Table 30: Content in the NCERT and IB MYP Social Studies

	NCERT	IB MYP
	IX-X	
Topics	History Geography Political Science Economics	**Key Concepts:** • Change • Global interactions • Systems • Time, place and space **Related concepts in:** • Economics • Geography • History
Number of topics	4 main topics	n/a
Teaching hours	Estimated 200 periods each year (400 overall).	50 required per year (250 required overall, 290 recommended for those taking the eAssessment

The NCERT and IB MYP have similar breadth and depth of in terms of the range of topics studied. The IB MYP Guide outlines the key concepts and related concepts to be included within the curriculum. The IB MYP related concepts can fall under other disciplines in addition to Economics, Geography, and History. For instance, related concepts regarding Political Science could be included.

The NCERT secondary Social Sciences syllabi each include themes, topics, or units regarding the content that should be taught within the course. Detail is provided on specific concepts, events, and information that should be taught. The below table presents the wider topics for each of the four social science subjects, and compares them to the MYP key concepts and related concepts.

Table 31: Content Comparison of the NCERT and IB MYP Social Studies

NCERT Social Science Topics	Included in the IB MYP
History	
India and the Contemporary World I • Events and Processes • Economics and Livelihoods • Culture, Identity and Society	✓*
India and the Contemporary World II • Events and Processes • Economics and Livelihoods • Culture, Identity and Society	✓*
Geography	
India - Land and the People	✓*
India - Resources and their Development	✓*
Political Science	
Democratic Politics I	✓*
Democratic Politics II	✓*
Economics	
Class IX	✓*
Class X	✓*

Each of the four sections of the NCERT secondary Social Sciences syllabi has a breakdown of the content, themes, and topics for both Class IX and X. These are organised in different ways, but are demonstrated in the table above. All of the topics are considered partially identified within the IB MYP. The NCERT content is more detailed and specific to India; whilst the IB MYP is structured on concepts within History, Geography, Political Science and Economics; nevertheless these concepts do relate to the topics and themes within the NCERT. For instance, the IB MYP has multiple related concepts under History such as *conflict, culture, identity* and *significance*. For Geography there are the concepts of *globalisation* and *power resources*, and for Political Science the concepts of *government, right,* and *power*. The NCERT Economics class years focussed on resources, poverty, food, money, globalisation, and other economic topics. The IB MYP similarly has economic related concepts on *resources, poverty, consumption,* and *globalisation*.

Some similarities can be found between the NCERT topics and the IB MYP optional eAssessment topic lists. As seen with the IB MYP Guide, the eAssessment topic lists includes broad topics and concepts that could encompass the more detailed sub-topics of the NCERT, but do not explicitly include them.

7. Comparing the Principles, Curriculum and Assessment of the IB and CBSE Programmes

7.1 Core Components, Goals and Outcomes of the IB MYP and CBSE

Key findings – the key principles, goals and outcomes of the IB MYP and CBSE curriculum

When looking at the CBSE core components, the IB MYP demonstrates some clear areas of similarity, fully addressing five of the six core components, in particular through its intentions to develop **life skills** and instil a **global perspective** among its learners, with the latter being an over-riding objective of the IB education.

Whilst the CBSE syllabus aims to firmly embed the Indian Constitution, the IB similarly seeks to develop certain core values and attributes among learners, with the understanding that IB World Schools would further support this through adaptation of the curriculum relevant to appropriate local, regional or national contexts.

Both the CBSE and the IB hold similar principles to take a holistic approach to development and encourage individuality and the need to appreciate individual differences.

Furthermore, they both aim to develop life-long learners and future citizens. Value-based learning activities and collaborative learning activities are included within both of the programmes.

These principles and aims are then reflected within the goals and core competences of the CBSE in addition to the aim to develop creativity, communication, empathy, and problem-solving skills. These and other developmental goals are included within the IB key concepts, global contexts, and IB Learner Profile attributes.

Several main outcomes are also established by the CBSE and shared by the IB MYP including for learners to develop: language skills, conceptual understanding, technological skills, and understanding of other cultures and opinions.

The CBSE *Main Subjects 2015-2016*[127] curriculum document outlines the underpinning philosophies of the programme in the following key sections:

- Core components: included within the rationale of the curriculum, defining the underlying values
- Curriculum, mission, and goals: includes the principles to be adopted in the curriculum, the aim of education, and the curriculum goals that teachers should help learners achieve

[127] Central Board of Secondary Education, 2015. *Secondary School Curriculum 2015-2016 - Volume 1 Main Subjects.*

- Core competence and outcomes: a list of core skills that should be developed by students in order to achieve the above goals
- Main pedagogical outcomes for curriculum learning areas: A list of the outcomes that students achieve from the curriculum learning areas.

The principal reference point for the IB in this comparative analysis has been the *IB MYP: From Principles to Practice* (IB, 2014), which includes the IB Learner Profile and other key features of the IB philosophy.

7.1.1 Core Components of the CBSE

Within the CBSE syllabus section on *Core rationale of CBSE school curriculum-The underlying values*[128] there are six core components that make up the rationale of the overall curriculum. These can be seen in the table below. Each of these core components are considered either included or partially included within the IB MYP.

Table 32: Comparison of the IB to the Core Components of the CBSE

CBSE	Included in the IB MYP
The CBSE curriculum should:	
Develop life-skills	✓
Support integration	✓
Reflect the values of the Constitution	✓*
Develop a global perspective among learners	✓
Promote lifelong learning	✓
Take account of and appreciate individual differences	✓

The first component on nurturing life skills (including building self-esteem, empathy, critical and creative thinking, and problem-solving) is included within the IB MYP. The IB MYP states that it is "designed as a coherent and comprehensive curriculum framework that provides academic challenge and develops the life skills of students from the ages of 11 to 16"[129]. Further, the IB learners become *Thinkers* with creative thinking skills. *Differentiated* learning can also be seen as meeting this component as seen in the table below:

[128] Central Board of Secondary Education, 2015. *Secondary School Curriculum 2015-2016 - Volume 1 Main Subjects.*
[129] International Baccalaureate Organization, 2014. *MYP: From principles into practice*.

Figure 6: IB MYP Principles of good practice for differentiated learning[130]

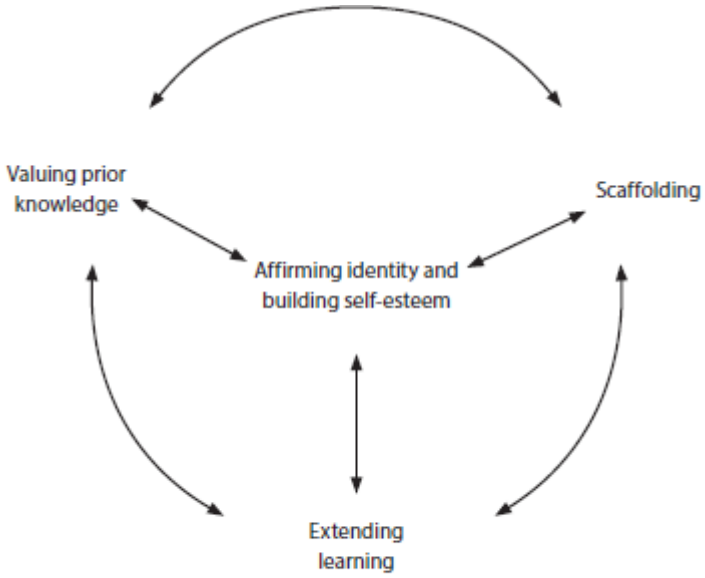


Figure 10
Principles of good practice for differentiated learning

The second component, *integration*, focusses on connecting knowledge and application including science and technology, and "sense and sensibility". This is included within the IB MYP as part of the aim to have a connected curriculum where the students "learn to draw connections and pursue rich understandings about the interrelationship of knowledge and experience across many fields" [131]. The MYP Guides also frequently reference the connection of knowledge and application.

Upholding constitutional values, the third component, is partially included within the IB MYP. As an international qualification, the IB MYP does not reference the Indian or any one nation's constitution, nevertheless the CBSE component is partially included in other similar sections of the IB MYP. For instance, the IB MYP key concepts on *communities* and *culture* include the beliefs and values shared by people or groups. The IB MYP does not require students to uphold these beliefs or values, but they would be able to learn and discuss them.

When considering the fundamental duties included within the Indian constitution (i.e. harmony, dignity of others, protecting the environment, being inquisitive, and achieve personal goals) these can be identified within the IB Learner Profile. For instance, the aim for learners to be *Inquisitive* is shared by the IB. IB learners strive to be determined, and respect the dignity and rights of others. They are also *Caring* toward the world and the environment. Therefore, IB learners develop similar values to those found within the Indian constitution. The Constitutional values are also ingrained within the NCF, with the relevance of the IB Learner Profile in the context of the NCF already discussed in Section 5.

The CBSE component related to a global perspective aims for students to position themselves in the global community and understand the interconnectedness of the world. It also focusses on the student's role in process of change. This is similar to the IB MYP's

[130] International Baccalaureate Organization, 2014. *MYP: From principles into practice*.
[131] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*

focus on global contexts within the taught curriculums and the IB Learner attribute to be *Open-minded* toward other perspectives. The IB MYP aims to provide common points of reference from global themes (i.e. *personal and cultural expression*, *orientation in space and time*). The IB uses these global contexts, among others, to "inspire explorations of our common humanity and shared guardianship of the planet"[132]. *Change* is also one of the IB MYP key concepts.

The importance of lifelong learning is evident in both the CBSE and IB MYP. The CBSE sees a lifelong learner as one that explores, solves problems, and uses information[133]. The programme model for the IB MYP states that it "helps to prepare students for further education, the workplace and a lifetime of learning"[134]. Overall, the IB includes in its mission statement that the "programmes encourage students across the world to become active, compassionate and lifelong learners"[135]. As *Inquirers*, IB learners should continue to learn throughout their lifetime.

The last component of CBSE is on appreciating individual differences. This is described as supporting learners of different capacities, and acknowledging intelligence as being diverse and needing room to grow. This component is included within a few sections of the IB MYP philosophy. To start, differentiation in the IB allows for students to "develop, pursue and achieve appropriate personal learning goals"[136]. The IB MYP contextual curriculum helps schools to "plan concrete, memorable engagements that can be tailored to individual students and their learning styles, diverse backgrounds and cultures"[137]. The IB MYP also places emphasis on diversity in learning and points out that education should be inclusive and respond "positively to each student's unique learning profile, including students with diverse learning needs"[138].

7.1.2 Curriculum Mission and Goals

The *CBSE School Curriculum Mission and Goals* section of the CBSE *Main Subjects* includes principles that must be adopted within the programme. Paraphrasing these, clear parallels can be drawn from the IB MYP:

[132] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*
[133] Central Board of Secondary Education, 2015. *Secondary School Curriculum 2015-2016 - Volume 1 Main Subjects.*
[134] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics Guide*.
[135] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*
[136] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*
[137] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*
[138] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*

Table 33: Comparison of the IB to the CBSE Curriculum Mission and Goals

CBSE	Included in the IB MYP
To take a holistic approach to learners' development, (encompassing cognitive, ethical, mental, physical, spiritual, and social development)	✓
To encourage individuality, supporting individuals to reach their potential	✓
To embed and promote the values and responsibilities outlined in the Constitution, in particular to encourage tolerance for different cultures	✓*
To develop scientific outlook and transformative competences	✓

The first principle in the table above is integral to the IB MYP as part of the IB mission to promote holistic learning. This is further found within the IB Learner Profile, especially in the attributes to be *Balanced*, *Open-minded*, and *Communicators*[139]. This principle is similarly included in one of the IB MYP global contexts: *identities and relationships*. This context includes the questions 'who am I?' and 'who are we?' and allows student to "explore identity; beliefs and values; personal, physical, mental, social and spiritual health; human relationships including families, friends, communities and cultures; what it means to be human"[140]. This and other global contexts are used to provide context to the teaching and learning of the IB MYP.

The CBSE also aims to nurture individuality, an aim shared by the IB MYP. The IB MYP suggests that teachers use formative assessment to explore the individual learning styles and any strengths, challenges, or preferences that can be used to inform differentiated learning.

The third principle is partially included within the IB MYP key concepts relevant to *culture, perspective,* and *communities*. IB students may learn about constitutions within a subject, but the Indian constitution itself is not part of the IB philosophy. However, when considering the fundamental duties included in the Indian constitution, these can be found within the IB Learner Profile. For instance, both promote caring for the environment, striving to achieve and succeed, and being inquisitive. The IB MYP provides similar aims on accepting other cultures, as seen within two of the IB Learner Profile components: *Open-minded* and *Caring*.

Another global context, *scientific and technical innovation,* focusses on similar points to the CBSE principle on developing a 'scientific outlook and transformative competences'. This global context explores "how humans use their understanding of scientific principles; the impact of scientific and technological advances on communities and environments; the impact of environments on human activity; how humans adapt environments to their needs"[141].

[139] International Baccalaureate Organization, 2014. *MYP: From principles into practice*
[140] International Baccalaureate Organization, 2014. *MYP: From principles into practice*
[141] International Baccalaureate Organization, 2014. *MYP: From principles into practice*

The CBSE *School Curriculum Mission and Goals' section*[142] also includes information on the aims of the CBSE education.

Table 34: Comparison of the IB and the CBSE aims of education

CBSE	Included in the IB MYP
Learners become life-long learners while also obtaining basic knowledge	✓
Nurture future citizens who are mentally and physically robust, assertive, confident, empathetic and helpful to the community, intellectually inquisitive and reflective, tolerant and with a creative vision and global perspective	✓
Schools promote value based learning activities -emphasis on: humanity, practicality, individuality, inclusiveness, and modernity	✓
Such activities involve collaborations between oneself and others, individuals and the community, as well as humans and nature	✓

The table above demonstrates where the CBSE aims can be similarly identified within the IB MYP. As mentioned previously in the discussion of mission and goals, both the IB and CBSE aim to develop lifelong learners. Nurturing future citizens is an aim of the IB MYP, with focus on developing a confident, empathetic, and inquisitive learner. Similarly, the IB MYP promotes its own form of value-based learning through the IB Learner Profile. The attributes within the profile would develop an inclusive individual who thinks through problems and considers others' perspectives.

Collaborative activities are also similar between the programmes with the MYP approach to teaching including 'collaborative learning through inquiry'[143].

7.1.3 Goals, Core Competence and Outcomes

The CBSE further sets out ten curriculum goals that are used to achieve the principles included in the section above. The CBSE also aims for the programme to develop a set of core competences and outcomes in learners in order to achieve the curriculum goals. These goals, core competences and outcomes can be summarised as follows:

Table 35: Comparison of the IB and the goals of the CBSE

Key themes of the CBSE Curriculum Goals, Core Competencies and Outcomes	Included in the IB MYP
Curriculum should support learners in developing:	
Self-awareness and individuality	✓
Creativity and the appreciation of art and beauty	✓
Lifelong learning skills including the ability to set goals and make decisions	✓
Communication, interpersonal, and listening skills	✓

[142] Central Board of Secondary Education, 2015. *Secondary School Curriculum 2015-2016 - Volume 1 Main Subjects.*
[143] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*

Empathy, dignity and respect to others, the community, and the environment while following the law	✓*
Cultural and international learning and understanding	✓
Skills and knowledge related to livelihood, including community and country involvement	✓
Technology and information use toward improving the world	✓
Functional and participatory learning attitude and higher order thinking skills	✓
Problem-solving and creative, reflective, logical thinking and resolution skills	✓

Similar to the first and ninth goal and outcome, the IB MYP focusses on higher-order thinking skills that allow students to become more self-aware; and as previously stated, teachers are able to tailor their teaching to the strengths of their students using differentiation. *Differentiation* is also used in the curriculum to allow students to set and achieve goals. This is similar to the third goal in the table above; *lifelong learning*, which has been seen in previous sections, and is a similar focus in the IB.

Creativity is a key concept in the IB MYP and through the global context, *personal and cultural expression;* students learn to appreciate the aesthetic. This is similar to the CBSE goal to develop creativity and appreciation for art.

Development of communication and interpersonal skills is a CBSE goal included within the IB MYP overall aims for schools and as part of the language policy and the IB Learner Profile attribute for students to be *Communicators*. Listening skills are also an outcome of the CBSE goal, which can be found within the *Communicators* attribute of the IB.

The CBSE goal to develop students' empathy towards others has been demonstrated as included within the IB MYP in previous sections. Demonstrating dignity and respect for the others (particularly the other gender) and the environment is not directly stated in the IB MYP, however an action in learning is to focus on the respecting the dignity of others. Additionally the IB Learner Profile aims to develop *Caring* learners who demonstrate empathy, compassion, and respect. As *Caring* learners they contribute to society and make a difference in the world. Further the IB MYP key concept on *global interactions* includes relationships with natural environments. The IB does not, however, specify that learners must follow the law.

The CBSE also aims to promote cultural learning, international understanding, and livelihood skills. These are both included within the IB MYP global contexts which aim to "provide common points of entry for inquiries into what it means to be internationally minded, framing a curriculum that promotes multilingualism, intercultural understanding and global engagement"[144].The IB Learner Profile also aims to develop learners who are *Open-minded* and *Balanced* by understanding different cultures and histories and important elements that make up a person's life.

[144] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*

Inquiry in the global context is encouraged by the IB MYP in order to get students "actively engaged in learning"[145]. The CBSE goal to inspire participatory learning shares a similar focus to this aim.

The CBSE goal regarding the use of technology is similar to the IB MYP approaches to learning (ATL) skills, which include the use of technology in an effective, productive, and appropriate manner. The last CBSE goal seen in the table above regarding the development of thinking and problem-solving skills is similarly found within the IB MYP ATL skills.

7.1.4 Main Pedagogical Outcomes for Curriculum Learning Areas

Within the CBSE *Main Subjects* document[146], a list of fifteen outcomes is provided. These have been compared with the IB MYP in the table below.

Table 36: Comparison of the IB and the CBSE Outcomes for Curriculum Learning

CBSE[147]	Included in the IB MYP
The main outcomes, drawing on all areas of the curriculum, should be that learners:	
Through language can understand and articulate ideas and information; and are able to interact with others (1)	✓
Understand key concepts and techniques (e.g. numerical and spatial) and are able to apply these in, and make linkages to, real life (2)	✓
Understand the world – in the physical, biological and technological sense – and hold relevant values and the ability to make decisions in this context (3)	✓
Understand their cultural, geographical and historical surroundings and learn how to support continuous improvement in the country (4)	✓*
Can identify, source and evaluate information effectively, using it and making linkages as needed (5)	✓
Are able to select and use existing (and, as required, new technologies), synthesise and innovate (6)	✓
Can apply rationalisation and reasoning skills to understand, decode, confirm and develop patterns (7)	✓*
Take responsibility for their actions, and with awareness of the consequences of these. They are able to think critically, laterally, and challenge themselves (8)	✓
Are tolerant and empathetic to all, irrespective of background or culture (9)	✓
Can appreciate and recognise others' artistic, cultural and intellectual work; and actively engage in their own (10)	✓
Understand and engage in practices promoting all forms of development and well-being (i.e. cognitive, mental, personal and physical) (11)	✓

[145] International Baccalaureate Organization, 2014. *MYP: From principles into practice.*
[146] Central Board of Secondary Education, 2015. *Secondary School Curriculum 2015-2016 - Volume 1 Main Subjects.*
[147] Central Board of Secondary Education, 2015. *Secondary School Curriculum 2015-2016 - Volume 1 Main Subjects*, p 17-18.

Are confident, self-motivated, positive, and able to work on their own and with others (12)	✓
Understand their constitutional rights, duties and responsibilities and respect the rights of others (13)	✓*
Can contribute responsibly to cultural, economic, political and social developments (14)	✓
Are willing and able lifelong learners (15)	✓

The IB MYP sets similar outcomes to the CBSE within its overall structure, model, and mission. Many of these are not specified as 'outcomes' but they aim to achieve a similar goal or result. For example, the IB global contexts or ATL skills aims for students to build in confidence and develop similar skills in relation to communication skills, technological understanding, cultural expression and understanding, organisation skills, collaboration skills. Both the CBSE and IB connect the curriculum to real-world experiences and aim for students to have an understanding of the world.

Conceptual understanding is emphasised in the IB through the prescribed key concepts, and is comparable to the CBSE outcome for learners to understand and apply concepts. Further, conceptual thinking skills are developed in the IB which involves collecting and analysing data and information which can be used to draw conclusions. Similarly, CBSE learners value information and data which can be examined and presented to others.

Many of the attributes in the IB Learner Profile can also be compared to the CBSE outcomes. Both programmes aim for learners to be *Communicators* who collaborate with others, and *Knowledgeable* on a number of issues and ideas. By being *Open-minded* and *Risk-takers*, the IB learners are similar to CBSE learners in that they accept challenges, appreciate the cultures and perspectives of others, Further, the attribute to be *Balanced* is shared by the programmes in that the learners will be consider their physical and emotional well-being.

Three of the CBSE outcomes above are considered partially included in the IB MYP. Two of these include a component specific to India, a context not prescribed in the IB. For example, the CBSE outcome to understand different cultural attributes and how they transform India, is specific to learners in India. It is anticipated that the CBSE learners will understand how and why other should be respected and their constitutional rights. This is referencing the Indian constitution, which is not a prescribed element in the IB MYP, as an international qualification. It is acknowledged that IB students may learn similar values and achieve similar outcomes, such as the attributes in the IB Learner Profile (as also discussed in the NCF analysis). IB World Schools can also teach national values as part of the curriculum.

7.2 Comparative Analysis of Selected Subjects: IB MYP and CBSE Standard IX - X

Key findings – comparing selected subjects of the IB MYP and CBSE curriculum

The aims and objectives of the CBSE are based on the NCERT secondary syllabus and therefore, share common themes and principles highlighted and discussed within the NCERT analysis. Similar comparisons can be drawn between the CBSE and IB MYP aims as seen in the NCERT section showing that reasoning and analytical skills are developed in Mathematics; investigative and practical skills in Science, and diversity and contemporary issues in Social Studies. Curriculum for all subjects should facilitate connections between knowledge gained in the classroom and real-life experiences.

The topics taught in the CBSE are also similar to those presented in the NCERT secondary syllabi and accordingly the findings of the content comparison between the IB MYP are largely consistent with those identified in Section 6, namely that:

- CBSE Mathematics covers the same branches of mathematics as the IB MYP
- CBSE Science includes science-specific topics, whereas the IB MYP provides broader concepts that are observed as only partially similar to the CBSE topics
- The Social Science syllabi in the CBSE and IB MYP both cover economics, politics, geography, and history and share some transferrable or comparable content whilst also having differences that reflect the differing contexts within which their qualifications are offered (national versus international).

Internal and external assessment is used in both programmes. Considerable differences can be observed in terms of assessment format/design of the Class X (drawing on the question paper design guidance provided in the CBSE syllabi) and IB MYP eAssessment (although it should be noted that the MYP eAssessment is optional). In summary these differences related to:

- Exam duration: Typically 3 hours for the CBSE, 2 hours for the IB MYP.
- Number, type and weighting of questions:
  Across all subjects, the CBSE exams include a much higher number of questions than the IB MYP but the MYP questions are longer. Questions in the CBSE exams are worth 1, 3 or 5 marks meaning that the highest weighted questions are worth 5.6% (5 marks out of a possible 90). The number of marks assigned to IB MYP questions varies much more, with some worth 1-2 marks, others worth 25-30 marks, requiring more detailed answers. In the eAssessments viewed in this study, a single question (with all its subparts) could be worth as much as 25-30% of the paper.
- Typology of questions:
  Within the CBSE syllabi, there is typically a relatively even distribution of questions and marks across the five main typologies identified (Remembering, Understanding, Application, Higher Order Thinking Skills, and Creating [Mathematics and Social Studies] or Inference [Science]), whilst across all the IB MYP eAssessments viewed, the questions suggest greater weighting is put on Higher Order Thinking Skills and Creating, closely followed by Application. Whilst knowledge recall would inevitably be integral to the IB MYP questions (and associated marks), there are no questions within the specimen assessment which solely tested this.

7.2.1 Mathematics

Aims and Objectives

The below table compares the objectives of teaching the CBSE Mathematics syllabus[148] to the MYP aims, objectives, and overall rationale for the programme.

Table 37: Aims and objectives of the CBSE and the IB MYP Mathematics

CBSE: Key Themes	Included in the IB MYP
Build upon previous knowledge of mathematics from primary stage	✓
Excellent algebra skills	✓
Drawing skills	✓*
Application of knowledge toward solving problems	✓
Analytical. reasoning, and logical thinking skills and communication	✓
Awareness of social norms and biases	✓*
Technological skills	✓
Interest in Mathematics and as tool for solving problems.	✓
Knowledge and respect of Mathematicians	✓
Participation in mathematics related competitions	
Familiarity with the involvement of mathematics in everyday life	✓

As seen in the table above, the majority of the CBSE aims and objectives are included within the IB MYP syllabus. Some similarities between the IB MYP prescribed aims and the CBSE objectives can also be found. For instance, the IB MYP aim to "develop an understanding of the principles and nature of mathematics"[149] can reasonably encompass a few of the above CBSE aims, such as drawing and reasoning skills. Further the aim to "appreciate the moral, social and ethical implications arising from the work of mathematicians and the applications of mathematics" [150] is similar to the CBSE aims about social norms and respecting mathematicians.

Other similarities can be found between the IB MYP objectives and the CBSE aims. For example, the IB MYP objective to *apply mathematics in real-life contexts* involves students using mathematics as a tool for solving problems in an authentic real-life context. Students apply their knowledge to real-world situations and apply problem-solving strategies[151]. This objective is similar to many of the CBSE aims including the application of knowledge toward solving problems, for students to use mathematics as tool for solving problems, and familiarity with the involvement of mathematics in everyday life.

[148] Central Board of Secondary Education, 2014. *Secondary School Curriculum 2014-2015 - Volume 1 Main Subjects.*
[149] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics Guide*.
[150] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics Guide*.
[151] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics Guide*.

Both programmes also aim to develop knowledge and understanding, analytical and technological skills and algebraic skills.

The CBSE aim for students to participate in mathematics competitions is not evident within the IB MYP Guide. As this is an aim normally outside of the academic scope, it is not surprising this is not found within the IB MYP.

Content

The below table includes the topics (units) for both class years in the CBSE. These have been used as a reference to compare the IB MYP branches of mathematical studies to.

Table 38: Content comparison of the CBSE and the IB MYP Mathematics

CBSE Topic area and recommended proportion of teaching time [periods][152]	Included in the IB MYP standard
Number systems (9%): *Real numbers*	✓
Algebra (28%): *Polynomials* *Linear equations in two variables* *Quadratic equations* *Arithmetic progressions*	✓
Geometry (29%): *Introduction to Euclid's geometry* *Lines and angles* *Triangles* *Area* *Circles* *Constructions*	✓
Trigonometry (9%): *Introduction to trigonometry* *Trig identities* *Heights and distances*	✓
Coordinate geometry (5%) *Lines in two dimension*	✓
Mensuration (7%) *Areas* *Areas related to circles* *Surface areas and volumes*	✓
Statistics and probability (13%)	✓

[152] The proportion of teaching time was calculated by determining the number of periods per topic area out of the total number of periods for both Class IX and X.

As seen in table above, the CBSE and IB MYP cover similar mathematical topics within the curriculum. The CBSE topics and the sub-topics are similar to the IB MYP mathematical branches. For instance, both programmes include topics on numbers, algebra, geometry, trigonometry, statistics and probability. The IB MYP does not prescribe the content that would be taught under these topics, but provides suggestions including angle properties, surface areas, and linear and quadratic expressions[153]. The CBSE topic of *Mensuration* covers mathematical topics that could be included under the IB MYP branch *Geometry and Trigonometry.*

The IB MYP also offers an extended version of the programme which would allow IB schools to cover additional content if necessary.

Methods of Assessment

Both the CBSE and IB MYP Mathematics include forms of internal assessment that are set and delivered by the individual schools offering the curriculums. The CBSE internal assessment makes up 40% of the overall grade each class year. This internal assessment includes one Problem-Solving Assessment (PSA) each year with multiple choice questions. The assessment requires students to apply what they know in new contexts or demonstrate their understanding[154]. Other forms of internal assessment may include laboratory activities and projects.

In the IB MYP, internal assessment could include a range of tasks including tests, examinations, investigations, and reports. IB World Schools offering the programme must assess all strands of the prescribed assessment criteria at least twice in each year of the IB MYP. IB MYP students also have the opportunity to engage in a community project[155] and personal project during their studies and can take the (optional) eAssessment at the end of the programme.

Both programmes have forms of assessment prescribed and conducted externally. In Class IX, 60% of the overall grade for the year is assessed by examination conducted by schools, reflecting CBSE guidance. In Class X the assessment is prescribed by the CBSE and conducted externally[156] [157]. Within these assessments, the CBSE has prescribed some sections on *Open Text based assessment* on case studies that are provided to students prior to the assessment[158].

For Class X, the Mathematics paper design for the CBSE should include 33 questions[159], with just under a third of these requiring “very short” or “short answers” (1 or 2 marks each), and the others being 3- or 4- mark questions. In terms of the skills assessed, a little over half of the 90 marks are assigned to questions which test knowledge recall and understanding

[153] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics Guide*.
[154] Central Board of Secondary Education, 2014. *Annual Report 2014-2015.*
[155] The community project is required in schools that end the programme in MYP year 3 or year 4. It is optional for schools that end the MYP in year 5.
[156] For students studying in CBSE affiliated schools who intend to move out of the CBSE system upon completion.
[157] Central Board of Secondary Education, 2013. *Examination Bye-Laws.*
[158] Central Board of Secondary Education, 2014. *Secondary School Curriculum 2014-2015 - Volume 1 Main Subjects.*
[159] Central Board of Secondary Education, 2014. *Secondary School Curriculum 2014-2015 - Volume 1 Main Subjects.*

(23 marks each). The ability to apply knowledge, including for problem-solving, is also weighted highly in the assessment (24%).

In the IB MYP Mathematics specimen eAssessment reviewed for this study, there are 12 questions with marks ranging from 6 to 32 out of a possible 120. As with the CBSE, the ability to apply knowledge is highly weighted within the eAssessment, though potentially more so. Questions that test students' ability to "analyse", "create" and "evaluate", though weighted within the CBSE question paper design, appear to have more weighting attached in the IB MYP eAssessment, though it must be acknowledged that this assessment would not be taken by all students on the MYP.

7.2.2 Science

Aims and Objectives

Key aims and objectives for the CBSE Science programme can be found within the CBSE syllabus and introduction[160]. These have been used as a reference point for the comparison with the IB MYP aims below:

Table 39: Aims and objectives of the CBSE and IB MYP Science

CBSE: Key Themes[161]	Included in the IB MYP
Develop knowledge of key science concepts, methods and events.	✓
Develop scientific approach and investigative skills.	✓
Science builds cognitive, and physical skills	✓
Focus on abstract science and analytical thinking	✓
Develop scientific reasoning and practical experience	✓

The IB MYP and CBSE share a similar overall aim to gain and apply scientific knowledge and skills. The CBSE focusses on using knowledge and skills to improve the quality of life. The IB MYP relates to this through encouraging students to consider science as a human endeavour and developing 'sensitivities' to living and non-living environments. The IB MYP's core (i.e. inquiring, designing, processing and evaluating) aims to develop similar analytical, evaluative and creative minds as the CBSE curriculum.

The IB MYP objective on knowledge and understanding can also be considered similar to the CBSE aim to gain knowledge about specific scientific concepts.

The CBSE aims to develop abstraction and quantitative reasoning skills are similar to those included in the NCERT Science syllabus[162]. The IB MYP similarly includes a focus on summarization of science processes. Additionally, the IB MYP includes an objective for

[160] Central Board of Secondary Education, 2014. *Secondary School Curriculum 2014-2015 - Volume 1 Main Subjects.*
[161] Central Board of Secondary Education, 2014. *Secondary School Curriculum 2014-2015 - Volume 1 Main Subjects*, p 9 and p 138.
[162] National Council of Educational Research and Training, 2005. *Syllabus for Secondary and Higher Secondary Classes - Volume 2.*

students to "collect, process and interpret qualitative and/or quantitative data"[163]. Exposure to experiences and modes of reasoning is also identified within the IB MYP aim to "reflect on learning experiences and make informed choices"[164] and the use of scientific reasoning within an objective strand.

A focus on the well-being of students, including their cognitive, emotional, and physical development is a key aim for the overall IB MYP and similar to the CBSE Science aim to develop these skills.

Content

The CBSE curriculum for Class IX and X is shown in the table below. The syllabus is presented around broad topics, which are also those prescribed in the NCERT secondary Science syllabus.

Table 40: Content comparison of the CBSE and IB MYP Science

CBSE Topic areas and recommended proportion of teaching time [periods]	Included in the IB MYP
Food (3%)	
Materials (29%)	✓*
The World of the Living (26%)	
How Things Work (9%)	
Moving Things, People and Ideas (17%)	✓*
Natural Phenomenon (6%)	
Natural Resources (10%)	✓*

Similar to the comparison of the NCERT secondary syllabus and the IB MYP for Science, only a few topics in the CBSE syllabus can be partially identified within the IB MYP: *Moving Things, People and Ideas* and *Natural Resources* include sub-topics similar to the IB MYP. Both the CBSE and IB MYP include similar sub-topics related to *Materials*; however the sub-topics that the NCERT prescribed for the *Materials* topic are not considered included in the IB MYP. The CBSE includes sub-topics related to transformation (physics) and relationships, which are included within the IB MYP.

The IB MYP focusses on conceptual-understanding and provides broader topics that are developed into content curriculums at school level.

Methods of Assessment

Both the CBSE and IB MYP include various forms of internal and external assessment, with the internal assessment prescribed and conducted by the individual schools offering the curriculums. The CBSE internal assessment makes up 40% of the overall grade for Class IX and Class X and includes 'hands-on' practical assessments.

[163] International Baccalaureate Organization, 2014. *Middle Years Programme: Sciences Guide.*
[164] International Baccalaureate Organization, 2014. *Middle Years Programme: Sciences Guide.*

Similarly, the IB MYP includes a range of assessment tasks. IB World Schools offering the programme must assess all strands of the prescribed assessment criteria at least twice in each year of the IB MYP. IB MYP Science students must complete an independent scientific investigation each year of the programme. IB MYP students also engage in a community project[165] and personal project during their studies.

Both programmes have external assessment prescribed by the awarding body. For the CBSE, 60% of the assessment in Class X is developed and delivered by the CBSE[166] [167]. In Class IX this assessment can be conducted by schools. These assessments include practical-based questions to assess the skills learning from the practicals conducted during the curriculum in addition to *Open Text based assessment*[168]. IB MYP students take the (optional) eAssessment at the end of the programme. The examinations are offered in Biology, Chemistry, Physics, and Integrated Sciences.

Reviewing the IB MYP specimen eAssessment for Science found some clear differences in the overall format and scope of assessment for Science. As similarly observed for Mathematics, there are differences in the number and weighting of questions. The CBSE Class X paper includes 36 questions comprising theory-based questions (24) and practical-based questions (12), weighted at 83% and 17% respectively. The marks assigned to individual questions range from 1-5 in the theory-based questions, with practical-based questions worth 1 or 2 marks meaning that questions are weighted relatively evenly. The IB eAssessment instead has a much smaller number of questions (8 in the specimen reviewed) but which require more detailed responses, with the marks attached ranging from 7-30 (5-25% of the overall paper).

7.2.3 Social Studies

Aims and Objectives

The below table compares the IB MYP Individuals and Societies with the main objectives of the CBSE syllabus[169] .

[165] The community project is required in schools that end the programme in MYP year 3 or year 4. It is optional for schools that end the MYP in year 5.
[166] For students studying in CBSE affiliated schools who intend to move out of the CBSE system upon completion.
[167] Central Board of Secondary Education, 2013. *Examination Bye-Laws.*
[168] Central Board of Secondary Education, 2014. *Secondary School Curriculum 2014-2015 - Volume 1 Main Subjects.*
[169] Central Board of Secondary Education, 2015. *Secondary School Curriculum 2015-2016 - Volume 1 Main Subjects.*

Table 41: Aims and objectives of the CBSE and IB MYP Social Studies

CBSE Social Science: Key Themes[170]	Included in the IB MYP
The main objectives of the CBSE syllabus are to develop students in terms of:	
Understanding	
How human societies have evolved (change and development in terms of time and space)	✓
The need to view all events, issues and phenomena in a wider context (of space and time, and where change is a continuous process)	✓
India – contemporary and a historical perspective, understanding the general framework of national development goals and policies post-1947 and within the wider context of global development	✓*
The freedom struggle, recognising the contributions made across society and the values and ideals behind it	✓*
The Indian environment as a whole: – how the different aspects interact and the implications of this for society and quality of life in the future	✓*
– understanding environmental, economic and social issues and challenges	✓*
Geographical and social diversity across the country: appreciating the diversity as well as the underlying unity	✓
The need to appreciate and preseve India's rich and varied natural and cultural heritage	
Attributes, Skills and Qualities	
Prepared to participate effectively in contemporary society, – confident and able to deal with challenges as an individual and as part of a group	✓
– able to act effectively as citizens in a democracy and in conjunction with the constitutional values	✓*
– with personal, social, moral, national and spiritual values and qualities	✓
A scientific "temper", able to investigate, analyse and evaluate data, opinions and interpretations in a rational and objective way	✓
Academic and social skills, including critical thinking, communication (visually and verbally), leadership and problem-solving, working with others and on own initiative	✓*

As seen in the table above, all but one of the CBSE aims can be similarly identified within IB MYP, although the extent of coverage varies. Where only partial coverage can be determined, this is because the CBSE aim is specific to the Indian system or context. For instance, the CBSE aim for students to understand the values of the Indian Constitution is not present within the IB MYP. However, the rest of the aim regarding being an effective citizen aligns with the IB MYP aim to "act as responsible citizens of local and global

[170] Central Board of Secondary Education, 2014. *Secondary School Curriculum 2014-2015 - Volume 1 Main Subjects,* p 142.

communities"[171]. The one CBSE aim not found within the IB MYP is regarding India's heritage.

One additional aim of the IB MYP is to "identify and develop concern for the well-being of human communities and the natural environment"[172].

Content

The below table outlines the units and sub-units in the CBSE and compares them to the key concepts and related concepts in the MYP.

Table 42: Content comparison of the CBSE and IB MYP Social Studies

CBSE	Included in the IB MYP
India and the Contemporary World (I and II) (23%) *Events and Processes (I only)* *Livelihoods, Economies and Societies* *Everyday Life, Culture and Politics*	✓*
Contemporary India (I and II) (23%[173]) *India - Size and Location & Physical Features of India* *Drainage* *Climate* *Natural Vegetation and Wild Life* *Population*	✓*
Resources and Development *Forest and Wild Life Resources* *Water Resources* *Agriculture* *Minerals and Energy Resources* *Manufacturing Industries* *Life Lines of National Economy*	✓*
Democratic Politics (I and II) (23%) *Democracy in the Contemporary World & What is Democracy? Why Democracy?* *Constitutional Design* *Electoral Politics* *Working of Institutions* *Democratic Rights*	✓*
Power Sharing & Federalism: *Democracy and Diversity & Gender Religion and Caste:* *Popular Struggles and Movements & Political Parties* *Outcomes of Democracy* *Challenges to Democracy*	✓*
Economics (I) (11%) *The Story of Village Palampur* *People as Resource*	✓*

[171] International Baccalaureate Organization, 2014. *Middle Years Programme: Individuals and Societies Guide.*
[172] International Baccalaureate Organization, 2014. *Middle Years Programme: Individuals and Societies Guide.*
[173] Based on the assumption that Class IX has 40 periods (not specified in syllabus).

Poverty as a Challenge *Food Security in India*	
Understanding Economic Development (II) (12%) *Development* *Sectors of the Indian Economy* *Money and Credit* *Globalisation and the Indian Economy* *Consumer Rights*	✓*
Disaster Management (I and II) (9%)	

The majority of the above CBSE topics are partially included within the IB MYP Guide. The content under the CBSE topics is subject-specific with a few sections focusing on events or systems in India (i.e. sectors of the Indian economy). Many of the sub-topics, seen in the table above, relate to specific topics in Economics, Politics, History, or *Disaster management*. Alternatively, the IB MYP focusses on conceptual understanding with broader key concepts and related concepts. In broad terms, the CBSE content can be found in the IB MYP related concepts; for example the CBSE sub-unit on *Everyday Life, Culture and Politics* include content on the social history of clothing. This could be included under the IB MYP History related concept on culture. Further, the sub-topic on *Constitutional design* could be included under the IB MYP History related concepts on *governance* or the optional additional IB MYP topic of Political Science/Civics/Government as part of the related concepts on *government*. Many broad similarities could be found between the IB MYP Economics and Geography concepts and the CBSE sub-topics.

Methods of Assessment

Both the CBSE Social Science and IB MYP Individuals and Societies programmes include internal assessment that is prescribed and delivered by the individual schools offering the programme.

The CBSE internal assessment contributes 40% of the overall grade in each class year. This internal assessment can include projects, activities tests, and various assignments. Although schools develop these, they are based on guidelines provided by the CBSE[174].

In the IB MYP, internal assessment could include a range of tasks such as tests, examinations, investigations, and reports[175]. Further guidance is provided by the IB on tasks to address the objectives relating to investigation and communication; including but not limited to research papers, slide shows and websites. IB World Schools offering the programme must assess all strands of the prescribed assessment criteria at least twice in each year of the IB MYP. IB MYP students also engage in a community project[176] and personal project during their studies.

[174] Central Board of Secondary Education, 2014. *Secondary School Curriculum 2014-2015 - Volume 1 Main Subjects.*
[175] International Baccalaureate Organization, 2014. *Middle Years Programme: Individuals and Societies Guide.*
[176] The community project is required in schools that end the programme in MYP year 3 or year 4. It is optional for schools that end the MYP in year 5.

Both programmes have forms of assessment prescribed and conducted externally: 60% of the Class X assessment is through CBSE external examination[177] [178]. The CBSE has also prescribed some sections on *Open Text based assessment* on case studies that are provided to students prior to the assessment[179].

IB MYP students take the (optional) eAssessment at the end of the programme. The examination is offered in Geography, History and Integrated Humanities (including Economics, Geography and History).

Differences in the CBSE and IB approaches and format of external assessment echo those observed in the preceding analyses for Mathematics and Science. For example, the number and weighting of questions differ. Taking the final semester of Class X as an example[180], there are 29-30 questions set for a three-hour examination, of which eight require very short (1-mark) answers and the maximum number/weighting of marks assigned to any individual question is 5.6%. The IB eAssessment sets a smaller number of questions, but with a higher number of marks attached, reflecting the need for detailed answers.

The distribution of questions and marks by typology also differs between the CBSE and IB. The CBSE paper for Class-X SA-II seeks to test across the following domains: *Remembering; Understanding; Application; Higher Order Thinking Skills; Creating, Evaluation…;* and *Map.* A fifth of the marks is attributed to questions testing knowledge recall; with each of the remaining domains identified (excluding *Map*) having similar weightings attached, with slightly more emphasis on questions testing application over those testing understanding. By contrast, the IB eAssessment has a smaller number of questions but which tend to be more weighted towards higher order thinking skills (e.g. analysis and organisation of information from various sources) and creation and evaluation, closely followed by questions testing application. This is not to say that knowledge recall and understanding are not tested – inevitably they would be – but the IB MYP eAssessment specimen did not include any questions that solely reflected these typologies.

[177] For students studying in CBSE affiliated schools who intend to move out of the CBSE system upon completion.
[178] Central Board of Secondary Education , 2013. *Examination Bye-Laws.*
[179] Central Board of Secondary Education, 2014. *Secondary School Curriculum 2014-2015 - Volume 1 Main Subjects.*
[180] Question paper design is set out in the CBSE for Classes IX and X (separately for the first and second semesters).

8. Comparative Analysis of Selected Subjects: IB MYP and ICSE

Key findings – comparing selected subjects of the IB MYP and ICSE curriculum

The aims of the ICSE Mathematics, Science, and Social Studies (H.C.G.) syllabi are mostly shared with the IB MYP. Both aim for students to:

- Develop an understanding of mathematics and science,
- Be competent users of associated terminology
- Have the ability to make connections and apply their knowledge to real-life contexts.

In social studies, both share the aims to understand different cultures and the *cause-effect*.

The IB MYP content is partially similar to that of the ICSE in the subjects under review. For example, for Mathematics both the ICSE and the IB MYP syllabi covered the same topics with the exception of commercial mathematics (ICSE). Other subject findings are similar to those identified for both the NCERT and CBSE analyses reflecting the fact that both the CBSE and ICSE syllabi must reflect the NCERT requirements.

As with the IB MYP, all ICSE subjects have an internal assessment component. The ICSE subjects also have required external assessment, whereas external assessment in the IB MYP is optional.

When comparing the ICSE sample internal assessment learning outcomes and the IB MYP strands on what a student should be able to do, overall both include statements for students to understand and apply their knowledge, and analyse or discuss ideas. In mathematics and science, the ICSE includes an outcome for students to apply their knowledge in other disciplines which is coherent with the IB MYP interdisciplinary approach.

Both the ICSE and IB MYP have assessment criteria used for the internal assessment and similarly assess understanding. When comparing the descriptors, the ICSE criteria measure a students' ability to complete the assignment, whereas the IB MYP assessment criteria measure the skills demonstrated by the student.

As with the analyses of the NCERT and CBSE syllabi, this section reviews three subjects offered by the CISCE for Classes IX-X: Mathematics; Science and Social Science. The principal sources of information have been the syllabus regulations and individual subject syllabi which set out the aims of the programme, the format and content of the external Class IX and X exams; and guidance on the format and marking of the internal assessment.

8.1 Mathematics

The CISCE Mathematics syllabus for Class IX-X sets out aims for the two-year programme and the specific format and mathematics topics to be covered in each year's examination.

Suggested assignments for the internal assessment are included at the end of the syllabus with guidelines for marking these.

Aims and Objectives

Looking firstly at IB MYP Mathematics against the aims of the ICSE Mathematics, it is possible to see clear similarities, as summarised in the table below:

Table 43: Aims and objectives of the ICSE and IB MYP Mathematics

ICSE	Included in the IB MYP
Students should develop understanding of:	
Mathematical concepts, principles, processes, proofs, symbols and terms	✓
How mathematical concepts can be applied to further study in science and mathematics	✓
Students should develop skills in the following areas:	
Problem-solving in real-life contexts through the application of their mathematical knowledge	✓
The use of technology, such as calculators and computers	✓
Drawing and interpretation of tables, charts and graphs	✓
It is intended that students will:	
Develop an interest in mathematics	✓

All of the ICSE aims are at least somewhat similar to a prescribed aim within the IB MYP. Where the IB MYP aims are only partially similar, another section of the Mathematics Guide (i.e. Effective use of information and communication) is found similar to the ICSE aim. For instance, the ICSE aim to develop an interest in mathematics is included within the IB MYP aim to enjoy mathematics. The ICSE aim to develop drawing skills or skills to read graphs is similar to the IB MYP aim to "develop an understanding of the principles and nature of mathematics"[181] but only partially. The IB MYP section on the skills developed under each branch of mathematics includes graphing and drawing, which fits with the rest of the ICSE aim.

In addition to the IB MYP aims similar to the ICSE, the following aims are also present in the IB:

- Communicate clearly and confidently in a variety of contexts
- Develop logical, critical and creative thinking
- Develop confidence, perseverance and independence in mathematical thinking and problem-solving
- Develop powers of generalization and abstraction
- Appreciate the moral, social and ethical implications arising from the work of mathematicians and the applications of mathematics

[181] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics guide.*

- Appreciate the international dimension in mathematics through an awareness of the universality of mathematics and its multicultural and historical perspectives
- Develop the ability to reflect critically upon their own work and the work of others.

Content

Table 44: Content comparison of the ICSE and IB MYP Mathematics

ICSE topics by year	Included in the IB MYP
IX	
Pure Arithmetic	✓
Commercial Mathematics	
Algebra	✓
Geometry	✓
Statistics	✓
Mensuration	✓
Trigonometry	✓
Co-ordinate geometry	✓
X	
Commercial Mathematics	
Algebra	✓
Geometry	✓
Mensuration	✓
Trigonometry	✓
Statistics	✓
Probability	✓

All but one of the topics taught (in Class IX and X) within the ICSE curriculum are included within the IB MYP four branches of mathematics. *Arithmetic*, *Algebra*, *Geometry*, and *Trigonometry* could be similarly found within the IB MYP branches of *Numbers*, *Algebra, Geometry* and *Trigonometry*, respectively. The ICSE topic of *Mensuration* is also found within the IB branches of Geometry and Trigonometry, and the ICSE topics of *Statistics* and *Probability* within the IB MYP *Statistics and probability*. *Commercial mathematics*, (covering areas such as compound interest; banking; profit and loss; shares and tax) is not included within the IB MYP four branches of mathematics.

The majority of the ICSE sub-topics fit within the standard IB MYP Mathematics programme, however a few sub-topics, such as sine and cosine rules, could fall under the extended programme, according to the IB MYP Mathematics Guide.

Learning Outcomes

The IB MYP Mathematics Guide does not have identifiable learning outcomes. Instead, there are the aims (examined above) that the IB defines as "general statements about what teachers may expect to teach or do, what students may expect to experience or learn, and how students may be changed by the learning experience". The IB MYP does prescribe objectives and strands on what students should be able to do in order to achieve these aims. These can be used by IB World Schools to develop specific learning outcomes.

Similarly, no learning outcomes are prescribed by the ICSE in the mathematics syllabus; which, as mentioned above, focusses on aims and assessment format and content. Within the *Internal Assessment*[182] guide, a document provided by the CISCE for schools and teachers to use as a reference, learning outcomes and objectives are provided for sample individual internal assessment tasks. These learning outcomes include statements on understanding, using, and applying a mathematical concept or tool, and analysing data. One learning outcome specifically references the use of mathematics in other disciplines. The outcomes are normally specific to the tasks and the type of mathematics used and learned. Alternatively, the IB MYP strands are broader and applied to the whole mathematics programme. These include statements regarding applying, selecting and describing mathematics when solving problems in different contexts. Communicating mathematics, and selecting or applying mathematical strategies when solving real-life problems to reach a solution are also included. IB MYP students are also required to justify solutions.

Methods of Assessment

Table 45: Methods of assessment in the ICSE and IB MYP Mathematics

	ICSE Mathematics IX	ICSE Mathematics X	IB MYP Mathematics
Assessment type(s)	Internal assessment (20%) External examination (80%)	Internal assessment (20%) External examination (80%)	Optional formal eAssessment in either Mathematics or extended mathematics
Internal assessment format	Three internal assessments per year, set by the teacher.	Three internal assessments per year, set by the teacher.	Determined at school level.
External examination	One paper, of 2.5 hours; 80 marks. The paper is based on the syllabus and comprises two sections, equally weighted: 1. Short answer questions (candidates should attempt all questions) 2. Candidates answer four questions from a choice of seven.	One paper, of 2.5 hours; 80 marks. The paper is based on the syllabus and comprises two sections, equally weighted: 1. Short answer questions (candidates should attempt all questions) 2. Candidates answer four questions from a choice of seven.	The optional eAssessment includes short-answer and extended-answer questions, based on a prescribed set of Mathematics criteria.

[182] Council for the Indian School Certificate Examinations - New Delhi, 2012. *Internal Assessment - An Integral Component of ICSE*.

As shown in the table above, the ICSE internal assessment for Class IX and X consists of a minimum of three separate assignments for each year. Both the ICSE syllabus and *Internal Assessment: An integral component of ICSE* [183] provide examples of the types of assignments that teachers could prescribe, with the latter providing learning objectives, learning outcomes, methodology (how teachers should present the assignment to students) and grading ["evaluation"] which shows how marks should be distributed in terms of skill areas; however these vary by task. Criteria such as 'presentation', 'procedure', 'understanding', 'accuracy' and 'calculation' can be seen across some of the different possible assignments with varying weighting assigned to each, depending on the task.

The MYP has four assessment criterion areas for the Mathematics programme as a whole:

- Criterion A: Knowing and understanding
- Criterion B: Investigating patterns
- Criterion C: Communicating
- Criterion D: Applying mathematics in real-life contexts.

The IB MYP Mathematics Guide assesses criterion A, B, and D (through internal tasks. Criterion C is assessed in combination with B or D within responses or reports.

The IB MYP Mathematics Guide provides suggestion on activities that can take place within the programme. The tasks and assignements implemented are decided by the IB schools when developing the curriculum. The activities suggested by the IB include:

- Application of paleoanthropometry (relating sizes of bones to determine the height of a dinosaur/prehuman)
- Students will investigate the effects of changing the dimensions (radius and height) of a cylindrical container and produce a report describing which dimension has the greatest effect on surface area and volume.

[183] Council for the Indian School Certificate Examinations - New Delhi, 2012. *Internal Assessment - An Integral Component of ICSE.*

Figure 7: Sample task from IB MYP

Criterion	Typical assessment tasks	Notes
Criterion A: Knowing and understanding	Classroom tests Examinations Assignments that include both familiar and unfamiliar situations	Teachers who choose to use criterion A with criterion B should be able to clearly define which aspects of the task will be assessed with each criterion, ensuring that the task is rigorous enough to allow students to achieve the highest levels of both criteria.
Criterion B: Investigating patterns	Mathematical investigations of some complexity that allow students: • to choose their own mathematical techniques • to reason from the specific to the general	Assessment tasks could have a variety of solutions and should enhance independent mathematical thinking.
Criterion C: Communicating	Investigations and real-life problems Reports that: • require logical structure • allow multiple forms of representation to present information	Criterion C is often used when students present a report, for example, that requires a logical structure in order to be followed and that would allow for several forms of representation to be used to present information.
Criterion	Typical assessment tasks	Notes
Criterion D: Applying mathematics in real-life contexts	Opportunities to use mathematical concepts to solve real-life problems	For example: modelling or curve-fitting tasks based in authentic contexts. Mathematics can be used to model many situations (for example, painting a room, analysing mobile telephone tariff plans, triangulation, diet plans).

The ICSE internal assessments are worth 20 marks: the subject teacher (internal examiner) awards 10 marks and the external examiner awards 10 marks. These marks are awarded using guidelines with the ICSE grading criterion in the table below. Grade I out of I-V has been used for the anlaysis. Similarly, the MYP assessment objectives and criteria for Year 5 have been used for the comparison in the table below.

Table 46: Assessment criteria in the ICSE and IB MYP Mathematics

	ICSE[184]	MYP
ICSE Internal assessment criteria and MYP assessment criteria for final year	**Preparation** Exhibits and selects a well-defined problem. Appropriate use of techniques.	**Criterion A: Knowing and Understanding** The student is able to: i. select appropriate mathematics when solving challenging problems in both familiar and unfamiliar situations ii. apply the selected mathematics successfully when solving these problems iii. generally solve these problems correctly in a variety of contexts. **Criterion B: Investigating Patterns** The student is able to: i. select and apply mathematical problem-solving techniques to discover complex patterns
	Concepts Admirable use of mathematical concepts and methods and exhibits competency in using extensive range of mathematical techniques.	
	Computation Careful and accurate work with appropriate computation, construction and measurement with correct units.	
	Presentation Presents well stated conclusions; uses effective mathematical language, symbols, conventions, tables, diagrams, graphs, etc.	**Criterion C: Communicating** The student is able to: i. consistently use appropriate mathematical language ii. use appropriate forms of mathematical representation to consistently present information correctly iii. communicate through lines of reasoning that are complete, coherent and concise
	Understanding Shows strong personal contribution; demonstrate knowledge and understanding of assignment and can apply the same in different situations.	**Criterion B: Investigating Patterns** The student is able to: i. select and apply mathematical problem-solving techniques to discover complex patterns **Criterion A: Knowing and Understanding** The student is able to: i. select appropriate mathematics when solving challenging problems in both familiar and unfamiliar situations

The above table demonstrates how the assessment criteria in the IB MYP compare to the ICSE internal assessment criteria. Similar criteria are used by both the IB MYP and the ICSE with shared emphasis on mathematical language, selecting to the appropriate form of mathematics, and correctly solving problems. However, the IB MYP criteria place more

[184] Council for the Indian School Certificate Examinations, 2013. *Mathematics Paper.*

emphasis on the level of complexity or difficulty in the task. The descriptors in the top grade are based on 'challenging problems', and 'consistently' using correct approaches and language. Alternatively, the ICSE descriptors are broader and focussed on the students' completion of the assessment, rather than the students' skills and knowledge of mathematics. For instance, the criteria for *Understanding* at the top grade requires students to demonstrate their knowledge and understanding of the assignment.

In addition to the assessment criteria and strands seen above, the IB MYP also uses *Criterion D: Applying mathematics in real-life contexts*. To achieve the top grades, students are measured against five different strands including to justifying accuracy of solutions, and if a solution "makes sense in the context of the authentic real-life situation"[185].

8.2 Science

The ICSE Science programme is organised into three parts based on the examination papers. This includes Physics (Science Paper 1), Chemistry (Science Paper 2), and Biology: (Science Paper 3). Each of these syllabi are organised in a similar way to the other ICSE and begin with a set of relevant aims. The internal and external assessment is also explained, with information provided on the marks and question types. The main body of each syllabus is split by class year and describes the key themes and information that will be taught for the course. All three include information on the internal assessment of practical work and provide the information that should be tested. Information on how this practical work should be evaluated is also included. A guideline for marking with grades that applies to all three parts of the ICSE Science programme is included at the end of the Biology syllabus.

[185] International Baccalaureate Organization, 2014. *Middle Years Programme: Mathematics guide.*

Aims and Objectives

The aims for each of the three Science syllabi are included in the below table and have been compared to the IB MYP Science aims:

Table 47: Aims and objectives of the ICSE and IB MYP Science

ICSE Science	Included in the IB MYP
Physics:	
The programme aims for students to develop:	
Knowledge and understanding of Physics concepts, definitions, facts, laws, principles and processes	✓
Practical skills in drawing (e.g. diagrams and graphs); recording observations and using apparatus	✓
Communication, problem-solving and reasoning skills	✓
Understanding of physics in the world around us	✓*
Chemistry:	
The programme aims for students to develop:	
Knowledge of Chemistry-related terminology, concepts and principles, techniques and processes	✓
The ability to apply their knowledge of Chemistry (key content and principles) in unfamiliar situations	✓
Practical skills to use apparatus and chemicals appropriately	✓*
Scientific “temper”, attitude and problem-solving skills	✓*
Understanding of the important impact Chemical Science has on the environment (nature; natural resources, pollution)	✓
Biology:	
The programme aims for students to develop:	
Awareness of the economic importance and interdependence of plants and animals; understanding therefore their significance to human welfare	✓
Understanding of the linkages between environmental adaptations and sustainability	✓
Understanding and appreciation of biology and biological economics (scope and limitations), and link this to quality of life	✓
Skills in hypothesising, observation and recording, inference, use of equipment and conducting experiments	✓

The overall aims of the ICSE Science can be similarly observed within the IB MYP, as seen in the table above. The ICSE aims to understand or acquire knowledge in science are typically included within the IB MYP aim to “understand and appreciate science and its implications”. Generally though, the IB MYP aims are broader and can encompass a larger array of topic-specific aims.

A few of the ICSE aims are more specific, and as such only partially identifiable within the IB MYP. For instance, the IB MYP aim to "cultivate analytical, inquiring and flexible minds that pose questions, solve problems, construct explanations and judge arguments"[186] can be considered to reflect, in part, the ICSE aim to "develop scientific temper, attitude and problem-solving skills"[187] given its reference to problem-solving skills, but less so the scientific temper and attitude.

Some similarities can be found between the ICSE aims and IB MYP objectives. For instance, both programmes aim for students to apply their scientific knowledge in unfamiliar situations.

Content

Table 48: Content comparison of the ICSE and IB MYP Science

ICSE	Included in the IB MYP
Physics:	
• Measurement and experimentation (Class IX only) • Motion in one dimension (Class IX only) • Laws of motion (Class IX only) • Fluids (Class IX only) • Heat • Light • Sound • Electricity and Magnetism • Force, work, energy and power (Class X only) • Modern physics (Class X only)	✓*
Chemistry:	
Class IX	
• Matter and its Composition: Law of Conservation of mass • Study of Gas Laws • Elements, Compounds and Mixtures • The langauge of Chemistry: • Physical and chemical changes • Water • Atomic Structure • The Periodic Table • Study of the First Element – Hydrogen • Atmospheric pollution	✓*
Class X	
• Periodic properties and variations of properties – physical and chemical • Chemical bonding • Study of acids, bases and salts • Analytical Chemistry – use of ammonium hydroxide and sodium hydroxide • Mole concept and stoichiometry • Electrolysis • Metallurgy • Study of compounds • Organic chemistry	✓*

[186] International Baccalaureate Organization, 2014. *Middle Years Programme: Sciences Guide*.
[187] Council for the Indian School Certificate Examinations, (n.d.). *Science (52) Chemistry: Science Paper 2.*

ICSE	Included in the IB MYP
Biology:	
• Basic Biology • Flowering plants (Class IX only) • Plant Physiology • Diversity in living organisms / Eco systems • Human Anatomy and Physiology • Health and Hygiene / Physical health and hygiene • Waste generation and management (Class IX only) • Pollution (Class X only)	✓*

The topics and content in the ICSE Physics, Chemistry, and Biology syllabi can be seen in the table above. In comparison to the IB MYP, the content is subject-specific and focusses on the many facts, laws and principles of these science subjects. As the IB MYP Guide is structured differently, this content had to be identified under the IB MYP key and related concepts, with some assumption made that these facts, laws, and principles would fall under them. The IB MYP provides a sample of possible statements of inquiry that take the key and related concepts and suggest possible statements of inquiry, projects, or topics to study. For example, it provides the Physics topic of *Magnetism* and *Electricity* (a topic included in the ICSE as seen above) in association with the key concept of *change* and the related concepts of *environment, consequences, development,* and *energy*. The statement of inquiry is on "increasing electrical energy production to meet the needs of an expanding global population can have environmental consequences"[188]. It is likely that many of the above ICSE topics fit under the IB MYP key and related concepts in a similar format.

Therefore, the ICSE topics and content are considered to be partially included under the IB MYP key concepts of *change*, *relationships*, and *systems*. They are also partially included under the related concepts such as *form, evidence, interaction, patterns, movement, energy, environment, consequences,* and *transformation*. For example, the ICSE Physics content regarding the consequences of expansion of solids, liquids and gases is included within the IB MYP related concept of *consequences*.

The IB MYP also includes objectives that "encompass the factual, conceptual, procedural and metacognitive dimensions of knowledge" [189]. The first objective on knowing and understanding includes the development of scientific knowledge. This knowledge includes facts, ideas, concepts, processes, laws, principles, models and theories. Although the IB MYP does not specify these concepts and laws in the same format as the ICSE, it can be assumed that it will include them.

As with the ICSE syllabus, the IB MYP develops students' mathematical skills throughout the MYP programme, where students would be expected to:

- Perform the basic arithmetic functions: addition, subtraction, multiplication and division
- Use calculations involving means, decimals, fractions, percentages, ratios, approximations and reciprocals

[188] International Baccalaureate Organization, 2014. *Middle Years Programme: Sciences Guide.*
[189] International Baccalaureate Organization, 2014. *Middle Years Programme: Sciences Guide.*

- Use standard notation (for example, 3.6 x 10^6)
- Use direct inverse proportion
- Solve simple linear simultaneous equations
- Plot graphs (with suitable scales and axes), including two variables that show linear and non-linear relationships
- Interpret graphs (with suitable scales and axes), including two variables that show linear and non-linear relationships
- Interpret graphs, including the significance of gradients, changes in gradients, intercepts and areas
- Draw lines (either curves or linear) of best fit on a scatter plot
- Interpret data presented in various forms (for example, bar charts, histograms and pie charts)
- Represent arithmetic mean using x-bar notation.

Learning Outcomes

As was the case with the comparative analysis of Mathematics seen above, neither the ICSE nor IB MYP syllabi define overarching or topic-level learning outcomes for Science. Within the *Internal Assessment Guide*[190], a document provided by the CISCE for schools and teachers to use as a reference, learning outcomes are provided for sample individual internal assessment tasks. These can be compared the IB MYP prescribed criteria strands that are used by IB World Schools to assess students. The ICSE includes task specific learning outcomes for a student to be able to compare and understand different scientific processes, scientific concepts and principles. They should be able to write a report, and identify ways in which science can be used toward saving energy. Recall of various principles and processes is also stated. One learning outcome references that students have an understanding of cross-curricula linkages of science (i.e. Chemistry) with other disciplines.

In the IB MYP the strands are broader and applied to the whole course. These include statements such as explaining, applying, and analysing scientific knowledge, principles, scientific investigations, and data. Students are expected to be able to design scientific investigations and interpret data. When reflecting on the impacts of science, IB MYP students apply scientific language and discuss implications of science.

[190] Council for the Indian School Certificate Examinations - New Delhi, 2012. *Internal Assessment - An Integral Component of ICSE.*

Methods of Assessment

Table 49: Method of assessment in the ICSE and IB MYP Science

	ICSE Science IX	ICSE Science X	IB MYP
Assessment type(s)	Internal assessment (20%) External examinations (80%)	Internal assessment (20%) External examinations (80%)	Optional formal eAssessment in Biology, Chemistry, Physics, or Integrated Sciences Independent scientific investigation (each year of MYP)
Internal assessment format	Practical work in all three subjects, set by the teacher.	Practical work in all three subjects, set by the teacher.	Independent scientific investigation (each year of MYP). Further internal assessment determined at school level.
External examination	Three papers, of two hours each; 80 marks each Each paper comprises two sections, equally weighted: 1. Short answer questions (candidates should attempt all questions) 2. Candidates answer four questions from a choice of six.	Three papers, of two hours each; 80 marks each Each paper comprises two sections, equally weighted: 1. Short answer questions (candidates should attempt all questions) 2. Candidates answer four questions from a choice of six.	The optional eAssessment includes short-answer and extended-answer questions. For example, students may be asked to state one advantage and one disadvantage of using certain techniques, and /or evaluate the strengths and limitations of different methods.

The IB MYP internal and external assessment is graded using four assessment criterion including:

- Criterion A: Knowledge and understanding
- Criterion B: Inquiring and designing
- Criterion C: Processing and evaluating
- Criterion D: Reflecting on the impacts of science.

As seen in the table above, the IB MYP requires students to complete an independent scientific investigation each year of the programme. These investigations are used to assess criterion B and C.

The *Internal Assessment: An integral component of ICSE* document provides examples of internal assignments that teachers could prescribe. The Science assignments involve practical work including experiments. These experiments include following instructions, taking observations, and presenting the collected data using an appropriate format. Graphing, calculating, measuring, tabulating and other scientific skills are included. In

Chemistry, students are required to identify gases. In Biology, plant and animal specimens are examined (i.e. onion peel, cheek cell).

The ICSE provides a grading rubric for the required internal assessments in Science. The top grade that can be achieved, and the descriptors for this grade, have been compared to the IB MYP assessment criteria (for year 5) in the table below:

Table 50: Assessment criteria in the ICSE and IB MYP Science

	ICSE[191]	MYP
ICSE Internal assessment criteria vs MYP objectives /assessment criteria for final year	**Preparation** Follows instructions (written, oral, diagrammatic) with understanding; modifies if needed. Familiarity with and safe use of apparatus, materials, techniques.	**Criterion A: Knowing and Understanding** The student is able to: i. analyse and evaluate information to make scientifically supported judgments. **Criterion B: Inquiring and designing** The student is able to: i. design a logical, complete and safe method in which he or she selects appropriate materials and equipment.
	Procedure / Testing Analyses problem systematically. Recognises a number of variables and attempts to control them to build a logical plan of investigation.	**Criterion B: Inquiring and designing** The student is able to: i. formulate and explain a testable hypothesis using correct scientific reasoning ii. explain how to manipulate the variables, and explain how sufficient, relevant data will be collected
	Observation Records data/observations without being given a format. Comments upon, recognises use of instruments, degree of accuracy. Recording is systematic.	**Criterion C: Processing and evaluating** The student is able to: i. correctly collect, organise, transform and present data in numerical and/ or visual forms
	Inference / Results Processes data without format. Recognises and comments upon sources of error. Can deal with unexpected results, suggesting modifications.	**Criterion C: Processing and evaluating** The student is able to: i. correctly collect, organise, transform and present data in numerical and/ or visual forms ii. accurately interpret data and explain results using correct scientific reasoning

[191] Council for the Indian School Certificate Examinations, (n.d.). *Science (52) Biology: Science Paper 3.*

		iii. evaluate the validity of a hypothesis based on the outcome of a scientific investigation iv. evaluate the validity of the method based on the outcome of a scientific investigation v. explain improvements or extensions to the method that would benefit the scientific investigation.
	Presentation Presentation is accurate and good. Appropriate techniques are well used.	**Criterion C: Processing and evaluating** The student is able to: i. correctly collect, organise, transform and present data in numerical and/ or visual forms

The ICSE descriptors seen in the table above are specifically formatted for internal assessment of scientific investigations. There is clear emphasis on understanding the investigation provided to the students, and completing the experiment. Alternatively, the IB assessment criteria are used for all forms of internal assessment. The scientific investigations that the IB requires students to complete each year of the MYP Sciences, is assessed against criterion B and C. These two criterions are the most similar to the ICSE descriptors, as demonstrated in the table above. The other IB criterion, A (*Knowledge and understanding*) and D (*Reflecting on the impacts of science*), are less relevant to the investigations.

It is also observed that some of the IB assessment strands (descriptors) for lower grades could be similar to the ICSE top grade descriptors. For example, the IB grades progress from students simply outlining variables, to outlining how to manipulate variables, then describing how to manipulate variables. The top grade requires students to explain this process. Alternatively the ICSE requires that students recognise the variables and attempt to control them.

Another difference seen above is that IB students design and outline their own investigation, demonstrating (at grades 1-2) that they can 'outline a testable hypothesis' and 'design a method, with limited success'. The ICSE is testing the student's ability to understand an investigation provided to them.

8.3 Social Studies

The ICSE does not have a specific Social Studies curriculum but instead has a History, Civics and Geography syllabus (hereafter referred to as "H.C.G."), covering similar themes to the IB MYP Individuals and Societies; and is therefore used as the point of comparison for this study. The HCG syllabus is split into two parts for each paper:

- History and Civics: H.C.G. Paper 1
- Geography: H.C.G. Paper 2.

The ICSE includes a separate syllabus for the subject of Economics. This has been examined alongside the H.C.G. papers.

Both parts include aims and a description of the assessment (internal and external). The content of the examinations, and therefore the syllabus, is outlined by Class (IX and X respectively) and sections (History, Civics, or Geography). Both parts include suggestions on the internal assessment assignments and guidelines for marking the internal assessment.

Aims and Objectives

The aims of the ICSE H.C.G. Paper 1 of been compared to the MYP aims and other relevant sections of the Guide in the table below:

Table 51: Aims and objectives of the ICSE HCG1 and IB MYP Social Studies

ICSE HCG 1	Included in the IB MYP
Students should develop an understanding of:	
The Indian government and how it works; developing learners that are aware of their responsibilities as a citizen in a secular democracy	✓*
Key aspects of Indian history, so as to be able to sufficiently understand contemporary India	
Contributors and contributing factors to the growth and development of India, its culture and civilisation	✓*
How different cultures of the world have contributed to global heritage	✓

Three of the four ICSE H.C.G 1 aims are similar to the aims and concepts prescribed within the IB MYP. The ICSE aims for students to understand the Indian government and become an enlightened citizen and understand the factors that contributed to the development of the Indian nation are partially reflected by two of the IB MYP aims (that of acting as responsible citizens of local and global communities; and of understanding how both environmental and human systems operate and evolve) although it is acknowledged that the specific workings of the Indian government would inevitably not be an integral part of the IB curriculum:

Some of the IB MYP related concepts are similar including the Political Science/Civics/Government concepts of *citizenship* and *government*. The History-related concepts on *civilization* and *culture* are also similar. However, the two ICSE aims are only considered partially included as a result of the aims being specific to the national context.

The last aim in the table above is considered to be included within the IB MYP key concept on *global interactions* (i.e. taking a world perspective) and the related History concepts of *culture* and *perspective.*

The aims of the H.C.G. Paper 2 have been compared to the MYP in the table below:

Table 52: Aims and objectives of the ICSE HCG2 and IB MYP Social Studies

ICSE HCG 2	Included in the IB MYP
Students should develop an understanding of:	
Geograpical terms, concepts and principles	✓*
Processes and patterns affecting human response to natural environment	✓
Regional development and human use of natural resources	✓*
The interdependence of countries and world regions	✓
Resources, and specificially their uses and availability; and the related problems of development in India and South Asia	✓*
Students should also develop:	
Practical skills in map-reading	✓*
The ability to explain cause-effect in relation to natural phenoma	✓

All of the above ICSE aims are considered to be included or partially included within the IB MYP. None of the IB MYP prescribed aims are necessarily similar, but rather the programme's concepts (Geography-related) reflect similar aims as the ICSE. For instance, the related concept on c*ausality* (case and consequences) includes the *cause-effect* relationship from the ICSE aim. Other similar related concepts include *patterns and trends*, *processes, interdependence,* and *power*. Some of the ICSE aims are only partially included as a result of the Indian context, or as a result of the IB MYP covering broader concepts that only partially align to the ICSE.

The ICSE Economic syllabus includes similar aims to the ICSE H.C.G. syllabi, with a focus on economics knowledge, terminology, and processes. The IB similarly focusses on knowledge and understanding within the overall programme, but Economics is a subject that can be focussed on in the IB MYP. The ICSE also aims for students to develop the ability to handle statistical data. This aim is not directly prescribed in the IB MYP, but is included as one of the IB's suggestions for facilitating interdisciplinary teaching and learning.

Content

The MYP key concepts and related concepts have been compared to the content of the H.C.G Paper 1 in the table below:

Table 53: Content comparison of the ICSE HCG1 and IB MYP

ICSE H.C.G 1 Paper Content	Included in the IB MYP
Class IX	
Section A: Civics • Our constitution • Salient features of our constitution • Elections and politcal parties • Local self government	✓*
Section B: History • The Harappan Civilization • The Vedic Period • India in the 6th century B.C. • The Mauryan Empire • The Sangam Age • The Age of the Guptas • Medieval India • The Mughal Empire • The beginning of the Modern Age in Europe	✓*
Class X	
Section A: Civics • The Union Legislature • The Union Executive • The Judiciary	✓*
Section B: History • The Indian National Movement (1857-1917) • Mass phase of the National Movement (1915-1947) • The Contemporary World	✓*

As seen in the table above, the ICSE H.C.G 1 paper includes sections on *History* and *Civics* with sub-sections that outline key events in Indian or world history and the Indian governing system. These topics show many similarities to the IB MYP related concepts under Political Science/Civics/Government (i.e. *government, power, leadership, rights, authority*) and History (i.e. *civilization, conflict, culture, governance, identity,* and *significance*). As the majority of the above ICSE topics are about the Indian government and history, they are considered partially included within the IB MYP related concepts on similar but broader topics, reflecting the international nature of the IB programme.

The MYP key concepts and related concepts can also be considered in relation to the H.C.G Paper 2, as shown in the table below:

Table 54: Content comparison of the ICSE HCG2 and IB MYP

ICSE HCG 2	Included in the IB MYP
Class IX	
Principles of Geography • Our World • Structure of the Earth and Internal Processes • Weathering • Hydrosphere • Atmosphere • Pollution • Natural regions of the World • Map work	✓*
Class X	
Part 1: Map Work **Part 2:** Geography of India	✓*

The topics presented in the ICSE HCG Paper 2 are seen in the table above. Although these topics are less India-centric in comparison to the ICSE HCG Paper 1, they include geographically related factual content. For instance, the section on *Our World* includes content on the shape, size and measurement of the earth. This specific content is not included within the IB MYP Guide; however the IB concept of *scale* would likely include this content and additionally look at how 'challenges, problems, and ideas can be analysed' using scales. The rest of the Geography-related concepts cover or may cover the rest of the ICSE topics in a similar form. These related concepts include: *causality, culture, disparity and equity, diversity, globalisation, management and intervention, networks, patterns and trends, power, processes, scale,* and *sustainability*.

When comparing the IB to the ICSE Economics syllabus, similar comparisons are made using the IB key or related concepts. The IB content is mostly included in the ICSE, with similar topics on scarcity, poverty, and consumption. As with the other subjects, the IB focusses on the wider Economic concepts rather than the specific topics in Economics.

Learning Outcomes

No learning outcomes have been identified for the ICSE History Civics and Geography course. The IB MYP Guide does not have identifiable learning outcomes either, but instead prescribes overarching aims (examined above) that the IB defines as "general statements about what teachers may expect to teach or do, what students may expect to experience or learn, and how students may be changed by the learning experience". Alongside aims, the IB MYP prescribes strands that are used in the assessment of students work. These can be compared to the sample learning outcomes that the ICSE provides in the *Internal*

Assessment[192] Guide, a document provided by the CISCE for schools and teachers to use as a reference for the internal assessment tasks. For History, Civics, Geography, and Economics, the ICSE learning outcomes state that students who complete the assignments should be able to analyse options, understand concepts and issues, identify and describe systems or processes, and justify choices. Comparisons, recall and relating something to real-life are also included

In comparison, the IB MYP strands state that students should be able to use terminology and demonstrate knowledge, formulate research questions and investigations, evaluate results, communicate information, and analyse and interpret data and different perspectives.

Methods of Assessment

As the ICSE in Social Studies include two papers, and ICSE Economics is a separate course, each is compared in the below table:

Table 55: Method of assessment in the ICSE and IB MYP Social Studies

	ICSE HCG 1 Class IX-X	ICSE HCG 2 Class IX-X	ICSE Economics Class IX-X	IB MYP
Assessment type(s)	Internal assessment (20%) External examination (80%)	Internal assessment (20%) External examination (80%)	Internal assessment (20%) External examination (80%)	Optional eAssessment in either History, Geography, or Integrated humanities
Internal assessment format	One internal assessment each year, set by the teacher.	• Class IX internal assessment: three exercises (50%) and one project report (50%) • Class X internal assessment: one project report.	Three internal assessments each year, set by the teacher.	Investigation (each year of MYP). Further internal assessment determined at school level.
External examination	One paper each year, of two hours; 80 marks. The paper comprises two sections, equally weighted: 1. Short answer questions (candidates	One paper each year, of two hours; 80 marks. The paper comprises two sections, equally weighted: 1. Short answer questions and questions	One paper each year, of two hours; 80 marks. The paper comprises two sections, equally weighted: 1. Short answer questions (candidates	The optional eAssessment includes: includes short-answer and extended-answer questions.

[192] Council for the Indian School Certificate Examinations - New Delhi, 2012. *Internal Assessment - An Integral Component of ICSE.*

	should attempt all questions) 2. Section A: Candidates answer two questions from a choice of three Section B: Candidates answer three questions from a choice of five.	based on Maps (candidates should attempt all questions) 2. Candidates choose any five questions to answer.	should attempt all questions) 2. Candidates choose four questions to answer.	

As outlined in the preceding subject comparisons, the IB MYP has four assessment criteria for the internal and external assessment including:

- Criterion A: Knowing and understanding
- Criterion B: Investigating
- Criterion C: Communicating
- Criterion D: Thinking critically.

Both the ICSE syllabus and *Internal Assessment: An integral component of ICSE* document provide examples of the types of assignments that teachers could prescribe. For example the HCG Paper 1 syllabus includes suggestions for a field trip, describing the function of the local government, or presenting a brief history of an Indian monument. The HCG Paper 2 syllabus requires students to have a file with three completed practicals or projects in order to complete the assignment. These included map work and drawings. Students are also required to complete two reports on topics of their choice from a suggested list in the syllabus.

The ICSE in Economics includes internal assessment, with three assignments each year being prescribed by the teacher. The syllabus provides suggestions such as conducting a survey or case study.

The IB MYP in Individuals and Societies also includes internal assignments such as tests, examinations, investigations and research that lead to a report. Many suggestions are provided in the IB MYP Guide in relation to how an IB school can assess objective B- Investigating, and objective C- Communicating.

The internal assessments for ICSE HCG Paper 1 are graded using a grading rubric.

Table 56: Assessment criteria in the ICSE HCG 1and IB MYP Social Studies

	ICSE HCG Paper 1[193]	MYP
ICSE Internal assessment criteria vs MYP objectives /assessment criteria for final year	**Preparation/Research** • Follows instructions with understanding. • Masters research techniques easily. • Reference work is orderly.	**Criterion B: Investigating** The student: i. formulates and effectively follows a comprehensive action plan to investigate a research question ii. uses research methods to collect and record appropriate, varied and relevant information **Criterion C: Communicating** The student: i. consistently documents sources of information using a recognized convention.
	Information • A good deal of relevant matter. • Uses wide range of sources.	**Criterion C: Communicating** The student: i. consistently documents sources of information using a recognized convention.
	Concepts • Good understanding of historical concepts - sequence/ reconstruction- causes and consequences - continuity and change • Empathy.	**Criterion A: Knowing and understanding** The student: i. demonstrates excellent knowledge and understanding of content and concepts through thorough, accurate descriptions, explanations and examples.
	Thinking skills • Different interpretations of evidence. • Can draw Inferences/ deductions/ conclusions.	**Criterion D: Thinking critically** The student: i. completes a detailed discussion of concepts, issues, models, visual representation and theories ii. synthesizes information to make valid, well-supported arguments iii. effectively analyses and evaluates a range of sources/data in terms of origin and purpose, consistently recognizing value and limitations iv. thoroughly interprets a range of different perspectives and their implications.

[193] Council for the Indian School Certificate Examinations, (n.d.). *History, Civics and Geography (50) Geography: H.C.G. Paper 1.*

	Presentation – • Matter presented is clear and is in coherent form (sub-headings, sections, chapters etc.) • Work is neat and tidy and not over elaborate.	**Criterion C: Communicating** The student: i. communicates information and ideas effectively and accurately by using a style that is completely appropriate to the audience and purpose ii. structures information and ideas in a way that is completely appropriate to the specified format iii. consistently documents sources of information using a recognized convention.

As seen from the ICSE descriptors above, the ICSE internal assessments are investigative or report writing tasks where instructions are provided to the student, and research to find sources must be used. The IB MYP assessment strands are designed for a range of assessment tasks, and are therefore less specific to a type of task. However, both programmes measure students' knowledge and understanding, thinking skills, and research skills. The ICSE also heavily emphasises the use of sources and references which is similar to the IB assessment strand to document sources in a recognized convention.

When comparing the descriptors (and IB MYP strands) in the table above, the IB MYP measures different skills under the criteria than the ICSE. For instance, IB MYP students must demonstrate *excellent* understanding of concepts, whereas ICSE students must demonstrate *good* understanding. Further, the IB MYP focusses on synthesizing information, justifying research questions, and thoroughly evaluating results.

The ICSE HCG Paper 2 syllabus provides different assessment criteria specific to this paper. These can be seen in the table below:

Table 57: Assessment criteria in the ICSE HCG 2 and IB MYP Social Studies

	ICSE HCG Paper 2 [194]	MYP
ICSE Internal assessment criteria vs MYP objectives /assessment criteria for final year	**Preparation** Gives complete theoretical information using relevant geographical terms	**Criterion A: Knowing and understanding** The student: i. consistently uses a wide range of terminology effectively ii. demonstrates excellent knowledge and understanding of content and concepts through thorough, accurate descriptions, explanations and examples.
	Procedure / Testing States the objectives and defines the aspects to be studied.	**Criterion B: Investigating** The student: i. formulates a clear and focussed research question, thoroughly justifying its relevance with appropriate evidence ii. formulates and effectively follows a comprehensive action plan to investigate a research question
	Observation Studies text and source material and makes a list.	**Criterion B: Investigating** The student: i. uses research methods to collect and record appropriate, varied and relevant information **Criterion D: Thinking critically** The student: i. effectively analyses and evaluates a range of sources/data in terms of origin and purpose, consistently recognizing value and limitations
	Inference / Results States theoretical information in a coherent and concise manner using geographical terminology. Uses a variety of techniques. Shows resourcefulness. Supports investigation with relevant evidence.	**Criterion D: Thinking critically** The student: i. completes a detailed discussion of concepts, issues, models, visual representation and theories ii. synthesizes information to make valid, well-supported arguments **Criterion A: Knowing and understanding** The student: i. consistently uses a wide range of terminology effectively ii. demonstrates excellent knowledge and understanding of content and concepts through thorough, accurate descriptions, explanations and examples.
	Presentation Neatly and correctly stated statement of intent and conclusion matches with objectives.	**Criterion B: Investigating** The student: i. thoroughly evaluates the investigation process and results.

[194] Council for the Indian School Certificate Examinations, (n.d.). *History, Civics and Geography (50) Geography: H.C.G. Paper 2.*

Similar to the ICSE HCG Paper 1, the assessment criteria for HCG Paper 2 is referring to a specific type of assignment such as a research report or investigative task. Alternatively, the IB MYP criteria are based on what a student should know and understand, and be able to do. Despite these differences, both programmes assess the students' knowledge, investigative and critical thinking skills. However, the IB MYP assessment criteria strands are more descriptive regarding what a student should have achieved. For example, the ICSE *Observation* criterion requires a student to study sources and make a list, whereas the IB MYP student "effectively analyses and evaluates a range of sources/data in terms of origin and purpose, consistently recognizing value and limitations"[195].

[195] International Baccalaureate Organization, 2014. *Middle Years Programme: Individuals and Societies Guide.*

9. Summary of Key Findings

Drawing on the document analyses conducted within this study, it is possible to identify clear areas where both the principles and practice of the IB education can be considered compatible with the Indian school system from primary to lower secondary (IB PYP and MYP).

9.1 The IB and the NCF

Firstly the IB educational philosophy reflects all of the guiding principles documented in the Indian NCF 2005, with both systems favouring a holistic and inclusive approach to education. Further, they both promote flexible assessments, and a curriculum that highlights the connections between what is learned in the classroom and a student's real-life experiences. The programmes both aim to support students in developing a personal identity and becoming citizens of the world.

The IB Learner Profile, setting out the attributes that are developed by students, is compatible to the overall NCF objectives regarding holistic education. Both strive for students to be inquirers and be able to think independently. Knowledge acquisition is similarly emphasised in both programmes, although the development and application of global knowledge is only found in the IB. IB learners are also intended to be courageous risk-takers; however the NCF does not make reference to this aim. Communication skills, sensitivity, integrity and open-mindedness are similarly developed by learners in both the IB and NCF.

Acknowledging that, as is the case for the NCF, philosophies and aims can be aspirational[196], consideration has also been given to the implementation of the key principles and aims of the Indian national curriculum and that of the IB PYP and MYP.

9.2 The IB and the NCERT

When comparing the national standards set in the primary and secondary syllabi of the NCERT to the IB PYP and MYP, many similarities can be found despite noticeable structural and contextual differences within the syllabi. The analysis highlighted that the IB PYP and MYP are structured by the philosophy of the course, the framework for the curriculum, aims, objectives, and concepts. On the other hand, the NCERT syllabi are framed in a context for textbook writers and prescribe various key themes and principles that apply either to the subject or the programme as a whole. The curriculum also draws on the specific challenges and values pertaining to the national context. Keeping these differences in mind, the following findings are made.

[196] The NCF was written in 2005 to support an ongoing process of reform, providing a framework from which those involved in writing syllabi, textbooks and examinations, along with teachers and other stakeholders, could work within and towards.

Primary education

Across the subjects reviewed, the majority of key themes and principles found within the NCERT syllabi can be similarly found within the IB PYP. In Mathematics and Science, both programmes have a shared theme to ensure that the curriculum is relevant and interesting to children while connecting the content to their real-life experiences. In the Social Studies programmes, both aim to develop students' comprehension skills.

The content, topics and concepts of the Mathematics, Science, and Social Studies syllabi are broadly similar between the IB PYP and NCERT. Almost all of the NCERT topics are found within the IB PYP Scope and Sequences syllabi for the three subjects though with some variations in the level of coverage. The NCERT Social Sciences topics for Class VI-VIII are considered only partially included within the IB PYP because of the specific nature of the content. Alternatively, the IB PYP focusses on broader concepts and strands that connect the Social Studies topics.

Some differences in the structure of the IB PYP content can be found in comparison to the NCERT primary syllabi. For example, the NCERT syllabus document is primarily knowledge-based, describing the expected topics and sub-topics to be taught in the curriculum, whereas the IB PYP focusses on the overall expectations for a topic in terms of the expected skills that should be developed by students.

Secondary education

As with the primary education comparisons, the IB and NCERT syllabi for secondary education (MYP and Class IX-X respectively) share similar key themes and principles for the curriculum and teaching. Some of these themes are also present in the primary syllabi. For example, both the IB and NCERT emphasise that topics should be connected to real-life experiences in Mathematics and Science.

In secondary education, both the IB and NCERT aim to build on primary Mathematics. In Science, both incorporate practical skills. Overall, all of the identified key themes and principles for Science are shared between the programmes, including the focus on inquiry.

In the NCERT Social Science syllabus, the key principles and objectives are presented at subject level (History, Geography, Political Science, and Economics) whereas the IB MYP is concept-based and provides overall principles and objectives. As a result, the key themes and principles are less aligned between the programmes.

The content and key topics of the NCERT and IB MYP documents have also been compared. In Mathematics, both programmes teach similar branches of mathematics to study, including: number, algebra, geometry, trigonometry, and statistics and probability. When considering the exemplary sub-topics provided in the IB MYP, the NCERT and IB MYP standard programme demonstrate similar coverage of topics.

Unlike the Mathematics Guide, the IB MYP Science and Individuals and Societies Guide are concept-based, and do not identify branches of study. Rather, the subject-specific content is selected and prescribed by IB World Schools when developing the curriculums. In

comparison, the NCERT is knowledge-based and provides subject-specific content and topics for the curriculum as a national standard. Therefore, the IB MYP Science and Individuals and Societies Guides have fewer comparable topics with the NCERT than the IB MYP Mathematics Guide.

Although the structure of the content is different, some similarities can be drawn between these programmes. The NCERT and IB MYP Science syllabi include some similar sub-topics on the environment, movement and energy. In Social Studies, the NCERT sub-topics are considered comparable to many of the subject-specific related concepts in the IB MYP. As the different related concepts are selected and elaborated on at school level, it is anticipated that an IB World School could develop a curriculum that includes the NCERT topics under these IB concepts.

One key observation for Social Studies would be that the NCERT topics are discussed in the context of India and include study of the Indian constitution. These topics are not present in the IB; however, when considering a broader historical or geographical context, similarities can be drawn to the IB. Similarly, when considering the themes and values presented in the Indian constitution, these can be identified within the IB, particularly the Learner Profile.

Overall, for primary and secondary, the principles and content of IB and NCERT Mathematics and Science demonstrate the most similarities. Slightly greater differences are evident between the Social Studies syllabi.

9.3 The IB MYP and the CBSE

Focussing in on the MYP, consideration was given to how the programme compares, in principle and practice, to the CBSE curriculum. To establish this, reference was made to overall aspects of the CBSE curriculum as well as specific aims and content prescribed for Classes IX-X in the three subject areas.

The principles and underlying philosophies of the CBSE define the underlying values of the education. When comparing these with the IB, similar values are stated within the *IB MYP: From Principles to Practice* (IB, 2014). These shared aims include nurturing life skills; connecting knowledge and application; developing a global perspective; teaching students to become lifelong learners; and acknowledging the individual differences in students. The CBSE further aims for students to develop an understanding of the Indian constitutional values, an aim that is not directly prescribed in the IB; however the values themselves are taught and discussed in the IB. Some of these core components and themes (i.e. lifelong learners, life skills, and constitutional values) are repeated within further sections of the CBSE philosophy. For example, the promotion of constitutional values is stated within the CBSE mission and goals.

Upon reviewing the principles for the curriculum and the key aims of education, the CBSE provides two other principles (to provide a holistic education; and to support a student's individuality) that are similarly shared by the IB MYP. The IB mission is to promote holistic learning. Individuality is also explored in the IB within the Learner Profile attributes.

The aims of the CBSE can also be found with the IB MYP. In addition to previous aims already discussed, the CBSE aims to nurture future citizens and teach students to collaborate. The IB MYP similarly aims to develop confident and empathetic future citizens, and includes collaborative activities and learning.

The goals, core competences and outcomes in the CBSE share similar themes on what a student should develop with the support from teachers and the curriculum. These can be similarly identified within the IB MYP. Both support students in developing creativity, communication skills, technology skills, higher order thinking skills, and logical problem-solving skills.

Overall, the key philosophies shared by both the IB MYP and CBSE are to promote a holistic education that develops lifelong learners. Both syllabi focus on individual and personal development of the students in non-academic contexts.

In terms of curriculum content, the CBSE secondary syllabi for Mathematics, Science and Social Studies include aims and objectives developed from the themes and principles in the NCERT syllabi. These aims and objectives are developed at subject level for both the CBSE and IB MYP. Therefore, many of CBSE aims can be found within the aims specified for the IB MYP. In Mathematics, both focus on developing an understanding of mathematics and mathematicians, and developing analytical and reasoning skills. In Social Studies, the IB MYP aims are at least partially similar to those in the CBSE. The IB MYP aims are broader than the CBSE subject-specific aims to develop specific understanding of Indian history or geography.

The CBSE aims and objectives are similar to specific objectives or concepts within the IB MYP. For instance, in Mathematics, both the CBSE and IB MYP aim to apply mathematics in real-life contexts. Further, both the CBSE and IB MYP develop investigative and practical skills in Science, and diversity and contemporary issues in Social Studies.

The content comparison demonstrated many similarities between the CBSE and IB MYP, especially in Mathematics. In Mathematics, similar branches of mathematics are shared between the syllabi with the sub-topics being included within the IB MYP standard sample topics. Unlike the CBSE, teaching hours by topics or sub-topics are not prescribed in the IB MYP: this is something developed by an IB World School, and therefore could be customised to compare to the CBSE syllabi. The CBSE Science and Social Studies content topics are also similar to the IB MYP, but with more topics only partially included within the IB MYP. In both instances, the CBSE curriculum is knowledge-based and outlines subject-specific sub-topics that are often not identifiable in the IB MYP key or related concepts. In terms of topics covered in Science, *Materials*, *Moving things* and *Natural resources* are included in the CBSE and IB MYP. In Social Studies, all CBSE topics areas are partially included within the IB MYP with the exception of *Disaster Management*.

Both programmes assess content through internal and external assessment. Where the underpinning key principles and content of the two syllabi across the three subjects may be similar, the format and approach to assessment is where the greatest differences between the IB and CBSE become apparent. For each subject in the CBSE, a question paper design is provided that includes the typology of questions in the paper. When using this typology as

a reference point to compare the optional IB MYP eAssessments, the duration of a CBSE exam is longer and includes more questions than the IB MYP exam; however, the IB MYP includes extended questions with a greater number of marks attached (and therefore greater weight towards the overall mark) than those in the CBSE. When using the five main CBSE typologies (*Remembering, Understanding, Application, Higher-order thinking skills,* and *Creating and Evaluating* (Mathematics and Social Science) / *Inference and evaluation* (Science)) to compare the papers, it can be observed that the IB MYP eAssessments place greater weighting on *Higher-order thinking skills* and *Creating*. Testing of skills under *Application* is also common in the IB MYP eAssessments, however there are no questions which solely focussed on testing knowledge recall (*Remembering*), as found in the CBSE although it is recognised that some level of knowledge recall would be required to answer the questions, which may be acknowledged within the mark schemes.

9.4 The IB and the ICSE

In the ICSE, the syllabi are structured based on the examination papers; with three papers for Science (Biology, Chemistry and Physics) and two for Social Studies (History and Civics; and Geography). The aims provide guidance on what students should know for each subject paper, and the content is split by which paper it is tested in.

When comparing the ICSE and IB MYP aims, many similarities can be found. In Mathematics, both aim to develop understanding of mathematics and apply their knowledge to real-life contexts. In Science, knowledge and understanding is also emphasised, however the ICSE provides these aims in each paper (Biology, Chemistry, and Physics) whereas the IB MYP provides aims for the programme as a whole. In Social Studies, both aim to develop an understanding of different cultures. Some of the ICSE aims reference Indian history and the Indian government which are not directly found within the IB MYP as an international qualification. For aims or content not prescribed in the IB framework, IB World Schools could adapt the programme to include aims or content that reference Indian history and the Indian government.

The topics taught within the ICSE and IB MYP curriculums are mostly similar, particularly for Mathematics, with both teaching the same general topics of arithmetic, algebra, geometry, mensuration, trigonometry, statistics, and probability. The content in the ICSE Science papers and the History, Civics, and Geography papers is considered partially included in the IB MYP. In both subjects, the ICSE provides subject-specific topics and sub-topics that, in the IB, are normally prescribed at school level. By contrast, the IB MYP syllabi are conceptually based, and provide a framework for which the Science or Social Studies topics can be discussed within. Therefore some of the ICSE topics can be identified within the IB MYP but only partially.

Both the ICSE and IB MYP include internal and external assessment. The ICSE provides sample learning outcomes for the possible internal assessment tasks in each subject. When comparing these to the IB MYP strands, both included statements that students should understand, apply or analyse knowledge, ideas, and processes. The ICSE Mathematics and Science sample learning outcomes included statements on students applying their subject knowledge in the context of other subjects or disciplines. This cross-curricular outcome

indicates that the ICSE includes some level of cross-curricular linkages within the curriculum or internal assessment.

9.5 Cross-curricula linkages

Cross-curricula linkages, or connections between different disciplines, subjects, or knowledge across the curriculum, can be identified within the IB MYP, CBSE and ICSE. Each of the programmes prescribe these linkages to different levels and through different techniques.

Within the ICSE, cross-curricula linkages are seen within the internal assessment learning outcomes. Further connections between subjects could not be found within the subject syllabi. It is possible that this form of teaching is developed in the internal assessment by schools.

The CBSE includes a section on developing cross-curricular linkages within the *Principles of School Curriculum*[197]. The CBSE feels these linkages are important for connecting prior and new knowledge and experiences. Further, the connections between the different subjects allow students to apply what they learn in relevant contexts and reflect on their learning. The CBSE states that problem-solving, reasoning, and creative thinking are used across the curriculum, and are facilitated by the cross-curricular linkages provided to students[198]. The CBSE encourages teachers to include interdisciplinary projects as part of the curriculum. These linkages are not explicit within the subject level syllabi, however; it may be that the projects and school level lesson plans more fully illustrate how these linkages are incorporated. When observing the possible elements CBSE teachers should include in lesson plans, *interdisciplinary linkages* is one of many[199].

The IB MYP demonstrates cross-curricular linkages and an interdisciplinary focus within the main framework for the programme. The IB document *MYP Guide to interdisciplinary teaching learning (IB, 2010)* describes how the IB MYP promotes interdisciplinary teaching and learning throughout the curriculum. The IB defines interdisciplinary learning as "the process by which students come to understand bodies of knowledge and modes of thinking from two or more disciplines or subject groups and integrate them to create a new understanding"[200]. When implementing the curriculum, teachers are encouraged to 'make meaningful connections across the subject groups'. Further, the approaches to learning (ATL) are also used across subject groups and allow for connections among the subjects.

The IB MYP further facilitates these linkages most noticeably through key concepts that are shared between subjects and allow students to consider the same concept in the context of different disciplines. These key concepts are mostly similar to the aims and topic areas included within all three subjects in the CBSE and ICSE. Therefore, the IB MYP framework

[197] Central Board of Secondary Education, 2015. *Secondary School Curriculum 2015-2016 - Volume 1 Main Subjects*.
[198] Central Board of Secondary Education, 2015. *Secondary School Curriculum 2015-2016 - Volume 1 Main Subjects.*
[199] Central Board of Secondary Education, 2015. *Secondary School Curriculum 2015-2016 - Volume 1 Main Subjects.*
[200] International Baccalaureate Organization, 2010. *Middle Years Programme: MYP guide to interdisciplinary teaching and learning*.

for interdisciplinary teaching and learning is compatible with the Indian system for cross-curricular linkages.

In summary, when considering the underpinning philosophies, curriculum, and assessment of the IB PYP and MYP alongside the Indian education system, many similarities can be found. Both teach similar values and skills to students, and provide a broadly similar coverage of topics within Mathematics, Science, and Social Studies. Despite structural differences in the documentation and programme frameworks, IB World Schools could adapt the PYP and MYP to include the topics taught in the Indian system.

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Appendix 1: Teaching Hours in the CBSE

Table 58: Teaching hours in the CBSE Mathematics

CBSE Mathematics Units	Number of Periods
Class IX First Term	
Number systems • Real numbers	18
Algebra • Polynomials	23
Geometry • Introduction to Euclid's geometry • Lines and angles • Triangles	6 13 20
Coordinate geometry	6
Mensuration • Areas	4
Class IX Second Term	
Algebra • Linear equations in two variables	14
Geometry • Quadrilaterals • Area • Circles • Constructions	10 7 15 10
Mensuration • Surface areas and volumes	12
Statistics	13
Probability	9
Class X First Term	
Number systems • Real numbers	15
Algebra • Polynomials • Pair of linear equations in two variables	7 15
Geometry • Triangles	15
Trigonometry • Introduction to trigonometry • Trigonometric Identities	10 15
Statistics and probability • Statistics	18

Class X Second Term	
Algebra • Quadratic equations • Arithmetic Progressions	15 8
Geometry • Circles • Constructions	8 8
Trigonometry • Heights and Distances	8
Statistics and probability • Probability	10
Coordinate geometry • Lines (In two-dimensions)	14
Mensuration • Areas related in circles	12
Total Class Periods	358
Class hours (if periods are 40-45 minutes each)	238-268

Table 59: Teaching hours in the CBSE Science

CBSE Science Units	**Number of Periods**
Class IX First Term	
Materials	22
The World of The Living	22
Moving Things, People and Ideas	36
Food	10
Class IX Second Term	
Materials	28
The World of The Living	23
Moving Things, People and Ideas	24
Natural Resources.	15
Class X First Term	
Materials	30
The World of The Living	20
How Things Work	32
Natural Resources.	8
Class X Second Term	
Materials	25
The World of The Living	30
Natural Phenomenon	23

Natural Resources.	12
Total Class Periods	360
Class hours (if periods are 40-45 minutes each)	240-270

Table 60: Teaching hours in the CBSE Social Science

CBSE Social Science Units	Number of Periods
Class IX	
India and the Contemporary World-I	40
Contemporary India-I	None indicated [201]
Democratic Politics-I	40
Economics	40
Disaster Management	25
Class X	
India and the Contemporary World- II	45
Contemporary India-II	45
Democratic Politics- II	45
Understanding Economic Development	45
Disaster Management-II (formative assessment only)	10
Total Class Periods	335
Class hours (if periods are 40-45 minutes each)	223-251

[201] This may have been a typo in the syllabus.