



The Effect of the Diploma Programme on Critical Thinking Development: An International Multisite Evaluation

Final report

September 17th 2020

Therese N. Hopfenbeck

Kit S. Double, Yasmine El Masri, Joshua A. McGrane

Oxford University Centre for Educational Assessment

Department of Education

University of Oxford

Foreword

The current report details the research study *The Effect of the Diploma Programme on Critical Thinking Development: An International Multisite Evaluation*, conducted by a team at the Oxford University Centre for Educational Assessment and funded by the International Baccalaureate. The purpose of the report is to examine the effects of participation in the Diploma Programme on students' critical thinking skills, and specifically whether student participation in the Diploma Programme leads to higher levels of critical thinking as measured by an established critical thinking assessment. The research team collected data in IB schools in Australia, England and Norway in 2019 and 2020.

We would like to thank Olivia Halic, Senior Research Manager at the International Baccalaureate for her commitment to the project, and in particular for her feedback on the research instruments, the interim report and analyses, for her support in recruiting schools in the three countries of interest, and for providing key IBO documents, some of which were not publicly available.

We would also like to thank the participating teachers in Australia, England and Norway who participated in this research study, and provided their time to share their knowledge and experience on teaching and learning in the IB programme. This research study could not have been conducted without their valuable input. In addition, we would like to thank all the students in the three countries, who agreed to take part in the study and volunteered to be interviewed to elaborate on the issues around critical thinking, learning, and assessment.

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1. Introduction

Critical thinking plays an important role in the classroom and our everyday lives. Furthermore, it is a key factor in determining individual and collective success in the face of mounting complex global challenges (Butler, 2012; Clarke, Double, & MacCann, 2017; Griffin & Care, 2015; Kirschner, 2020). Policymakers and educators have argued that developing critical thinking is an important goal of 21st Century education, and international organizations such as the Organization for Economic Cooperation and Development (OECD) and Partnership for 21st Century Learning are currently developing new frameworks to support and assess students' critical thinking across countries and contexts (Rotherham & Willingham, 2010; Vincent-Lancrin et al., 2019; Partnership for 21st Century Learning, 2019). Despite this interest in critical thinking, there is little agreement over both what constitutes critical thinking and how best to develop it (Facione, 1990b; Paul & Binker, 1990, Griffin et al., 2012). Nonetheless, it is widely agreed that formal schooling plays an important role in developing critical thinking skills (e.g., Niu, Behar-Horenstein, & Garvan, 2013) although uncertainty remains over what teaching practices can enable students to develop these skills (Nehring, Charner-Laird & Szczesiul, 2019; Johnson, 2018).

The recognition of the importance of critical thinking to students' future life outcomes has resulted in many educational institutions modifying their curriculum to focus more on the development of critical thinking skills (Australian Department of Education, Skills and Employment, 2020). Of most relevance to the present report is efforts made by the International Baccalaureate (IB), an international education organization, to make critical thinking a central focus of its programmes and approach. In this report, we discuss the evidence regarding how educational instruction affects critical thinking as well as the types of pedagogical approaches that appear to be most beneficial to critical thinking skills. We subsequently explore the extent to which the frameworks, policies, and documents used within the IB programme reflect this evidence base, particularly with respect to the effect of the Diploma Programme (DP) on students' development of critical thinking. It involves an evaluation in three distinct educational environments and cultures, Australia, UK and Norway, and is conducted in three phases:

Phase 1: Review of the literature and IB and Diploma Programme documents to ensure that the study builds on previous research, and to investigate previous claims that the Diploma Programme benefits students critical thinking skills, as well as to provide an understanding of how the IB integrates critical thinking within and across its Diploma Programme subjects.

Phase 2: Fieldwork in schools including quantitative data collection, which involved the assessment of Diploma Programme and non-Diploma Programme students' critical thinking using the previously validated Cornell Critical Thinking Test (CCTT, Ennis, Millman & Tomko, 2005) to assess the potential differences in the critical thinking skills of the two samples of students.

Phase 3: Qualitative interviews with students and teachers from several schools that participated in Phase 2, concerning their experiences of learning and teaching critical thinking in the Diploma Programme.

The following research questions were agreed with IB to be addressed in the research study:

1. Which features of the Diploma Programme are expected to foster the development and enhancement of critical thinking abilities in students? How are these features integrated into the IB documentation for the Diploma Programme? [Phase 1]
2. What is the relationship between participation in the Diploma Programme and an ability-based measure of critical thinking? Which Diploma Programme student characteristics predict higher levels of critical thinking? [Phase 2]
3. Do Diploma Programme students differ on average from their matched non-Diploma Programme peers in their levels of critical thinking measures when other student characteristics are considered? [Phase 2]
4. Drawing on a group of courses that represent a typical route in the Diploma Programme, in what ways do Diploma Programme students and teachers encounter, experience and develop critical thinking skills? [Phase 3]

2. Literature Review of Critical Thinking

2.1 Defining Critical Thinking

To begin with, we discuss the conceptualization and operationalization of critical thinking within the fields of education and psychology. While an emphasis on critique is central to many traditional philosophical approaches, modern conceptualizations of critical thinking have proposed that critical thinking is a multifaceted construct comprised of many skills and sub-skills (Facione, 1990b). This is reflected in the following definition characterizing critical thinking as, “the process of purposeful, self-regulatory judgement. At the core of critical thinking are the cognitive skills of interpretation, analysis, inference, evaluation and explanation” (Facione & Facione, 1992, p.1). Thus, in broad terms, critical thinking refers to a person’s ability to analyse, synthesize, and evaluate information (Halpern, 2001). Unsurprisingly, given the complex nature of critical thinking, discipline-specific definitions of critical thinking are often adopted (e.g. Castle, 2009; Gordon, 2000; Jacobs, Ott, Sullivan, Ulrich, & Short, 1997). Moreover, it is unclear whether educators and students share a common implicit understanding of what constitutes critical thinking, let alone the broad definition offered here (Huber & Kuncel, 2016).

Critical thinking tends to be measured and operationalized using either standardised assessments or more bespoke assessments developed by educators (Niu et al., 2013). These tests tend to either be ability-based, with participants needing to analyse and respond to problems or, alternatively, self-report based. Standardized measures of critical thinking include the Cornell Critical Thinking Test (Ennis, Millman, & Tomko, 1985), the Watson–Glaser Critical Thinking Appraisal (Watson, 1980), and the California Critical Thinking Skills Test (Facione, 1990a). While most standardized measures view critical thinking as a skill or ability, many self-report assessments of critical thinking take a dispositional view of critical thinking, focusing on an individual’s willingness to engage in critical thinking, rather than their ability to arrive at a particular solution (e.g. Kwon et al., 2006; Stuppel et al., 2017).

2.2 Why is Critical Thinking Important?

Critical thinking is an important predictor of future success in a wide range of domains. Critical thinking predicts real world outcomes such as employment prospects, years in education, and fewer negative life events (Butler, 2012). It is also increasingly valuable in the labour market given the growing complexity of job roles (Clarke et al., 2017). Indeed, analytical thinking, complex problem solving, and critical thinking were identified as the three most sought-after postgraduate skills according to a survey of large corporations (World Economic Forum, 2018). Critical thinking is also important for an individual's personal and professional decision making (Butler, 2012; Park & Kwon, 2007). Furthermore, it is seen as an important 'intellectual virtue' providing a capacity for the individual to make rational ethical decisions (Bailin, Case, Coombs, & Daniels, 1999; Facione, Sanchez, Facione, & Gainen, 1995).

In addition to benefiting the individual, critical thinking skills are valuable for societal and communal functioning (Paul, 1984; Schrag, 2016; Vincent-Lancrin, 2019; Williams, 2005). For example, these skills are viewed as a key component of the democratic process within liberal democracies (Abrami et al., 2015; Paul, 1984). Furthermore, critical thinking is also seen as an important tool for combating many of the global challenges facing society such as climate change and automation (Schick Jr & Vaughn, 2014; Vincent-Lancrin, 2019). The rise of globalization and the Internet have also meant that individuals need to be able to conceptualize problems within a global framework and understand the often distal consequences of policies and political action (Rothenberg, 2006).

2.3 Developing Critical Thinking

Given the importance of critical thinking to attaining valued outcomes, it is unsurprising that there is substantial interest in how to develop critical thinking skills in both young people and adults (Abrami et al., 2015; Brookfield, 2005; Garrison, 1991). Research has suggested that critical thinking tends to improve with each year of education (Feldman & Newcomb, 1969; Huber & Kuncel, 2016; Williams, 2003). For example, a meta-analysis by Huber and Kuncel (2016) found that the average effect of college attendance on critical thinking was approximately 0.6 of a standard deviation, although the observed effect was much larger in studies that used a cross-sectional as opposed to a longitudinal design. In addition, participation in extra-curricular activities in college have been found to predict increases in critical thinking (Gellin, 2003).

While it appears that participation in formal education improves critical thinking skills, there is less certainty over what instructional approaches are most effective at developing critical thinking. In a meta-analysis of 341 critical thinking interventions, Abrami et al. (2008) found that, on average, interventions have a moderate effect on critical thinking (0.3 standard deviations), but there was a large amount of heterogeneity in the effectiveness of the reviewed interventions. Their analysis indicated that several pedagogical practices are important for critical thinking development, including the opportunity for dialogue, the exposure of students to authentic or situated problems and examples, and one-on-one mentoring (Abrami et al., 2015). Perhaps most importantly, their meta-analysis suggested that critical thinking skills had to be specifically targeted and taught, that is, critical thinking cannot be assumed to inevitably develop from normal content instruction. Furthermore, the ability of students' to improve critical thinking is not only dependent upon an explicit focus on teaching critical thinking skills, but also

on teachers having sufficient training and expertise to deliver critical thinking instruction (Abrami et al., 2015; Grosser & Nel, 2013; Shim & Walczak, 2012; Yeh, 1997).

Much of the appeal of prioritizing critical thinking within the education system is the potential for critical thinking skills to transfer across subjects and domains. While it is educationally desirable for skills and knowledge to transfer across contexts, in practice, many skills have shown limited potential for transfer beyond their original domain (Protzko, 2017; Sala & Gobet, 2019). Indeed, many authors have argued that critical thinking is domain-specific and inseparable from a given context (McPeck, 1981; Holmes, Wieman, & Bonn, 2015). As an extension of this, many of these same authors argue that domain expertise is a prerequisite to the development of critical thinking (Alexander, Kulikowich, & Schulze, 1994; Ceci, 1993). Proponents of this view suggest that critical thinking should not be taught independently of content, as such skills are unlikely to transfer to other learning contexts (Sala & Gobet, 2019). However, others, such as Siegel (1988), posit that critical thinking skills, including recognizing fallacies in reasoning, are transferable across disciplines because they relate to flaws in the reasoning and construction of arguments in general, rather than being solely specific to the subject-matter.

Similarly, instructional interventions tend to either target critical thinking by focusing on teaching general critical thinking skills distinct from subjects or, alternatively, focus on trying to improve the way that critical thinking is embedded within a subject. Moreover, many interventions attempt to use a mixture of these two approaches (Ennis, 1989). On this point, the meta-analysis by Abrami et al. (2008) found that both domain-specific and domain-independent instructional interventions can be effective at improving critical thinking, however, interventions that used a mixture of domain-general and domain-specific critical thinking instruction were the most effective at improving critical thinking (an improvement of 0.94 standard deviations).

2.4 Critical Thinking in the IB

The IB has claimed to offer a strong focus on critical thinking and successfully promoting the development of its students' critical thinking abilities (Dickson, Perry, & Ledger, 2018; IBO, 2012). Consequently, several studies have investigated critical thinking development in International Baccalaureate students (Cole, Ullman, Gannon, & Rooney, 2015; Dickson et al., 2018; Horn, 2018; Lee, Spinks, Wright, Dean, & Ryoo, 2017; Wilkinson & Hayden, 2010; Wright & Lee, 2014). The IB programme includes two components that are particularly focused on critical thinking. The first component, 'Theory of Knowledge', focuses on teaching critical thinking skills in a domain-general fashion. The second, 'Extended Essay', involves producing a long-form research essay where students are required to apply their critical thinking skills in a deeper, more domain-specific manner.

High levels of critical thinking among International Baccalaureate Diploma holders have been found using self-report measures of critical thinking in research carried out in Australia, Canada, Mexico, Turkey, and the United Kingdom (Cole, Gannon, Ullman, & Rooney, 2014; Cole, et al., 2015; Saavedra, Lavore & Flores-Ivich., 2016; Sagun, Ateskan, & Onur, 2016; Taylor & Porath, 2006; Wray, 2013). For example, a survey examining the perceptions of IB graduates suggested that despite the high intensity of the programme, most participants valued the intellectual stimulation the IB offered and agreed with the statement, 'My IB courses taught me to think critically and flexibly' (Taylor & Porath, 2006, p. 152). Similarly, Wray (2013) reported that International Baccalaureate Diploma holders in England valued their experience of the research they carried out in the Extended Essay and identified critical thinking as

one of the main skills they gained through the process. Others, however, have found little evidence that IB participation affects self-report measures of critical thinking. For example, Cole et al. (2014) interviewed and gave a self-report measure to students and teachers to evaluate their perceptions of the Theory of Knowledge course and found that participation in the Theory of Knowledge course did not affect the critical thinking disposition of IB Diploma holders. While this provides some preliminary evidence that the International Baccalaureate enhances critical thinking, it is unclear whether any benefits are limited to self-report and survey measures of critical thinking. This is particularly important to consider, as there is little evidence that teachers and students share a common definition of critical thinking or can accurately assess their own critical thinking (Huber & Kuncel, 2016). Furthermore, many IB schools are comprised of high-achieving students and evidence suggests that teachers are more likely to overestimate the effectiveness of their teaching practices in such environments (Double, Chow, Livesey & Hopfenbeck, 2020). Notably, one of few studies using both self-report and ability-based measures of critical thinking found that, while university students who had previously undertaken the IB reported that the IB was useful in developing their critical thinking skills, there was no evidence that they had superior critical thinking skills compared to those who had been educated through the national curriculum (Sagun et al., 2016).

2.5 The Theory of Knowledge in IB

The Theory of Knowledge course is a core element of the Diploma Programme, is compulsory for all Diploma Programme students and requires schools to allocate a minimum of 100 hours of class time to it. It is assessed through an externally examined essay and an internally assessed presentation. The essay component consists of a 1,600-word written response to one of six prescribed titles issued every examination session by the IB. The presentation component includes a presentation planning document and an oral presentation. The presentation is carried out by one to three students with 10 minutes allocated per presenter. The presentation planning document is used for external moderation.

In substantive terms, the Theory of Knowledge does not cover a particular body of knowledge; instead, the course focuses on critical thinking and the process of knowing, including ways of knowing (such as language, sense perception, reason, emotion) and areas of knowledge (such as mathematics, natural sciences, human sciences, arts, history). Students are provided with the opportunity to investigate the nature of knowledge by, for example, scrutinizing knowledge claims and studying knowledge questions. While the Theory of Knowledge does not apply a single-domain focus, the course does refer to specific Diploma Programme subjects and these subjects, in turn, reinforce common goals by embedding some references to the Theory of Knowledge within them.

2.6 The Extended Essay in IB

The Extended Essay is a compulsory component of the Diploma Programme. It is an in-depth piece of independent research focused on a topic chosen by the student from a list of Diploma Programme subjects and carried-out under the guidance of a qualified member of staff who acts as the supervisor. Students are expected to spend 40 hours of work on the extended essay and are required to participate in three reflection sessions with their supervisor; one acting as a brief final interview where students defend their essay. The final extended essay consists of a formally written 4,000-word long essay that is required to be coherent and well-structured, as well as a 500-word long reflection form. The Extended

Essay is externally assessed against criteria that are common to all subjects. Students should achieve a grade D or higher to be awarded the Diploma Programme and in combination with the grade of the Theory of Knowledge, the Extended Essay contributes to up to three points out of the maximum 45 available constituting the IB Diploma.

3. Document Analysis of Critical Thinking in IB Documents

3.1 Methodology

A document analysis was performed on a collection of documents selected through collaboration between the research team and the International Baccalaureate, as summarized in Table 1. These include formal policy documents, instructional materials, and subject guides. The documents were reviewed and synthesized to address possible pathways by which IB Diploma Programme students develop critical thinking. To accomplish this, the document analysis combined elements from both thematic and content analysis methodologies (Bowen, 2009). This process involved skimming (superficial examination), reading (thorough examination) and interpreting included documents, as well as organizing information according to identified themes. Under this approach, we coded the document text according to their relevance to several themes that were iteratively determined by two members of the research team, and which ultimately resulted in the following four themes:

1. Instruction and teaching
2. Outcomes and values
3. Assessment and evaluation
4. Management, policy, and teacher development

Given the variety and number of documents, the first step in the process was to review the complete set of documents for relevance. A research team member read through all documents and selected those that were most appropriate to the inquiry. This resulted in the selection of 8 documents relevant to the question of how the IB promotes critical thinking. Three members of the research team reviewed the content of these remaining documents. The content of each document was highlighted according to the previously mentioned themes, analysed, and then synthesized into relevant findings presented in Table 2 and discussed below.

Table 1. List of IB documents included in the document analysis

Publication	Document title	No of pages
IBO (2012)	What is an IB education?	14
IBO (n.d.)	Approaches to Teaching and Learning	49
IBO (2015)	Diploma Programme: From Principles into Practice	95
IBO (2017a)	Theory of Knowledge guide	74
IBO (2019a)	Extended Essay guide	376
IBO (2013a)	Language A: Language and Literature guide	76
IBO (2014b)	Biology guide	179
IBO (2019b)	History guide	108

3.2 Findings

3.2.1 Instruction and teaching

This theme was concerned with the instructional techniques mentioned within the analysed documents and how they provide pedagogical pathways to improve critical thinking. In general, the IB documents emphasized many of the key instructional practices identified as important by the preceding literature review. We discuss the instructional techniques that represent plausible pathways to developing critical thinking skills based on the extent to which they align with the review of the evidence presented in Section 2.

The IB documents consistently highlighted a willingness to make teaching critical thinking and associated metacognitive skills explicit. This approach was perhaps best captured by the ‘Approaches to Teaching and Learning’ document which explicitly put forward an approach to integrating the teaching of critical thinking skills in the classroom and a focus on “not what is learned but learning how to learn” (IBO, 2015). The documents indicated that making critical thinking an explicit aspect of instruction is accomplished through six pedagogical principles that underlie teaching within Diploma Programme: (1) involves inquiry, (2) focuses on conceptual understanding, (3) is based on local and global contexts, (4) involves collaboration and teamwork, (5) caters for learners with different needs, and (6) is supported by assessment (IBO, 2019a, p.20; IBO, n.d., p.14.)

A clear emphasis on explicitly teaching critical thinking skills was accompanied by a willingness to teach critical thinking in both a domain-general and a domain-specific fashion. At a domain-general level, the Theory of Knowledge component provided explicit critical thinking instruction outside of any content area. The Theory of Knowledge guide explicitly stated that the course focused on critical thinking skills as well as building epistemic understanding, i.e., an understanding of how humans attain knowledge (IBO, 2017a). Furthermore, our analysis also suggested that subject-specific instructional approaches to critical thinking were presented within the documents. For instance, one of the aims of the science subjects in the Diploma Programme was to “develop an ability to analyse, evaluate and synthesize scientific information” (IBO, 2014b, p. 18). Critical thinking was also present in the Language and Literature course and involved promoting students’ ability to examine how the meaning of a text related to the context in which it was embedded, and varied across cultures (IBO, 2013a). Another example was the nature of critical thinking skills in the History course. One of the mentioned aims of this subject was stated as being to “encourage students to engage with multiple perspectives and to appreciate the complex nature of historical concepts, issues, events and developments” (IBO, 2019b, p. 11). These findings indicated that instructional approaches to critical thinking were shaped by the norms and values of a subject, which in turn relied upon a student’s domain-specific knowledge of both content and methodology.

An additional potential pathway to critical thinking development was presented through the emphasis on one-to-one mentorship indicated in the documents, for which the above described Extended Essay provides an opportunity. This mentoring is focused on various critical thinking skills such as inquiry skills, research skills, planning, writing, etc. and provides unique opportunities for one-to-one tutoring (IBO, 2019a). The focus on mentorship may be an important pathway for critical thinking development, given the significance of one-on-one mentorship for improving critical thinking skills (Abrami et al., 2015), as

well as the fact that such opportunities are relatively rare under non-IB public education. Overall, this analysis suggests that the instructional approach taken by the IB aligns well with the evidence available from the literature.

3.2.2 Outcomes

The outcomes theme focused on analysing the values and aims of the IB curriculum as indicated by the included documents. In particular, the analysis paid attention to whether these values emphasised critical thinking and related constructs. It was important to determine what emphasis was placed on critical thinking in the documents and how it was situated in relation to other outcomes. This could elucidate what role the IB saw for critical thinking in the development of its students. For instance, did the IB largely view critical thinking as an aspect of achieving other valued outcomes, or as an end in itself?

Critical thinking is perhaps most explicitly placed as an outcome within the IB documents through its inclusion in the IB Learner Profile, where it is incorporated within several attributes. This was most notable within the “Inquirers” and “Thinkers” attributes. According to the IB documents, the attribute of being an “Inquirer” entails three critical thinking skills (analysis, inference and evaluation) as well as three critical thinking dispositions (inquisitiveness, analyticity and truth-seeking). Meanwhile, the “Thinkers” attribute referred specifically to students’ ability to “exercise initiative in applying thinking skills critically and creatively” (IBO, n.d., p.4). This emphasis on thinking skills as an important outcome of the IB programme was emphasized elsewhere in the documents, including a quote from Swartz and Perkins (1989, p. 5), which identified the development of students’ thinking skills as the most important educational aim: “Concern with developing students’ thinking, far from being a fad, is one of the most persistent and ambitious aspirations of education” (IBO, n.d., p. 4).

The document analysis indicated that the ideal outcomes of the IB programme are often high-level overarching values. According to their documents, the IB aspires to develop ‘internationally minded’ students (IBO, 2012, p. ii), which has been described as an educational philosophy and school culture that is integrated in the learning, the teaching and the assessment in all IB programmes, including the Diploma Programme (IBO, 2015). In order to produce well-rounded students, the IB claims that their programmes adopt a holistic vision of education focused on the learner, and that their mission is “to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect” (IBO, 2012, p. ii). The document analysis suggested that within this overarching aim, critical thinking was often referenced within other skill sets, such as thinking skills and international mindedness. This practice may suggest that the IB programme views critical thinking as situated within higher-order thinking skills, or alternatively signal that the IB views critical thinking as essential to achieving these higher-order values.

The document analysis suggests that critical thinking is a valued and explicit outcome within the IB programme. Critical thinking is often viewed within other broader constructs such as thinking skills and inquiry. This suggests that critical thinking is developed as part of a broader holistic vision of education. This perspective may be particularly effective because it places an emphasis on the interconnectedness between critical thinking and other outcomes of education.

3.2.3 Assessment and Evaluation

Assessment should support the curricular and philosophical goals of a programme through the encouragement of good classroom practice and appropriate student learning, and it must reflect the international mindedness of the programme (IBO, n.d.). Encouragingly, according to the IB document 'From Principles into Practice', "the single most important aim of the Diploma Programme assessment is that it should support curricular goals and encourage appropriate student learning" (p. 39). According to the documents, assessment should measure students' achievement levels against published criteria, and teachers are expected to make these criteria available for students. More specifically, the assessment in the programme is high-stakes and criterion-related, as shown in the document 'Diploma Programme Assessment: Principles and Practice', (IBO, n.d.). Below, we consider how critical thinking is incorporated within the assessment criteria included within the document analysis.

Assessment of critical thinking is, unsurprisingly, more explicit in the Theory of Knowledge course than specific subjects. The assessment objectives in the Theory of Knowledge course break down critical thinking into measurable facets; for instance, "identify and analyse the various kinds of justifications used to support knowledge claims" and "formulate, evaluate and attempt to answer knowledge questions" (IBO, 2013, p.15). The Theory of Knowledge essay is assessed based on two aspects: (1) the extent to which the students demonstrate understanding of knowledge questions, and (2) the quality of students' analysis of the knowledge question. The second aspect includes judging the quality of inquiry undertaking, evaluating whether students justified points raised in the essay and whether arguments have been effectively studied (IBO, 2013, p.61). Descriptor levels related to the Theory of Knowledge essay describe a "compelling" essay (Level 5) as one where "arguments are clear, supported by real-life examples and are effectively evaluated; counterclaims are extensively explored; implications are drawn", while it describes an essay as "ineffective" (Level 1) when "assertions are offered but are not supported" (p.62). While these assessment criteria certainly included components of critical thinking broadly defined, it was noteworthy that across the assessment documents there were few specific references to the term 'critical thinking'.

More subject-specific approaches to assessing critical thinking were also identified within the document analysis. For instance, in Biology, an assessment objective focuses on students' ability to "formulate, analyse and evaluate hypotheses, research questions, predictions, methodologies and techniques, primary and secondary data, scientific explanations" (IBO, 2014b, p.19). In History, aspects of critical thinking are targeted by two assessment objectives: 'application and analysis' and 'synthesis and evaluation' (IBO, 2019b, p.19). In 'English A: Language and Literature', critical thinking is reflected in three assessment objectives. The first assessment objective 'knowledge and understanding' requires students to demonstrate critical understanding of a text, the second assessment objective 'application and analysis' requires students to demonstrate their ability to analyse the effects of text characteristics on the reader; and third, assessment objective 'synthesis and evaluation' requires students to demonstrate their ability to evaluate conflicting opinions within and about a text (IBO, 2013a, p.10).

The use of subject-specific nomenclature to describe critical thinking outcomes requires teachers and students to have specific knowledge of how critical thinking skills are manifested and assessed within a subject-specific framework. This requirement is supported by clear guidelines for teachers given in the IB document 'From Principles into Practice', including explanations of key terms and phrases (e.g.,

common command words) that will be used in the syllabus content and examination questions. The guidelines state that teachers should familiarize themselves with papers, mark schemes and subject guides, as they include examples of student responses and examiners' comments (IBO, 2015, p. 36). The guidelines further emphasise the need for having a language policy that identifies the principles and practices teachers are expected to adopt (IBO, 2015, p. 38).

Formative assessment is key to teaching and learning in the Diploma Programme and the delivery of its aims and objectives (IBO, n.d., 2015). It underlies teaching of all Diploma Programme courses including the Theory of Knowledge and critical thinking (see IBO, 2014a; 2016a; 2016b; 2017a) and is adopted "as an essential learning process" (IBO, 2015, p. 39). Teachers are required to design formative assessments to closely monitor their students' progress and employ practices that support students' deep learning. As part of this, teachers are expected to provide regular and thorough feedback on students' work while highlighting strengths and weaknesses and supporting students to develop strategies for improvement. In addition, teachers are required to promote students' self-evaluation and peer-evaluation skills and encourage the use of detailed assessment rubrics and matrices. Formal summative assessments are also considered part of the learning process and hence, teachers are encouraged to adapt and use them formatively in their instruction.

3.2.4 Management, Policy, and Teacher Development

Managerial decisions and policies have an important role to play in developing a context under which children can develop into effective critical thinkers. The document analysis focused on how policies relevant to critical thinking were implemented at an institutional level, particularly regarding the support provided by the International Baccalaureate to teachers and schools.

In terms of management and policy, the documents highlighted managerial goals and communicating changes. The increased emphasis on critical thinking through policies such as 'approaches to learning' for instance, made clear that such policies required investment and changes on a managerial level. For example, the 'Approaches to Teaching and Learning' document referred to a shift in focus or emphasis in the role of Diploma Programme coordinators as pedagogical leaders responsible for organizing cross-departmental and whole faculty planning of skills development. While the analysed documents were somewhat lacking in detail concerning the implementation of policies and procedures relating to critical thinking, this could reflect that such information was disseminated in a different way or through unanalysed documents. The analysis of the documents revealed a clear focus on teacher development and training. Various documents referred to workshops, lectures, and online materials for teacher development. This support included specific examples of how to integrate the IB's pedagogical principles into teachers' instructional practices with some suggestions of how to foster critical thinking. An example of such a suggestion was, "When planning Diploma Programme lessons, consider what higher-order questions you will ask your students to encourage higher-order thinking [...]" (IBO, n.d., p. 5). The support for IB teachers extended beyond guidance and suggestions available in IB publications, and teachers were also encouraged to participate in professional development conferences and workshops (IBO, 2015).

Furthermore, several documents, such as 'From Principles into Practice', stressed the importance for school leadership teams in IB schools to develop and maintain the school as a professional learning community. The document suggested that this involved nurturing reflection, innovative professional development and practice, and encouraging teachers to collaborate and share good practice (IBO, 2015, p.21). This document further outlined how the IB coordinator in each school should be a part of the leadership and support implementation of the IB programme. More specifically, the document suggested that "teachers can improve practice by sharing ideas with their colleagues and observing classes. Teacher collaboration should be seen as an important aspect of professional development." (IBO, 2015, p.36). Overall, the document analysis demonstrated that IB places a strong focus upon teaching all students' explicit knowledge of critical thinking, integrated in the different domains, through one-to-one mentorship and written and oral tasks such as in Theory of Knowledge and the Extended Essay. Such *instructional* approaches were expected across all courses and subjects. The analysis further outlined that critical thinking was valued as an *outcome* and as a part of strategy of learning how to learn as evident in the Learner Profile. Moreover, *assessment* of critical thinking was a key part of the IB programme, most prominently found in the criteria for Theory of Knowledge, but also when assessing critical thinking in specific subjects. To ensure these instruction and assessment approaches are followed, the IB documents emphasized the importance of an understanding of critical thinking being embedded in their management, policy and continuing teacher development.

Based upon the document analysis we have developed a logic model linking critical thinking outputs with processes at the student, teacher, and school levels (see Appendix 4). The model provides a framework to evaluate the approach towards critical thinking adopted by the IB and to understand how the methods and approaches used within the IB might translate into better critical thinking.

Table 2. Summary of potential pathways to critical thinking development arranged by theme

Theme	Pathway
Instruction	<ul style="list-style-type: none">• Explicit teaching of critical thinking skills• Utilising both domain-specific and domain-general approaches to teaching critical thinking• Opportunities for one-on-one mentorship
Outcomes	<ul style="list-style-type: none">• Critical thinking viewed as an outcome within a holistic view of student development• Critical thinking situated within broader outcomes such as thinking skills and inquiry thinking
Assessment and Evaluation	<ul style="list-style-type: none">• Critical thinking and related skills are valued within the assessment structure• Subject-specific assessment language is utilised• The use of subject-specific language is supported by written guidance
Management, Policy, and Teacher Development	<ul style="list-style-type: none">• Management support for policy changes, through leadership team and IB coordinator• Pedagogical support through examples and suggestions• Professional teacher development conferences and workshops• Building professional learning community where teachers collaborate and share good practice, focusing upon learning, rather than teaching

4. Quantitative Analysis of Critical Thinking in Diploma Programme Students

This study uses quantitative comparisons to evaluate whether participation in the Diploma Programme is associated with higher critical thinking skills compared to participating in respective national (or State) programmes.

4.1 Methodology

4.1.1 Participants

IB schools in Australia, England and Norway were approached to participate in the study. Based on which schools indicated interest in participating, control schools that broadly matched the participating IB schools' socio-economic and academic standing were also approached. In cases where schools administered both the IB programme and their national programme, we endeavoured to recruit both IB and non-IB students from the same school.

The IB project research co-ordinator supported the OUCEA research team with a list of IB schools in the three countries. The IB research co-ordinator sent supporting letters to the schools encouraging them to participate in the study before the research team contacted school IB co-ordinators and headteachers by email, phone, and Skype. One researcher travelled to Australia in September 2019, and Norway in March 2020, while a second researcher collected data in England in February 2020. The IB co-ordinator in each school selected students on a voluntary basis for interviews after they had sat the critical thinking and related assessments and responded to the survey.

Participating schools in Australia

Four Australian schools were recruited to the study, three of which were independently funded. Two schools were single sex boys' schools, one was a single-sex girls' school, and one was a coeducational school. All schools offered both the IB and national programmes (Higher School Certificate and South Australian Certificate of Education), however, only three of the schools were able to provide both IB and non-IB students for the study.

Participating school in England

In England, the participating school was a non-fee-paying, non-selective secondary school located in a city. It offered Key Stage 3-5 programmes as well as the International Baccalaureate's Diploma and Career-related programmes for students aged 11-18. The school was recently rated as outstanding by the Office for Standards in Education, Children's Services and Skills (Ofsted). It had a capacity of 1300 students. English was the first language of only a minority of students and a third of students were eligible for free-school meals. Additional schools were intended to be recruited from England, but data collection had to be suspended due to school closures related to the COVID-19 pandemic.

Participating schools in Norway

Three metropolitan schools were recruited from Norway. Due to the COVID-19 pandemic, we administered the study online for one of the Norwegian schools rather than administering the study in the school. One school provided both IB and non-IB students, while two provided only IB students. One Norwegian school was independently funded while the other two were state funded.

Overview

Overall, 566 students from 8 schools participated in the project from Australia, Norway, and England combined. Students were drawn from the final two years of secondary school, Year 11 (58.9%) and Year 12 (41.1%). 282 students were enrolled in the IB programme and 284 students were enrolled in non-IB national programmes. A breakdown of students by country and programme is provided in Table 3. Given that only one school could be recruited in England, we conducted additional analyses to ensure that our findings were not sensitive to the inclusion of this single English school and found that the results did not change substantively based on its inclusion. We therefore present the results with this school included.

Table 3. Student sample size as a function of country and IB status

	Non-IB	IB
Australia	200 (35%)	166 (29%)
England	0 (0%)	21 (4%)
Norway	84 (15%)	95 (17%)

4.1.2 Materials

In addition to basic demographic variables, participants completed the following tasks using their own laptop computers.

Socioeconomic Status:

Participants provided several indicators of socio-economic status, including parental income and education. Additionally, perceived social standing was measured by asking students to rate where they see themselves sitting within society on a ladder. Students were shown a ladder with 10 being the highest point on the ladder and 1 being the lowest.

Cornell Critical Thinking Test:

Students completed the Cornell Critical Thinking Test (Ennis, Millman, & Tomko, 2005), a 52-item multiple-choice test of critical thinking. The test covered multiple aspects of critical thinking including, “induction, deduction, evaluation, observation, credibility (of statements made by others), assumption identification, and meaning (including definition, sensitivity to meaning, and-ability-to-handle-equivocation)” (Ennis et al., 2005; p.2). The test takes approximately 50 minutes to administer and is broken into sub-sections with moderate to high reported reliability (.49-to-.87).

Big-5 personality assessment:

A 50-item personality battery was administered using items drawn from the International Personality Item Pool (Goldberg et al., 2006). The inventory is based on the five-factor model of personality (Goldberg, 1993) and consists of 10 items for each of neuroticism, extraversion, conscientiousness, agreeableness, and openness to experience. Participants rated each item on the extent to which it described them (extremely inaccurate = 0 to extremely accurate = 100). The assessment has high reported internal reliability, with an average alpha value of 0.84 (Goldberg, 1993).

Cognitive Reflection Task (CRT):

Participants completed the 3-item CRT. The task consisted of three questions taken directly from Frederick (2005) that have an intuitive yet incorrect response. The task measures the participants' ability to deeply process problems and override intuitive thinking.

The International Cognitive Ability Resource (ICAR-16):

Participants also completed the ICAR-16 (Dworak, Revelle, Doebler, & Condon, 2020). The ICAR-16 is a 16-item broad intelligence measure. The 16 items measure four aspects of intelligence: verbal reasoning, letter and number series, matrix reasoning and three-dimensional rotation. All items were in multiple choice format. The presentation of items was randomized.

4.1.3 Procedure

Originally, students completed the task in large groups in their classroom or the school hall using their own laptops. Students were always supervised by a proctor and/or teacher. Participants first completed the questionnaires and cognitive task in the following order: demographic variables, socio-economic indicators, personality, ICAR-16, then the CRT. All students subsequently completed the critical thinking test. However, due to school closures in response to the COVID-19 global pandemic, students that participated later in the project completed the tasks online. Sensitivity analysis suggested that the mode the study was administered by did not substantively change the findings.

4.2 Results

4.2.1 Descriptive Analysis

The demographic composition of the sample as a function of IB participation is presented in Figure 1. Preliminary analyses suggested that the IB sample differs significantly from the non-IB sample in terms of gender, $\chi^2=4.4$, $p = 0.04$. Males were slightly over-represented in the non-IB programme sample (77%) compared to the IB programme sample (68%). There were also significant differences in grade level as a function of IB participation, such that Year 11 students were over-represented in the non-IB programme sample (55%) compared to the IB programme sample (44%), $\chi^2=6.36$, $p = .01$. A Mann–Whitney test suggested that parental income did not differ significantly between the IB and non-IB samples, $W = 36692$, $p = .62$.

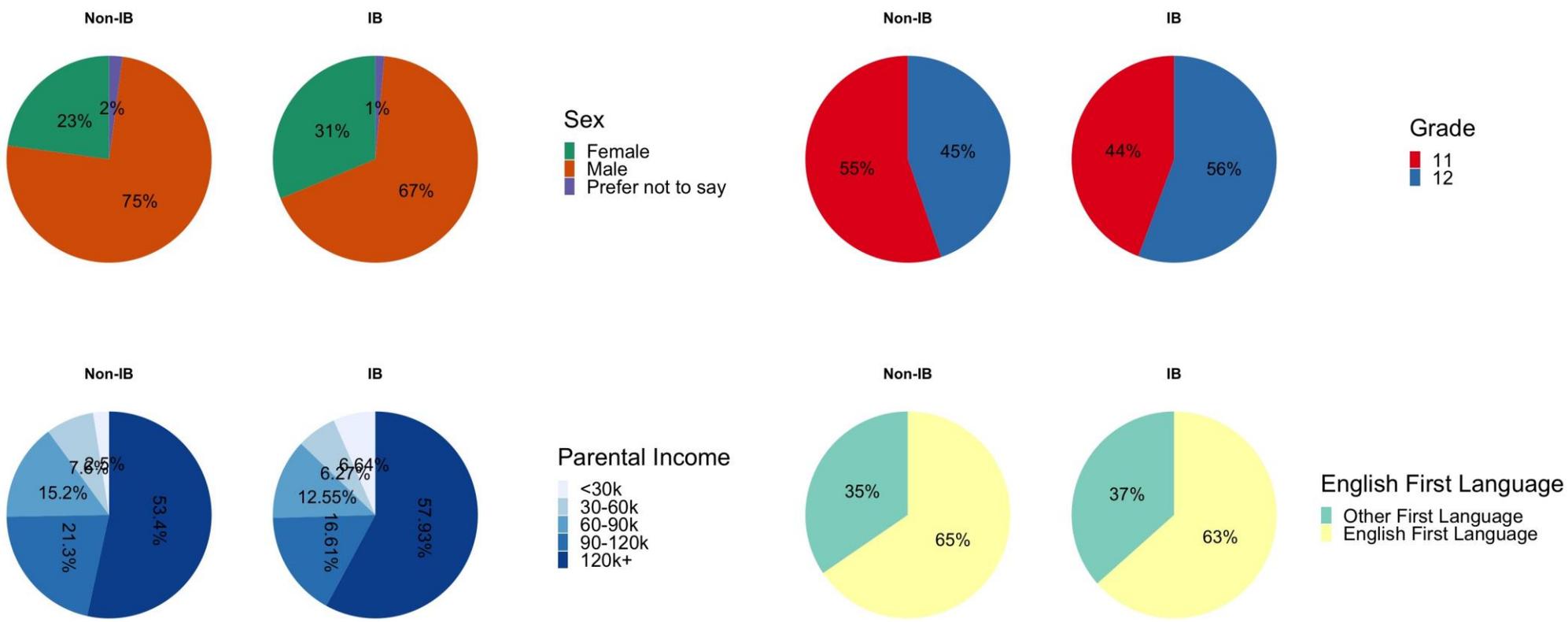


Figure 1. Demographic variables as a function of IB status

4.2.2 Correlations

Descriptive statistics and correlations of study variables are presented in Table 4. Focusing on critical thinking, the two measures of cognitive ability (intelligence and cognitive reflection) were moderately positively correlated with critical thinking, while the personality dimension openness to experience was a small positive predictor of critical thinking. Extraversion and age were small negative predictors of critical thinking.

4.2.3 Differences in Critical Thinking

An initial analysis was performed to determine if there were substantial differences in critical thinking between the IB and non-IB cohorts without accounting for covariates. Critical thinking was significantly higher in the IB sample ($M = 25.86$, $SD = 7.27$), compared to the non-IB students ($M = 21.52$, $SD = 7.77$), $t(564) = 6.86$, $p < .001$, $d = .58$.

4.2.4 Regression Analysis

Exploratory multi-level regression analyses were performed to examine differences in critical thinking performance after covariates were controlled for. The following variables were entered into the model: personality variables (openness, conscientiousness, neuroticism, extraversion, and agreeableness), cognitive abilities (intelligence and cognitive reflection), socioeconomic status indicators (parental income, parental education), and demographic variables (age and sex). School was entered as a grouping factor. Note that for this and subsequent analyses, students with incomplete data on any model variable were excluded from the analysis. Sample sizes for each model are noted where appropriate.

The results of the analysis are displayed in Table 5. The multi-level regression indicated that intelligence (ICAR 16), cognitive reflection, openness to experience, and parental income were significant positive predictors of critical thinking, while neuroticism and extraversion were significant, negative predictors. Crucially, after controlling for all covariates, IB status was a significant predictor of critical thinking, such that students in the IB programme had significantly higher critical thinking. This effect was small to moderate in size, $\beta = 0.21$.

Table 4. Descriptive statistics and correlations between study variables. Mean (SD)

Variable	N	IB	N	Non-IB	1	2	3	4	5	6	7	8	9
1. Age	282	18.2 (0.63)	284	18.12 (0.67)									
2. ICAR 16	282	10.12 (3.61)	284	8.05 (3.68)	0.05								
3. Openness	268	665.86 (143.93)	272	624.1 (141.19)	-0.04	0.11*							
4. Conscientiousness	272	598.17 (165.89)	275	605.37 (139.27)	-0.10*	0.06	0.26***						
5. Extraversion	272	577.68 (170.26)	277	595.4 (147.31)	0.04	-0.14**	0.26***	0.23***					
6. Agreeableness	273	639.95 (163.3)	274	668.86 (132.58)	0.03	0.01	0.25***	0.41***	0.17***				
7. Neuroticism	272	439.05 (183.76)	272	410.78 (158.96)	-0.03	-0.09*	-0.03	-0.31***	-0.32***	-0.30***			
8. CRT	282	0.57 (0.5)	284	0.4 (0.49)	0.12**	0.40***	0.01	-0.04	-0.10*	-0.05	0		
9. CCT	282	25.86 (7.27)	284	21.52 (7.77)	-0.09*	0.41***	0.10*	0.02	-0.12**	-0.06	-0.06	0.28***	
10. Social standing	282	7.15 (1.46)	284	7.21 (1.31)	-0.11**	-0.04	0.05	0.14**	0.23***	0.03	-0.08	-0.01	0.08*

Note: *** = $p < .001$, ** = $p < .01$, * = $p < .05$

Table 5. Results of the multilevel regression analysis on critical thinking

Predictors	Estimates	Std. Beta	Standardized CI	p
(Intercept)	12.34	-0.12	-0.42 – 0.18	0.292
IB	3.28	0.21	0.11 – 0.31	<0.001
ICAR 16	0.53	0.24	0.16 – 0.33	<0.001
CRT	1.64	0.1	0.02 – 0.19	0.015
Openness	0.01	0.1	0.02 – 0.19	0.02
Conscientiousness	0	-0.03	-0.12 – 0.06	0.561
Extraversion	-0.01	-0.13	-0.22 – -0.04	0.004
Agreeableness	0	-0.03	-0.12 – 0.06	0.497
Neuroticism	-0.01	-0.12	-0.21 – -0.03	0.012
Sex (Female)	1.87	0.24	-0.01 – 0.49	0.061
Age	0	0.02	-0.08 – 0.12	0.748
Mum education	0.17	0.03	-0.06 – 0.12	0.565
Dad education	-0.14	-0.02	-0.11 – 0.07	0.627
Parental Income	0.64	0.09	0.00 – 0.18	0.044
Social standing	0.18	0.03	-0.06 – 0.12	0.487
Random Effects				
σ^2	43.06			
$\tau_{00\ Q50}$	7.28			
ICC	0.14			
$N_{\ Q50}$	8			
Observations	474			
Marginal R^2 / Conditional R^2	0.239 / 0.349			

4.2.5 Propensity Score Matching

Finally, we performed a propensity score matching analysis. To determine relevant covariates for calculating a propensity score, we relied on both theoretical considerations and the empirical findings from a logistic regression with each of the covariates in the prior regression model but using IB participation as the criterion variable, see Table 6. Intelligence, openness to experience, agreeableness, and sex were predictors of IB enrolment, such that IB students tended to be more intelligent, have higher openness to experience, be less agreeable, and were more likely to be female. See Figure 2 for the distribution of propensity scores based on the model presented in Table 6.

Table 6. Results of the logistic regression analysis on IB participation

Predictors	Odds Ratios	Std. Beta	Standardized CI	p
(Intercept)	0	0.5	0.10 – 0.89	0.091
ICAR 16	1.15	0.51	0.29 – 0.74	<0.001
CRT	1.33	0.14	-0.07 – 0.35	0.183
Openness	1	0.33	0.11 – 0.54	0.003
Conscientiousness	1	-0.03	-0.26 – 0.20	0.778
Extraversion	1	-0.13	-0.35 – 0.10	0.277
Agreeableness	1	-0.31	-0.55 – -0.07	0.01
Neuroticism	1	0.09	-0.14 – 0.32	0.427
Sex (Female)	0.58	-0.54	-1.02 – -0.06	0.027
Age	1	0.15	-0.06 – 0.35	0.159
Mum education	1.17	0.19	-0.04 – 0.42	0.103
Dad education	0.99	-0.02	-0.25 – 0.21	0.88
Parental Income	0.93	-0.08	-0.31 – 0.14	0.459
Social standing	1.04	0.06	-0.16 – 0.28	0.62
Observations	474			

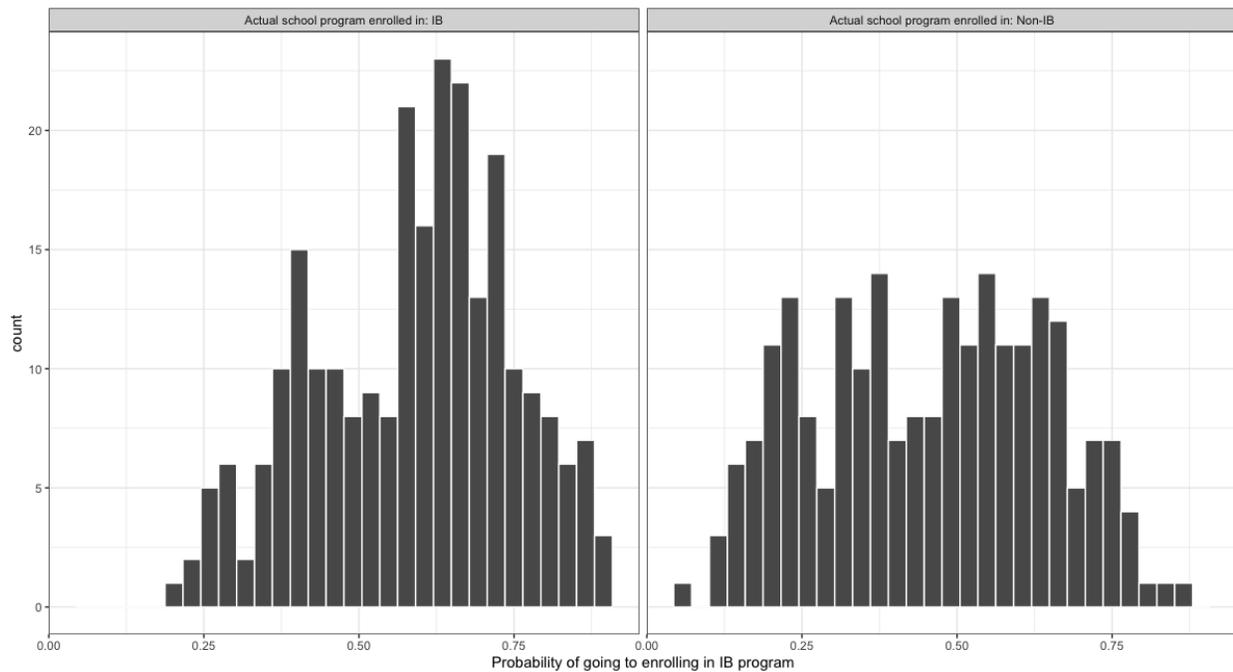


Figure 2. Distribution of propensity scores in the IB and non-IB samples

We then calculated a propensity score based on covariates identified in the previous regressions or deemed theoretically important. Covariates included: age, sex, socioeconomic status indicators (parental income, parental education), cognitive ability (intelligence and cognitive reflection), and personality (agreeableness, neuroticism, and openness to experience). Note that a ‘genetic’ matching procedure was used (Diamond & Sekhon, 2013). This is a reasonably conservative matching process that produced an adequately matched sample at the expense of a significant proportion of the sample being dropped (24.17%). Less conservative matching, such as nearest neighbour matching, did not reduce the differences in the covariates to acceptable levels. A comparison of the matched samples on covariates is shown in Table 7.

After creating a ‘matched’ sample, a t-test was run to examine whether there were significant differences between the IB and non-IB samples in terms of critical thinking. The results suggested that the matched IB programme sample had significantly higher critical thinking than those in the matched non-IB programme sample, $t(362) = 4.27, p < .001$. The effect was moderate $d = 0.48$.

Table 7. Comparison of matched samples

	Non-IB	IB	Sig
Age (Days)	6626.15 (233.59)	6642.59 (231.88)	0.531
ICAR 16	9.50 (3.01)	10.27 (3.44)	0.038
CRT	0.57 (0.50)	0.58 (0.49)	0.815
Mum education	4.13 (1.19)	4.26 (1.12)	0.326
Dad education	4.20 (1.20)	4.30 (1.20)	0.474
Parental Income	4.30 (0.99)	4.16 (1.21)	0.282
Openness	641.95 (126.02)	663.87 (146.30)	0.166
Neuroticism	423.92 (169.68)	438.88 (185.91)	0.464
Extraversion	603.86 (142.43)	575.06 (169.85)	0.115
<i>n</i>	115	249	

4.2.6 Cross-sectional Comparisons

Next, we examined whether the differences between IB and non-IB students differed as a function of grade level. An initial 2 (Grade: 11 vs. 12) X 2 (IB status: IB vs. non-IB) Analysis of Variances (ANOVA) was performed on the matched sample. The results again suggested that IB students ($M = 26.2$, $SD = 7.07$) performed significantly better than non-IB students on the critical thinking test ($M = 22.51$, $SD = 8.79$), $F(1,360) = 18.07$, $p < .001$. There was, no significant difference between Grade 11 ($M = 24.99$, $SD = 7.54$) and Grade 12 ($M = 25.08$, $SD = 8.11$) students on the test, $F(1,360) = 1.28$, $p = .259$. Importantly the Grade X IB status interaction was significant, such that the advantage seen in IB students was more pronounced in Grade 12 compared to Grade 11 Students, $F(1,360) = 7.11$, $p = .008$. We re-ran the model using the full (unmatched) sample and the findings did not substantively change.

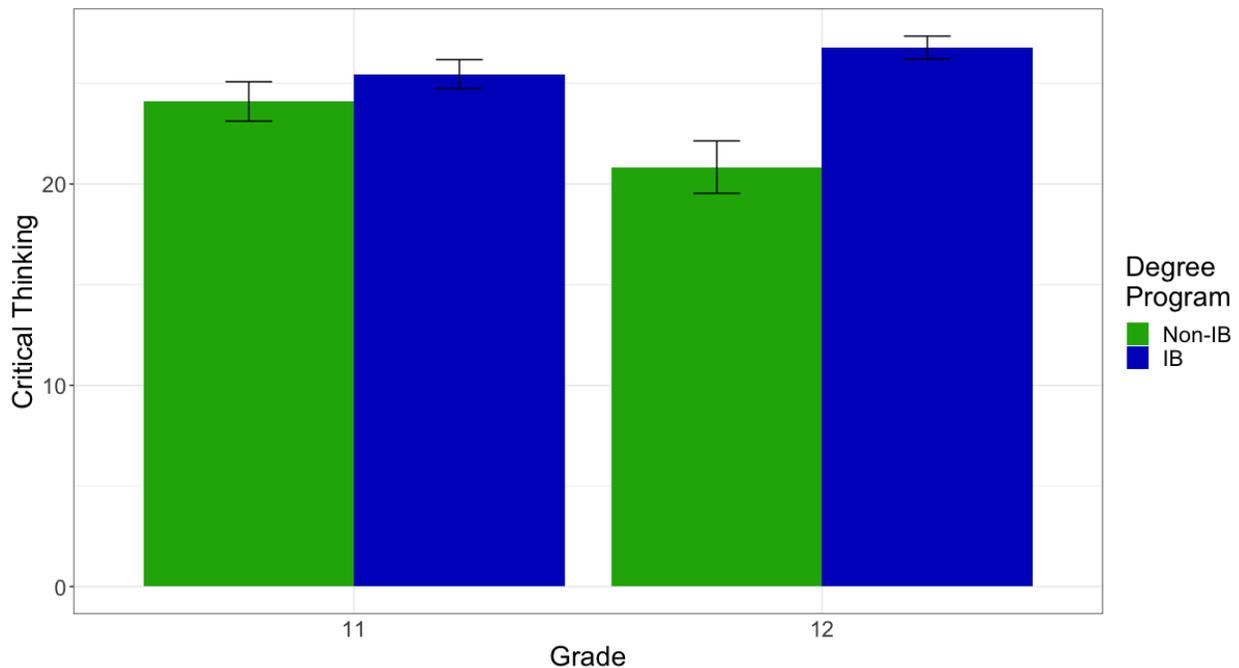


Figure 3. Critical thinking as a function of grade and IB participation

4.2.7 Country -level Comparisons

Finally, we examined whether the differences between IB and non-IB students differed as a function of country. As no comparison could be made in England, we excluded English students from the analysis. A 2 (Country: Australia vs. Norway) X 2 (IB status: IB vs. non-IB) ANOVA was performed on the matched sample. The results again suggested that IB students ($M = 26.64$, $SD = 6.82$) performed significantly better than non-IB students on the critical thinking test ($M = 22.51$, $SD = 8.79$), $F(1,342) = 26.79$, $p < .001$ in each country. However, critical thinking was significantly higher in the Australian sample ($M = 26.88$, $SD = 7.05$) compared to the Norwegian sample ($M = 22.18$, $SD = 8.17$), $F(1,342) = 34.33$, $p < .001$. Importantly, as shown in Figure 4, the Country by IB status interaction was not significant, such that the

difference in critical thinking between IB and non-IB students did not differ across countries, $F(1,342) = 1.39, p = 0.24$.

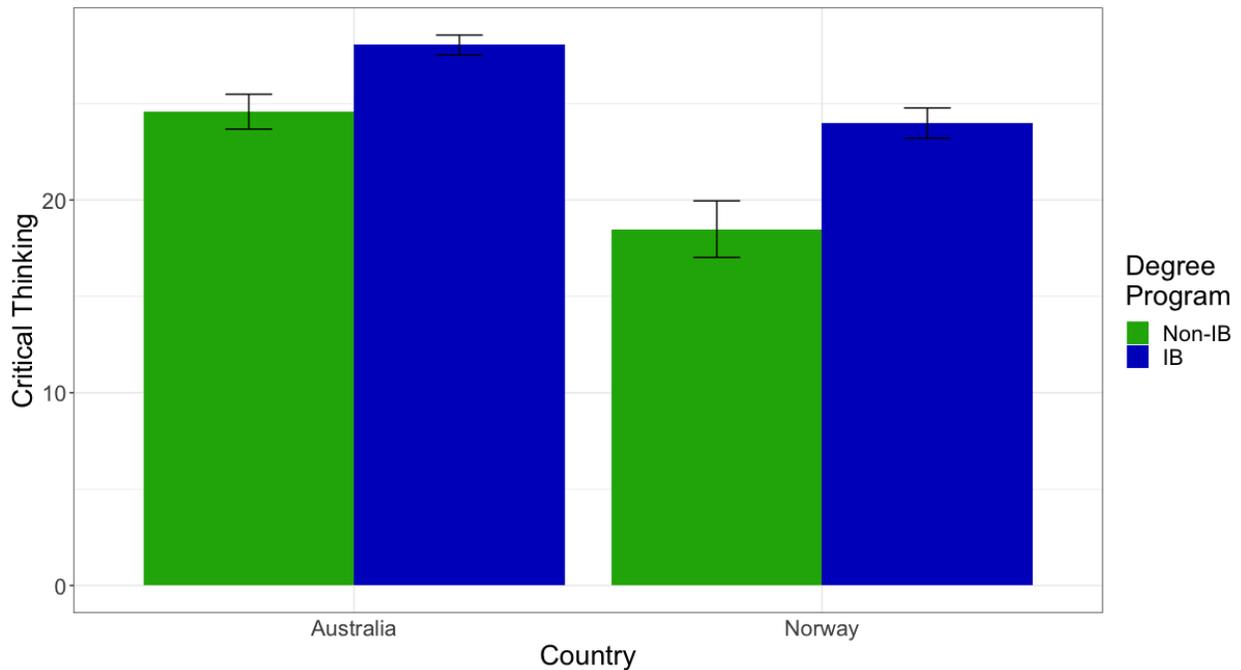


Figure 4. Critical thinking as a function of country and IB participation

4.3 Summary of findings

The findings of the quantitative study suggest that IB students have significantly higher levels of critical thinking than their non-IB peers. This advantage held even after several relevant covariates were controlled for using propensity score matching and regression analysis approaches. Importantly, analysis also suggested that the critical thinking advantage displayed by IB students increased over the course of the Diploma Programme. The findings were consistent across both Australian and Norwegian schools. While the findings were based on correlational data, the fact that the effect was both robust to covariates and was more pronounced in students at a later stage of the DP provides promising evidence that the IB participation may benefit critical thinking as measured by the Cornell Critical Thinking Test.

5. Qualitative Analysis of Students’ and Teachers’ Experiences of Critical Thinking

5.1 Methodology

This section focuses on the semi-structured interviews carried out with students and teachers in participating IB schools to explore more in-depth their understanding and interpretation of teaching, learning and assessment of critical thinking in the IB schools. We decided to have two windows for conducting interviews through the year (August/September 2019 in Australia and February/March 2020 in England and Norway), since Australian students ended their school year in mid-December and students in England and Norway ended their school year in June and July. Due to the COVID19 outbreak, semi-structured interviews were not conducted in Norway. The semi-structured interview protocols were developed based upon the literature review and document analysis in Phase 1. Semi-structured interviews were chosen as the methodology, as they allow the researcher to ask follow-up questions and explore topics that are brought up in the conversation (Kvale & Brinkmann, 2015). We further followed recommendations from Kvale (1996) when framing the questions for *introduction to the interview, follow up, probing, and specifying*. Interview schedules were also created to explore the main themes of the project and the document analysis, and the thematic coding guide for the analysis of the interviews (see Appendix 1 and 2) was based on the main themes in the document analysis: *teaching and instruction; assessment and evaluation; and management, policy and teacher development* (see Table 2, Section 3).

5.1.1 Piloting the instruments

Interview schedules were developed by the OUCEA team and piloted with a former IB student who had completed the Diploma Programme and an IB teacher in Oxford who teaches the Diploma Programme. This teacher was also asked to provide feedback on the students’ interview schedule. Based on the feedback from both participants in the pilot, the interview schedules were amended to include clearer questions that better addressed the research questions. For instance, the first question of the student interview schedule was too broad in the pre-pilot version: “How do you find the Theory of Knowledge course? Can you elaborate?”. Based on the pilot feedback, the question was modified to a more targeted question in the post-pilot version: “What skills have you developed through the Theory of Knowledge?”.

The teachers’ interview schedule underwent more significant changes based on the advice provided by the IB teacher. Two separate interview schedules were created; one tailored to interview subject teachers and the other adapted to interview the Diploma Programme Coordinator and the Theory of Knowledge teacher. Interview schedules probed teachers about their perceptions of the Diploma Programme, the Theory of Knowledge course and the Extended Essay in relation to enhancing students’ critical thinking. Teachers were asked to describe how they taught and assessed critical thinking within their courses and whether they collaborated with other subject or Theory of Knowledge teachers when planning lessons. Teachers were also asked whether they needed additional support (e.g., professional development, resources, time, etc.) to better foster critical thinking in their instruction.

5.1.2 Participants

To ensure we secured enough participating schools, students and teachers, we designed interview protocols that would not last longer than 30 minutes, although some teachers and students made themselves available for longer interviews when we visited schools. All interviews were conducted within the schools opening times and in classrooms and school libraries organised by the teachers. A total of 6 semi-structured group interviews were conducted in Australia and England, 3 interviews with teachers and 3 interviews with students from year 11 and year 12 (see Table 8).

Students and teachers were given an information sheet before the interviews and provided written consent for audio recording and transcription of the interviews. The interviews followed semi-structured interview guidelines where researchers prompted teachers and students to clarify their responses further or come up with examples or descriptions to better understand the teachers' and students' perspectives. All interviews were audio recorded and later transcribed using the software Trint, which is compliant with data protection laws including the General Data Protection Regulation (GDPR) and edited by a research assistant before the analysis was carried out by the research team.

Table 8. Overview of participants in interviews by country and schools

School	Country	Students interviewed	Duration (mins)	Teachers interviewed	Duration (mins)
1	Australia	6	23:55	4	47:27
2	Australia	9	21:44	0	N/A
3	England	3	30:48	3 & 2	26:50 & 41:19

In Australia, we conducted one group interview with four Diploma Programme subject teachers, a philosophy teacher, a history teacher, a biology teacher and a music teacher, in one of the two participating schools. The interview was just under 48 minutes long. In England, we carried out two group interviews with teachers. In the first one, we interviewed three Diploma Programme subject teachers (two female and one male) who taught a range of Diploma Programme subjects: anthropology and English; business management and economics; environment systems and society. The interview lasted nearly 27 minutes. In the second group interview, we interviewed the Diploma Programme coordinator and the Theory of Knowledge teacher (one male, one female) for over 41 minutes. In this school, the Diploma Programme coordinator also taught Theory of Knowledge as well as English. However, the interview only probed her as a Diploma Programme coordinator and a Theory of Knowledge teacher rather than a subject teacher.

In Australia, a total of fifteen students were interviewed in two participating schools. The first interview involved 6 students of mixed genders and lasted for around 24 minutes, while the second interview included 9 students, all male, as this was a single-sex school, and lasted just under 22 minutes. In England, three second year Diploma Programme students participated in the interview: one female and two males, the interview here lasted for half an hour.

5.1.3 Procedure

A research team member coded two interview transcripts before sharing the coding details with a second researcher who then coded the same interviews to check for consistency before coding the final interviews. Interviews were coded using a colour system, where statements addressing the different themes were coded in different colours: 1) Teaching and instruction, 2) Assessment and evaluation 3) Outcomes and values, and 4) Management, policy and teacher development (see interview coding guide, appendix 5). The first researcher analysed and categorised the interviews to address the second research question based on the emerging themes and key findings for both the teachers' and students' interviews. In the following section, we present the emerging themes with examples from the interviews. We report on students' experiences of the Diploma Programme and their perceived development of critical thinking throughout the programme. We also outline teachers' experiences teaching critical thinking within a variety of courses, including the Theory of Knowledge course and the Extended Essay, and report on any training need they expressed vis-à-vis promoting critical thinking skills in their classrooms.

In presenting the data we collected from students and teachers, we present students' and teachers' reported experiences of the Diploma Programme through the five themes identified in the Phase 1 literature review and document analysis. This helped in drawing a more coherent narrative reflecting students' and teachers' views of the teaching and assessment of critical thinking in the Diploma Programme and the perceived role of the Theory of Knowledge and the Extended Essay in students' development of critical thinking. Moreover, we report students' and teachers' views of the quality and extent of support they received in relation to developing critical thinking throughout the programme.

5.2 Results: Key Findings and emerging themes from students' perspective

In the following, we first present results from the students' perspectives as revealed through the interview analysis. As part of this, we discuss the emerging themes in relation to previous research, literature, document analysis and the quantitative results in the discussion chapter.

5.2.1 Teaching and instruction of critical thinking

Students were asked to explain critical thinking and how it was taught in Theory of Knowledge course and Extended Essay. They were also asked to elaborate on the link to critical thinking:

First, I think Theory of Knowledge develops your critical thinking skills because ... I think it makes you really be aware of how knowledge and its acquisition and production is significant to our everyday lives. And it makes you think about how there's also always two sides or more to things and how we can look at them from different perspectives and gain a greater understanding and a critical understanding of the significance of knowledge and acquisition (Student, Australia).

Students further explained that they believed the whole idea of the Theory of Knowledge course was to challenge their thinking and specifically the way they understood and accepted knowledge. They were constantly reminded by their teachers to a look at multiple perspectives and different points of views as they were challenged to think outside the box. In addition, students emphasised how the Theory of Knowledge course made them aware that knowledge was not static and that it constantly evolved. Thus, although they expressed they felt they could trust knowledge learned in school, at the time, they were

aware of its potential to evolve and change. One student referred to how scientific theories and assumptions are constantly re-examined and amended to make way for new insights and knowledge.

Students in Australia reflected upon the teaching and instruction in the IB schools by comparing it to other schools where other programmes such as the national (State) secondary programme is taught. Using examples from mathematics, in one group, a student explained how they have attended a non-IB school in earlier years and found that a lot of their past papers in the mathematic subjects contained questions where the large majority were of a relatively narrow type, for example, *factorise this ... differentiate this ... solve this equation*. Whereas in the IB schools, they found papers and exam questions to be more focussed on *applying* their knowledge. Students suggested that they believed IB courses are intended to assess more than just their rote learning in a subject.

Students in Australia expressed a very positive attitude to the teaching and learning in IB schools by drawing comparisons with their experiences in non-IB schools in relation to how the use of assessment criteria was preferable:

It's been probably like one of our greatest periods of learning like ... in all six years of schooling... and it's just like just interesting to talk to teachers because they say like ... whether it's for good or not ... and eighteen out of twenty in the HSC it's an eighteen out of twenty. In the IB it's like criteria and stuff that you have to get. It's just about learning to be an IB student as well. And maybe that's just the abilities like of learning how to learn (Student, Australia).

Students in both England and Australia discussed how they perceived themselves as IB students also in relation to critical thinking. One student from Australia expressed it as follows:

I think in terms of obviously... I think ...the IB cohort for our year and for the most part at our school is usually a bit more predisposed to more critical thinking than the HSC programme, I think... In terms of the students who select it...I don't mean to generalise as obviously there is critical thinking in other programmes [...] there is probably a greater predisposition towards more critical thinking in the IB programme (Student, Australia).

Students in IB schools in Australia believed it was a 'skewed pool of applicants for IB', and suggested IB students had come through 'A-stream' classes, with a lot of what they called 'smart kids'.

In England, students highlighted the importance of participating in many debates and 'playing the devil's advocate' to support the development of critical thinking skills in the Theory of Knowledge course and other subjects. Students reported finding debates valuable and enjoying taking part in them.

We did a lot of debating. You have really heavy critical thinking; I think we really did something like playing the devil's advocate and then we would have to do that. We did that heavily (Student, England).

Like looking at all these things from different perspectives, like seeing if your perception affects other things in your life [...] we even have that like outside of Theory of Knowledge ... philosophical debates ... and it's like it's ... it's interesting to kind of like more time you play ... you play devil's advocate and you kind of like even though it's not your opinion, you still have to work around it and just argue for the sake of having a counterpoint. Yeah, I love it. I think it's really cool (Student, England).

All three students believed that the Theory of Knowledge course challenged their thinking. One student provided a specific example about how she interpreted a Theory of Knowledge question

differently than her peer and related the difference in interpretation to the variation in 'personal circumstances, like the books we read in the literature that made us think differently'.

Another student thought that the critical thinking skills he had gained from the Theory of Knowledge helped him to better analyse sources and understand other perspectives of 'what actually is' in history, which he took as a higher-level subject. He also thought the course helped him formulate the points of an argument in writing, which he recognised as being different from orally developing an argument in a debate.

Yeah, it definitely challenged me. And kind of in all honesty, it actually helps significantly with kind of source analysis for history as well, because it basically gave me a completely new avenue to truly analyse the problem, the problem at source, kind of saying how this person would have seen it as opposed to how it actually was (Student, England).

A lot of arguments and debating side of that we did in Theory of Knowledge, definitely helped me formulate the points of an argument. How you're, like writing it down, it was just completely different (Student, England).

Similarly, students found what they learned in the Theory of Knowledge allowed them to address complex multifaceted questions in Business and English.

I think that Theory of Knowledge is sort of like ... it's hard to put value into something that's intangible like a service. It's all about what's in your mind, your perception, but then that's very hard for a business because they can't just tailor their price, for example, to certain people. So it's [the Theory of Knowledge] taught us to think of the wider picture (Student, England).

I think English is [...] like... oh, what the writer wrote, you have to look at his perceptions like where exactly like this time period there's a contextual stuff goes into it. And then also like kind of trying to decipher what he means or what the writer means when they're saying stuff. So, it's like is it considered ethical implications? Is it like feminist or not feminist? Try to get a complete picture, which is really hard to do (Student, England).

Students however found that the Theory of Knowledge was more useful for humanities subjects such as English and history than it was for sciences and mathematics where knowledge was, according to them, more 'black and white' and where there is less room for multiple acceptable perspectives.

In my humanities subjects like business and English. (...) Theory of Knowledge is really useful because it is like you have to evaluate whether this point is worth it or not, because you can't in most subjects say you can't write a point that you're half sure on. But I would... like the sciences, I don't think as much because ... like the way we get marked it's if we write a wrong answer and the right answer in the box, you still get the point for writing the right answer (Student, England).

Students were asked whether they felt that they could transfer skills they acquired in the Theory of Knowledge to the Extended Essay. They reported being able to do so to a certain extent, for instance when they needed to consider the implications of multiple factors, when they needed to write the reflection on their Extended Essay, or when they needed to formulate a plot.

Yeah, I guess I think the Theory [of Knowledge] kind of finds its way into every Extended Essay. You kind of have to consider like lots of different factors, like consider why or why you're saying what you're saying essentially (Student, England).

It [Theory of Knowledge] really helped me turn that around and times when I was frustrated... frustrated in my Extended Essay in the reflection part [...] I actually did learn something from it (Student, England).

Yeah, to a degree the Theory of Knowledge as a whole and kind of the 'Theory of Knowledge way of thinking' almost really did help in history and possibly just cause the area that I was working in was more conditional history as opposed to hard evidence history. It kind of helped me almost formulate a plot throughout it and really I, at least I think, I stuck to it (Student, England).

Students were asked to provide feedback on their experience of supervision of the Extended Essay and the extent to which they felt that their supervisor was helpful in promoting their critical thinking skills. While all three students thought their supervisors were supportive, each one had their own distinct supervision experience. The Diploma Programme requires students to be proactive, take initiative and seek the supervisor's help. One student seemed to have struggled with being proactive enough and, on reflection during the interview, he explained he wished he took more advantage of the supervisor's support, as he believed that seeking help and taking initiatives was very important preparation for the future be it at university or in the real world. He particularly appreciated when his supervisor pushed him to extend his research in business management beyond what had been covered in the course.

... my supervisor [...] was really helpful, like providing these not questions but like stuff that's beyond the topic, beyond business. So I think that's a big part of Extended Essay as well, so not focussing just on the... like what you're taught in Diploma Programme, but kind of going above and beyond (Student, England).

Another student found that his supervisor was helpful especially in the writing process rather than in critical thinking where the supervisor had less input. In hindsight, the student wished he had worked more with the supervisor and sought his input when developing a plan, as this may have led to more avenues for critical thinking.

And the critical thinking part, I found the supervisor did help, but it was more helping writing it as opposed to actually developing the idea or critical thinking, cause the way that I at least went around it was I kind of formulated an idea and formulated a plan and then asked them about it as opposed to formulating the plan with them. So but yeah, if it was to redo it, I probably would formulate a plan with them for increase amounts of critical thinking before just kind of to further analyse everything (Student, England).

A third student described a rockier supervision experience. She found that her supervisor was 'good', however, she did not have the subject expertise that could best support her project. This made her seek the help of another science teacher who would have been a more appropriate supervisor for her project if he had not already been supervising several other students. She acknowledged, however, that she was not proactive enough and that sometimes her supervisor had to chase her for submitting some work, which in turn made her reluctant to ask for help when she needed it. The student admitted she could have worked better on her relationship with her supervisor, but she expressed having been frustrated by the lack of support she received, which could have had serious implications on the quality of her Extended Essay.

I did think I would have done a bit better if I got a bit more support because with some of the questions I was really confused, like the science behind my Extended Essay. [...] I just had to go to someone else inevitably and figure out for myself which maybe that is part of the Extended Essay (Student, England).

5.2.2 Outcomes and values

Students in England believed that their choice to enrol in the Diploma Programme instead of the A Level programme meant they were choosing the “harder route”, as they had to do more subjects (6 instead of only 3) and demonstrate high levels of critical thinking and research skills that their A Level peers did not need to worry about. However, they expressed having enjoyed the journey. For example, one student in England described his rewarding journey: *“I liked it...[the] Diploma Programme was fun!”*. Another student thought that “the benefits [they were] gonna reap” from completing the Diploma Programme were much higher compared to the benefits they would have received from A Levels. She felt that by the end of the Diploma Programme, she had experienced a significant intellectual growth: *“I feel like my mind is bigger! I have more space to think about things”*. Students reported also gaining skills in specific subjects, some of which they could identify like writing and thinking academically.

Obviously, the main thing that I got from, from the IB as a whole is just writing. And it's a completely different way of writing to the GCSE that just I don't feel you ever get it from something like A-levels (Student, England).

I don't think I could name for you the skills I've gotten from English. I don't like English, but I know I've got skills from them and they just come naturally when I'm writing and things [...] My general way of thinking like academically is definitely been like risen (Student, England).

One additional point students highlighted at the end of the interview was that they believed that the Diploma Programme prepared them very well for university and life. Specifically, they believed they could handle high work pressure and cope with multiple deadlines.

5.2.3 Assessment of critical thinking

When asked about the extent to which students found that the Theory of Knowledge course supported them in other subjects, students reported that the course improved the way they would address essay questions in other subjects. One student gave the specific example of how he used what he had learned in the Theory of Knowledge course in an internal assessment of biology on ethical impacts of an experiment. The Theory of Knowledge allowed him “to have a wider, broader thinking” and address questions such as, “how could this affect other people and the environment”.

It's like even when I'm writing like long answer questions to like any subject I'm doing with like I don't know, I think it's because TOK made me [...] It's kind of like you're questioning what you write to make sure that it's you can actually verify it (Student, England).

Students were asked to discuss whether they found the structure of the Theory of Knowledge course prepared them well for the Theory of Knowledge written and oral examinations they were supposed to sit in the following months. One student explained that the debates were very helpful to deliver a coherent presentation. However, she said that the essay was more challenging for her when trying to write a coherent and structured text that developed a strong argument and reflected a position. She felt that discussing the importance of structure and making a clear argument further in class would have been very helpful.

I think if we're talking Theory of Knowledge assessments solely, I think in terms of the presentation, [it] was really useful because we did so much debating and the whole point ... and it's so easy in a

presentation to like get that sort of debate to come across coherently. But I think that in the essay I struggled a bit (Student, England).

One of the features that students found unhelpful in the assessment of Theory of Knowledge or Extended Essay was the ambiguity of the assessment rubrics. The students found the marking subjective and did not understand how they were graded despite being provided with model essays. The students suggested that the rubrics, and specifically, the rubric of the Extended Essay, would be more helpful if they were subject-specific without making them too prescriptive. They also thought that a checklist like the ones provided for the internal assessments would be useful. It was however unclear whether the comments they made about rubrics were general or specific to critical thinking criteria in the Theory of Knowledge and Extended Essay.

Students were asked whether they found the feedback they received on their essays was helpful for promoting critical thinking skills. Students did not all share the same experience. One student thought that the feedback she received from her supervisor on her Extended Essay was “really vague” and could have been “harsher”. She did not find that the feedback she received helped her improve her research or essay. Another student thought that the feedback he received was very helpful and pushed him beyond the specification. It was unfortunately not clear whether the student was referring to critical thinking or content knowledge when referring to his supervisor’s motivating feedback.

Students in Australia, suggested assessments in IB schools emphasised the need for developing a full understanding of the topics, and unlike their experience from previous non-IB school exams, they believed that simply memorising information in preparation for their assessments would not be sufficient:

And also the emphasis on skills development rather than rote learning ... like in the end in the HSC you can prepare for your exam... you can memorize a whole essay and probably do quite well... however in the IB ... it's much more focused on actually deeply understanding the concepts ... (Student, Australia).

From the students’ perspective, the assessments in IB schools were perceived as being integrated into the learning process. They even related understanding the assessment criteria with ‘learning to be an IB student’:

In the IB it’s like criteria and stuff that you have to get ... It's just about learning to be an IB student as well. And maybe that’s just the abilities like of learning how to learn (Student, Australia).

Both students in Australia and England claimed the assessment and learning process differed considerably in IB schools from non-IB schools with respect to being able to apply what you learn, and not only trusting that you could cram for the exam. We will revisit this point in our discussion.

5.2.4 Summary of findings

Students in both Australia and England believe the IB better prepares them for future studies than other school systems and suggested the teaching of critical thinking made them better learners, with deeper understanding and knowledge of the different subjects. Furthermore, students found critical thinking to be better suited for subjects such as history and English than Science and Mathematics. Although students spoke in favour of the Theory of Knowledge course with respect to development of critical thinking, they were more critical concerning how it is assessed, specifically in relation to the use of what they perceived to be ambiguous rubrics.

5.3 Results: Key Findings and emerging themes from teachers' perspective

In keeping with the same format adopted in the previous section, we present below the key findings based on the teacher interviews we carried out in Australia and England under the four main themes: (1) Teaching and instruction; (2) Outcomes and values; (3) Assessment and evaluation; and (4) management, policy and teacher development. We further summarise emerging themes for the discussion chapter based on the data collected from teacher interviews.

5.3.1 Teaching and instruction challenges students' thinking

All teachers interviewed in Australia and England, be they subject teachers or Theory of Knowledge teachers, agreed that the Diploma Programme challenged students' thinking. When asked about the specific critical thinking skills that students developed in the various Diploma Programme courses, a biology teacher in Australia reported that she in her teaching included a focus on supporting students' ability to identify "messy situations" as well as their ability to extract and analyse key principles underlying them. Subject teachers in England explained how the Diploma Programme required students to evaluate sources and possible biases within them and examine how they could compare different theories and use them to understand different social and economic phenomena. For instance, an English and anthropology teacher explained how students taking English needed to evaluate texts in terms of the context in which they were written and identify potential biases, while in anthropology they needed to evaluate different theories such as Marxism and Postmodernism and examine how these theories could explain some socioeconomic dynamics observed in the world. Similarly, a business management and economics teacher explained how in his subjects, students were required to compare different theories such as classical free market economics and Keynesian government intervention with business management emphasizing morals and ethics in addition to profit making and examine how these theories can shed light on global issues.

I think the material, like the syllabus for all the subjects requires you to include critical thinking. You can't do well let alone very well without critical thinking (English and anthropology teacher, England).

I think it's very, very curriculum driven. [...] The curriculum we're teaching them, the subject contents we're teaching them, is very much designed to encourage group critical thinking (Business management and economics teacher, England).

Teachers in Australia and England expressed a very favourable view of the Diploma Programme and how they believed it enabled students' growth, especially in terms of critical thinking skills.

I do think the IB does it well. Like students really when they grow confident with it they enjoy doing it. [...] So, I do think it's really worthwhile (English and anthropology teacher, England).

I feel like our students end up maybe more rounded than other students would, just because we, we kind of facilitate both sides and thinking about things from different perspectives and then coming up with their own validated conclusions. And I think that's a very valuable part of the course (Environment systems and society teacher, England).

The Diploma Programme coordinator in England highlighted the role of the Theory of Knowledge in promoting students' critical thinking by encouraging active thinking, questioning of knowledge and

awareness of the diversity of methodologies and perspectives available across different disciplines. This view of the value of the Theory of Knowledge course in students' development of critical thinking was also shared by subject teachers in Australia.

I see a similar thing in Theory of Knowledge, is the idea of shifting from being pretty passive recipients of knowledge and this kind of that the teacher is an unquestioned source of authority, that the material that they're presented with is an unquestioned source of authority and really being forced to think about that... how knowledge is constructed that each discipline has its own methodology that is built on certain assumptions about what is valuable knowledge and what's not (Diploma Programme coordinator, England).

I think it's important it garners in them an understanding of the methodology of subjects and how methodologies can have different varying levels of credibility or validity. And therefore, that prompts them to begin to reflect on the quality of evidence that they're presented with an argument rather than just accepting evidence or arguments on face value. They reflect and investigate further what evidence is being provided to support that. And then how has that evidence been derived and how does that influence how the quality of that evidence (Teacher, Australia).

Teachers in England and Australia reported on how they have witnessed evidence of students' development of critical thinking throughout the Theory of Knowledge course. For example, the history teacher in Australia described how she could see her students developing a critical perspective, such as when students were working on their extended essay and included a section where they questioned the historical method, its limitations, and also the limitations of sources. The Diploma Programme coordinator in England reported a similar experience with her year 12 students.

I certainly see, for example, with my year 12 of this year at Theory of Knowledge that they're starting to kind of question things much more and I think a little bit more critically about where they're getting knowledge from and [...] the fact that they're starting to doubt more things (Diploma Programme coordinator, England).

While teachers in England and Australia would suggest they had evidence of growth in critical thinking skills throughout the Theory of Knowledge course, teachers in Australia acknowledged it was hard to judge whether it was the Theory of Knowledge that enhanced the critical thinking in students. Teachers in Australia pointed to the different approach to teaching and learning adopted in IB compared with other curricula. For instance, teachers in Australia reported that their students had been taught content from one perspective before coming to IB schools, but after being through the IB instruction and the Theory of Knowledge course, they would be taught to think from different perspectives, and would realise, for example, that scientists did not always agree in their understanding of certain matters.

All interviewed teachers in Australia and England acted as Extended Essay supervisors for Diploma Programme students and therefore were also able to reflect on how and whether the Extended Essay promoted students' critical thinking. Teachers in Australia expressed how they would have valued having had the chance to write an Extended Essay when they were in high school, as it shifted students' away from a 'high school mentality' and moved them "from being a consumer to a producer" of knowledge.

...the first time they're ever realised that they are actually producing novel perspective ... I had a student this year and she compared two graphic novels. And she was saying where can I find information about it, and I was saying, well I don't think you can because you're the first person who did with this particular

research question and she got quite high on it and it got into the project. So, you know, get back to what was said, the idea that they are producers of knowledge, researchers, and that they don't have to necessarily get a received opinion you know they can create something new (Teacher, Australia).

The biology teacher in Australia supported this view by highlighting how the Extended Essay provided students with skills they could apply in every subject, such as knowledge production, describing concepts from different perspectives, and evaluating different opinions. The teacher really appreciated how the Extended Essay helped students understand the complexity of issues that appear to be simple at first glance. Indeed, the teachers wished they could have the IB students another year, as they saw how much students had gained from the IB programme in year 12.

Teachers in England highlighted the Extended Essay's emphasis on research skills and the importance for students to demonstrate critical thinking in their choice of methodology, i.e., in terms of choice of sources, methods, analysis and argument being developed. Moreover, the Theory of Knowledge teacher and the Diploma Programme coordinator believed that the supervision process and the feedback that they provided to their supervisees supported students' development of critical thinking to a certain degree. They explained how the process of supervision encouraged students to be more critical when developing an extended argument but that some students required more guidance than others. They viewed students' critical thinking growth as a life-long process and thought that one of the aims of the Extended Essay was to initiate the process and prepare students for university, an advantage that they would potentially have over many non-IB students.

I definitely think they have a really big head start over the non-IB students. [...]in terms of how they're going to be able to grapple with those problems once they get to uni, I think that once they get there is actually those really messy problems, once they get to uni [...] they've got a huge advantage over the non-IB students (Biology teacher, Australia).

There is just different degrees of how practised they are in their critical thinking. I think throughout the process of having these short meetings with their supervisor and then applying that by themselves for this extended argument, I think, yes, by the end they will all demonstrated a degree of critical thinking (Theory of Knowledge teacher, England).

I'm not expecting them to sort of walk out of here being fully accomplished, critical thinkers, because why on earth should they need to go to university. So also, I think it's a question of degrees. [...] they've all moved along ... further along that process. [...] what I do think is a really great advantage for them is that they've all been sort of walked through an extended essay process, which I think a lot of students don't get when they enter into undergraduate studies Diploma Programme coordinator, England).

During the interviews, teachers in Australia and England described their approaches to teaching critical thinking in their subjects and the Theory of Knowledge course. They reported using a variety of teaching strategies including making critical thinking an explicit objective of their lessons, using questioning debates and techniques, using reflecting writing, building links across subjects, and planning lessons with colleagues to better promote critical thinking in the Diploma Programme.

The Theory of Knowledge teacher in England explained that the emphasis on critical thinking should be made explicit to students. For instance, he made sure his students understood that the main aim of the IB schooling and the Theory of Knowledge course specifically was "for them to become critical thinkers and that it is their moral duty to teach students to do that and it is students moral duty to become

critical thinkers.” Similarly, teachers in Australia expressed that one of the outcomes of their teaching would be that their students would be able to question knowledge, and question authority in general.

The Theory of Knowledge teacher and the Diploma Programme coordinator in England stressed the key role that the teacher plays in promoting critical thinking skills in their subjects by adopting an effective instructional approach.

... not only does the course [Theory of Knowledge] promote critical thinking in a really excellent way, but it only does so if the teacher emphasises it as an objective (Theory of Knowledge teacher, England).

And unless the school and the people creating the curriculum are very thoughtful and deliberate, I think it can be a bit of a challenge to kind of create a really coherent course that, that, that really builds towards I'd say transferable, critical thinking that the kids will take with them (Diploma Programme coordinator, England).

In addition to deliberately planning activities that would enhance students' critical thinking, teachers like the environment systems and society teacher in England reported that there were instances where she would take advantage of some unplanned discussions and build on students' ideas to challenge the students' critical thinking.

I think I both plan trying to bring in critical thinking, but also in the spur of the moment, you know, you can easily adapt (Environment systems and society teacher, England).

All teachers interviewed in England and Australia reported using debates to promote critical thinking during discussions in their subjects. Teachers described how they facilitated dialogue in the classroom, convened debates, and found discussions to be of high importance for developing students' critical thinking skills, knowledge and deep understanding. It was also evident that teachers included different forms of formative assessment processes, such as giving feedback to students, to stimulate students' thinking.

... giving feedback to prompt their thinking. You have to use feedback as a teaching tool, not just as a way to get them where you want to go and so keep on teaching the course, you're in there with their ideas. And so if you don't use it as an opportunity to actually help to think and to make the connections, then they won't know how to do it, and you can't just give them false feedback. So I like to give them questions as feedback and say, well, what about this? (Teacher, Australia).

Teachers explained how they used critical questions as part of the feedback and challenged the students to provide examples to encourage them to think more critically about their own thinking. The teachers acknowledged it was challenging to gradually scaffold students to be able to think in an abstract way. One way in which teachers in Australia supported students' abstract thinking was to encourage students to listen to podcasts regularly. This strategy exposed students to different ideas and teachers found that students who listened to podcasts regularly also tended to do better in the IB. Teachers reported on how some of them were inspired by some of the podcasted topics and followed up on them by reading more widely about those topics. This teaching approach was described by one of the teachers as “lighting up a fire” when referring to the example of a student, who was a figure skater, studying Kant and Hume, as she wanted to better understand the criteria of beauty and aesthetic quality in her skating.

In addition to employing questioning techniques and organizing debates, teachers in England and Australia reported using writing, and specifically 'reflective writing', as a main strategy to support students' development of critical thinking. They supported students in their ability to draw common themes and examine counterarguments.

Like being able to extract the common theme of a real situation or being able to conclude from some different premises or being able to explore counterarguments to something so that there are certain skills we focus on we put them into a play. The emphasis now on the more reflective writing [...] (Teacher, Australia).

Teachers clarified the point by suggesting they taught students how to write from their own perspective about complex, but also simple ideas, emphasizing that the writing had to make sense not only to themselves, but also to their readers.

Teachers discussed how they encouraged their students to make connections across different parts of the curriculum, be it within a given Diploma Programme subject or across subjects. The music teacher in Australia gave the example of one of the students "who did an essay on [...] the music of Gershwin, and he went off and found out that Gershwin had a teacher who had studied with Schoenberg, and so he thought there might be some connections between some of Schoenberg's techniques". Similarly, the biology teacher in Australia explained that he tried to bring in elements from Theory of Knowledge when teaching biology. The Theory of Knowledge teacher in England also described how he created links between the Theory of Knowledge and other subjects and how he encouraged students to collaborate with peers so that the Theory of Knowledge course supported a deeper and more critical understanding of the other IB subjects, especially those taken at high level.

Teachers in Australia explained how they sometimes taught the whole student cohort together as a team. They described how they planned lessons together and developed workshops. They found working with a colleague with a different subject background rewarding. As one teacher put it, "We've got different headsets, my science head has been widened from being a historian and an artist". They also shared experiences of teacher development that they found had been gratifying, as they had attended talks with guest speakers where specialists spoke about different areas in the arts, such as film, the visual arts, music and painting.

Teachers in Australia also described a system they adopted where they discussed extended essays, identified common weaknesses across the essays and used these experiences in their future teaching. These teachers used lessons learned from year 12 to improve the teaching of year 11. More specifically, teachers described how they conducted in-depth analysis of the essays and classroom presentations, went through students' results and ended up with recommendations they put into their practice to improve future teaching. They did not specify whether the recommendations included suggestions for promoting critical thinking.

Overall, teachers from both England and Australia suggested that their teaching and instruction supported the development of critical thinking of their students. Teachers linked their feedback practices with questioning as a way of pushing students' critical thinking further. In this respect, students' approaches to learning and formative assessment seem to be an integrated part of teachers' instruction. Teachers also expressed strong views that IB schools and the IB programme offered a different view of critical thinking compared to other education systems. They saw the IB programme as offering a curriculum where critical thinking was taught as an integrated part across all subjects. They

also believed that the IB allowed them to observe and focus on the growth of their students, which they claimed was “absolutely fantastic”.

[...] the great thing about the IB is that it's got all the big picture stuff about critical thinking and ideas, but does not at all, sacrifice any of the little bits. And so there's this understanding that critical thinking is built on the little bits and you actually need to have foundation discipline knowledge to make connections. Whereas SACE [South Australian Certificate of Education] is all about starting to make connections before you even go in the discipline knowledge.... Right (Teacher, Australia).

it's very rewarding and that's something you don't ever wanna give up once you get into it... it's a lot of work and sometimes you feel like, you know, you're not getting anywhere. But I think we can all agree that every single student is better off having done the IB and core in particular (Teacher, Australia).

5.3.2 Outcomes and values in the Diploma Programme

When describing how teachers challenged students' thinking in their respective subjects, teachers often alluded to some attributes of the IB Learner Profile (IBO, 2015, pp. 8–10) underlying the IB's overarching aim – that of developing internationally minded people. We could identify three main attributes: *Inquirers*, *Knowledgeable* and *Thinkers*, reflecting the values from the IB programme.

Inquirers

During the interview, teachers in England mentioned various aspects of the Diploma Programme that related to the inquirers attribute. For instance, the business management and economics teacher thought that the Extended Essay improved students' research skills which served the IB's aim to develop students as inquirers. The English and anthropology teacher referred to the confidence students acquired during the programme and the subsequent joy they experienced alluding to the 'learning with enthusiasm' and 'love of learning'.

Knowledgeable

The attribute of being knowledgeable was also frequently implied in teachers' responses. Teachers often referred to how they linked their lessons to local and global perspectives and issues. For instance, the environment systems and society teacher highlighted the necessity of raising students' awareness of global perspectives and events happening around them: “I think mine need quite a lot of global perspectives and they need to be aware of what's going on in the environments around them”. Similarly, the business management and economics teacher referred to the importance of global perspectives and issues in his own subjects.

Economics again is from a global perspective, it's very much global issues. We have to get those students to be able to identify the difference between classical free market economics and Keynesian government intervention. So, it's politically even, it's from a right and left perspective (Business management and economics teacher, England).

Teachers provided specific examples of global and local issues they discussed with their students such as the USA imposing tariffs on Chinese goods, the sugar tax and Brexit in economics, the fires in Australia and the Amazon in the environment systems and society class.

Perhaps a good depiction of how IB frames the attribute of being knowledgeable was best articulated by the environment systems and society teacher when she said, “I feel like our students end up maybe more rounded than other students would”.

Thinkers

The attribute of thinkers was reflected in many of the subject teachers’ responses, which was to be expected given the emphasis of the interview on critical thinking. Teachers referred to how their instruction and assessment within their subjects offered opportunities for critical and analytical thinking about complex problems and ethical issues.

For anthropology they constantly have to question themselves in terms of what is normal, why are some things taboo in our culture and not in others and vice versa (English and anthropology teacher, England).

Business management has quite a strong emphasis on (...) morals and ethics as opposed to just profit (Business management and economics teacher, England).

It’s kind of both. I like to go off curriculum. It’s been a godsend for economics, isn’t it? With Donald Trump and tariffs and China and the USA. Things like sugar tax, Brexit... Everything... It’s been an absolute godsend. So we, you know, we sit and debate and so we always come back to the Keynesian perspective over Brexit that will be okay in the long run. We just don’t know what the long run will be (Business management and economics teacher, England).

There’s a wealth of stuff every day in the paper, on the news... Australian fires. It’s a lot of that kind of difficult bits, the fires in the Amazon, and then that leads to critical situations (Environment systems and society teacher, England).

... things like talking to them about, well, we spend millions of pounds trying to save the koalas when actually lots of people are trying to put off the fires, so do we actually just let the koalas go extinct, and put more of a ... resources to helping the people ... and so then that can shape debate, thinking about what’s more important (Environment systems and society teacher, England).

Thus, although the interviews were not designed to ask teachers directly about the way the Diploma Programme promoted the ten attributes of the Learner Profile (IBO, 2015), during the interviews, teachers referred implicitly to at least three attributes (‘inquirers’, ‘knowledgeable’ and ‘thinkers’) when discussing how the Diploma Programme in its various components fostered students’ critical thinking skills. These attributes relate to critical thinking as defined by Halpern (2001); i.e., a person’s ability to analyse, synthesize, and evaluate information, and serve the overarching aim of the IB education to develop internationally minded individuals capable of thinking about issues beyond their immediate context.

5.3.3 Assessment and Evaluation

Teachers in England and in Australia described their approaches to assessing critical thinking in their subjects. The Theory of Knowledge teacher in England explained that his approach relied mainly on carrying out practice runs of essays and presentations. Through classroom discussions, teachers could assess how well students expressed themselves, the extent to which they used terminology appropriately and how well they grasped the concepts. The Theory of Knowledge teacher admitted, however, that he was not confident that this always included an assessment of students’ critical thinking. Some of the criteria on which the teacher based his judgement when assessing critical thinking

related to how well students were able to come up with pertinent knowledge questions and address them.

I think the ... to having like these try-ons of these assessments is kind of where it really comes to the fore, they need to come up with their own knowledge question and respond to it and then reflect upon how pertinent that question was or how much sense that question made (Theory of Knowledge teacher, England).

The Theory of Knowledge teacher elaborated on this statement by explaining how addressing the knowledge question required high levels of critical thinking. He found that students' conclusion at the end of an essay or a presentation was very telling of the level of their critical thinking, as students are expected to end their essay with a nuanced conclusion and an explanation of the implications of such a conclusion. A teacher would normally be able to judge how many assumptions the student had and whether the student was aware of them or not.

While all teachers interviewed in England and Australia agreed that, overall, the Diploma Programme emphasised critical thinking, subject teachers in England suggested that this emphasis varied in the assessment across subjects, with different aspects underscored in different subjects. For instance, the business management and economics teacher distinguished between business management assessments, which highly emphasised critical thinking, and economics assessments, which focused more on factual knowledge.

Funnily enough Business Management is probably more conceptual and more inclined to allow critical thinking. It's more part of the assessment. [...] In economics you can get by purely on just factual (Business management and economics teacher, England).

Teachers discussed how they assessed critical thinking in the Extended Essay. Teachers in Australia claimed to be able to spot whether a student could form an argument from different perspectives. Teachers further suggested that it was easy to identify when an essay lacked argumentation. The subject teachers in England expressed the importance of students demonstrating their understanding of the assessment criteria, which they used as evidence of critical thinking in the Extended Essay. These criteria included being able to justify and/or critique a methodological approach, evaluating different sources, critically examining results, and evaluating different perspectives before reaching a given conclusion or taking a position.

I think they have to criticize like in terms of methodology ...such as... like ... the Theory of Knowledge they have to be critical where their information is coming from. Is it sufficient? And obviously, whatever argument they're making ... I think the stronger students will naturally be critical with their analysis, whereas, all the students have to be critical in terms of their methodology (English and anthropology teacher, England).

She was much more able to like to assess different sources and then also to critically examine her results (Environment systems and society teacher, England).

Particularly resources but also to considering other arguments and acknowledging that there is no one answer [...] there are also other options as well (English and anthropology teacher, England).

I guess a kind of balance of perspectives, showing that they're not just approaching it from one angle and that they're considering information from different directions, different perspectives, and how, and how

they all link together to produce like an overall consensus, a wider consensus that comes to you from different directions (Environment systems and society teacher, England).

Some of the teachers in Australia and England expressed their lack of understanding of the assessment criteria for the Extended Essay and related it to generic assessment criteria and vague expectations. The Theory of Knowledge teacher in England thought that it would be helpful to have a clearer idea of how 'academic' the essay was expected to be as teachers varied in their expectations of the quality of Extended Essays that Diploma Programme students were capable of. The lack of clarity around expectations was also shared by teachers in Australia who felt that the IB's expectations of the students for the Extended Essay were very high, and unrealistic for most students and only attainable by a few.

Moreover, teachers found interpreting the Extended Essay rubric difficult, especially because of its generic nature. This confusion led to many unpleasant surprises over the years with students being awarded grades that were very different from the ones the teacher had expected.

It (current rubric) can be really difficult to interpret because you think they fall into a certain box and then it comes back from the external examiner and it's very different. OK. And one year you might nail it. And then the next day you're way off (Environment systems and society teacher, England).

To address this challenge, teachers in England suggested having subject-specific rubrics for the Extended Essay. One of the teachers who had acted as an IB examiner in previous years implied that she was aware of the availability of more detailed mark schemes for Extended Essays. She suggested making this mark scheme available to teachers. Since critical thinking is supposed to be part of the Extended Essay and Knowledge of Theory essay, the lack of clarity around assessment criteria could be a challenge for both teachers and students. We will revisit this point in our discussion.

Teachers in England and Australia explained that they generally provided much feedback as part of the assessment process when students were writing their Extended Essays, and feedback would be in the form of both written and oral comments. Teachers in Australia emphasised the importance of having a conversation after the written feedback, as there were so many things students could misinterpret in the written feedback. They needed the "back and forward" conversation, as they referred to it, to also get into the complexities of the Theory of Knowledge. In England, the Theory of Knowledge teacher mentioned written feedback for essays while providing comments that encouraged them to be more critical about what they have written, such as "how is this a different perspective from the first one? What are the links that you've drawn here? How have you really rebutted the second perspective?". Students are required to rewrite sections of their essays as part of the school policy, a practice that the Theory of Knowledge teacher found "really, really powerful".

Another type of feedback the Theory of Knowledge teacher mentioned was oral feedback and peer assessment on presentations. Following Theory of Knowledge presentations, the teacher explained how they "went" through the different [...] slides together as a class and for "him" to ask the students, OK. Is this relevant? [...] Have they made that point well there? Is that an actually different perspective?" The Theory of Knowledge teacher added that this approach seemed to work well with students despite it being time consuming. The students find it 'motivational', as they realise that presentations are challenging for everyone. Moreover, the process promoted their critical thinking:

That (the process of peer assessment) really trains them to be a lot more critical about what they're saying and the assumptions that they're making and how much how they haven't thought through necessarily their ideas and their conclusions (Theory of Knowledge teacher, England).

The Diploma Programme coordinator identified that her feedback encouraged students to “shift from the passive to the sort of proactive, critical thinker” and centred on inciting students to explain logical links between a given piece of evidence and their conclusions, explain inferences clearly, appreciate implications, extrapolate from a statement or a claim and raise further questions.

I see it (critical thinking) in the degree to which students are really, are able to sort of think of new questions that are created or generated by a given problem. (Diploma Programme coordinator, England).

Teachers in Australia and England reported finding the assessment of the Theory of Knowledge course challenging. Despite his relatively long experience in teaching the course, the Theory of Knowledge teacher in England found that “assessing [the Theory of Knowledge course was] really tricky” because of its multiple components (e.g. writing an essay and oral presentation) and the ambiguity of a valid criterion to measure the level of critical thinking in the essays and presentations. Likewise, teachers in Australia expressed similar challenges. They found it hard to judge whether the final product was a student’s own original thinking and whether the higher quality that they perceived in classroom discussions throughout the course could be attributed specifically to critical thinking. As we have previously noted, students also found it challenging to understand the assessment criteria and expressed confusion around how they were assessed. We will return to this in our discussion of results.

Teachers in both Australia and England mostly focused on the assessment processes around feedback to students when working on their Theory of Knowledge or Extended Essay, and less on the final summative marking. Teachers also expressed their beliefs in how such assessment practices could enhance students’ critical thinking skills.

5.3.4 Management, policy and teacher development

In the interviews, teachers in England and Australia reported several challenges that limited their ability to promote and assess critical thinking in their teaching. They suggested it would be helpful if they were offered more professional development training such as sessions on research methods, as they observed a need to support some of their students better. Teachers particularly mentioned how students from non-IB schools who was new to the IB format found it challenging to grasp the understanding of the IB teaching:

I don't think that a GCSE curriculum naturally leads to the development of critical thinking. [...] As teachers, I feel we have to work quite hard to get the kids to develop it [critical thinking]. They want you as in GCSE to supply the answers to teach, you know, straightforward. What's, the right answer? (Business management and economics teacher, England).

It takes time for us to kind of break the students out from quite passive model learning up to GCSE (Theory of Knowledge teacher, England).

I think a lot of other IB schools that I've been in, they start building the research skills from quite a younger age and they kind of build them up. [...] They [GCSE students] really struggle with being critical of sources and that I think is a new challenge for, for us as a school. (Diploma Programme coordinator, England)

While teachers in Australia suggested they were more experienced with collaboration, sharing knowledge and teaching the cohort as a team and discussing essays and ways to improve teaching, teachers in England found it challenging to collaborate on lesson planning across subjects. Teachers reported that while they expressed interest in and attempted to work with their colleagues to reinforce the interdisciplinarity of the Diploma Programme and the integration of the Theory of Knowledge within different subjects, they struggled to do so because of lack of time, pressures on teachers and staffing issues.

I feel like it's something that we could do better in terms of linking it [Theory of Knowledge] to their actual subjects. [...] that's partly a timing issue ... of pressure on teachers. (Theory of Knowledge teacher, England)

As a solution, teachers requested time that could be scheduled in their timetable for collaborative planning with colleagues and one teacher thought that it would be helpful to be provided with a model of what such collaborative planning could look like.

While teachers in Australia and England thought that the Theory of Knowledge course supported students' development of critical thinking, the Diploma Programme coordinator in England identified an aspect of the course that she thought could be hindering the students' critical thinking growth. According to her, the use of, and emphasis on complex terminology in the course, such as “ways of knowing”, could be “awkward to work with” and hence become an obstacle for thought-provoking “organic conversations” and thus not encouraging critical thinking. The Diploma Programme coordinator described this as a “disconnect” between the course’s requirements (i.e., use of specific terminology) and the course’s aim (i.e., encouraging stimulating discussions). According to her, the terminology should be suggested as tools that students and teachers could use in the interest of precision rather than become a counter-productive box checking exercise that constrains critical thinking.

I think that's where the best discussions happened is when it wasn't constrained by these parameters of terminology and it was more like the terminology was used sometimes as, as a tool when and where it was useful, but otherwise it was a much more organic conversation. [...] These are the tools we can use to have a more precise discussion about [...] knowledge. But I think sometimes the terminology becomes an end in itself. And it becomes less about discussing knowledge and more about are we checking boxes by using the right terms that the idea requires us to use (Diploma Programme coordinator, England).

Pedagogical support through examples and suggestions is found to be of critical importance for teacher development (see Table 7 on pathways to critical thinking development). In England, the Theory of Knowledge teacher found that the teaching material provided by the IB for the course was “to a certain degree open” and provided a lot of ideas for teaching. However, together with the Diploma Programme coordinator, they felt that some course objectives were unclear, making the course “nebulous”. They both expressed interest in receiving more guidance including clear models of the IB’s expectations of robust thinking and lesson plans to support teachers in ensuring that the Theory of Knowledge course achieved its objectives. Teachers in England and Australia acknowledged that matching the optimal supervisor to each student could be difficult. According to teachers, there was significant variability in teachers’ supervision skills. Newly recruited teachers who were not previously IB teachers needed additional support to gain an understanding of the IB approach to learning and the expertise in

supervising the Extended Essay based on the assessment criteria. Experienced teachers addressed this challenge by regularly meeting with the new teachers and providing them with supporting resources.

In addition to being influenced by differences in levels of experience within IB schools, teachers attributed the large variability in supervision skills to teachers' different education backgrounds more widely. Teachers who had pursued an honours degree in research before their teaching qualification would typically be better versed in research methods than those who only held a teaching degree. Hence, these teachers would be better equipped to advise students in selecting and defending a methodology and writing a research piece. To overcome this challenge, teachers suggested it would be helpful if their professional development training included sessions focused on research methods.

5.3.5 Summary of findings

Teachers in both Australia and England, just like their students, generally believed that the IB program better prepares students for further study compared to national (or State) programmes, and they claim the Theory of Knowledge course and the Extended Essay play a central role in training students' critical thinking skills. Teachers in Australia claimed to collaborate more than teachers in England when working on how to teach critical thinking, but all teachers described mixed teaching approaches for critical thinking in line with best practice research evidence. Both teachers and students were more critical of some aspects of assessing critical thinking, such as the use of assessment rubrics and whether the assessments were able to adequately capture such a complex cognitive skill.

6. Discussion of Main Findings

6.1 Which features of the Diploma Programme are expected to foster the development and enhancement of critical thinking abilities in students?

Section 3 outlined the findings of a document analysis of internal and public documents provided by the International Baccalaureate and related these findings to a literature review of critical thinking to develop hypothetical pathways of how IB participation can foster critical thinking development. The document analysis identified several potential pathways by which the IB programme might enhance critical thinking. The pathways were organized along four themes: 1) instruction and teaching, 2) outcomes, 3) assessment & evaluation, and 4) management, policy, and teacher development. The analysis also indicated that several pedagogical practices within the Diploma Programme are important for critical thinking development, including the opportunity for dialogue, the exposure of students to authentic or situated problems and examples, and one-on-one mentoring.

Further, the document analysis suggested that, within the IB programme, critical thinking was situated within larger skill sets, including thinking skills and inquiry thinking. This may help students to link critical thinking to higher-order values such as international mindedness. Furthermore, it could result in greater motivation for developing critical thinking as well as a better understanding of the context of critical thinking. This is particularly noteworthy given that critical thinking is a central component of many of the traits and qualities that are ultimately valued in greater society (Paul, 1984; Schrag, 2016; Vincent-Lancrin, 2019; Williams, 2005). While there is no clear evidence that linking critical thinking to these higher-order thinking skills is in itself effective at promoting critical thinking, evidence suggests that

students engage more with content when they understand its purpose and value (Yeager, Bundick, & Johnson, 2012).

The assessment practices conveyed through the documents suggest that the IB values and prioritizes critical thinking skills within its assessment framework, but both teachers and students suggested they sometimes struggled with the application of assessment criteria. This was most obvious with the 'Theory of Knowledge' course, but also within specific subjects. This is important because, for a student to be motivated to develop higher order thinking skills such as critical thinking, they must feel that it is rewarded and valued by school assessments, particularly high-stakes assessments (Shepard, 1991). Notably, the language and specific indicators of critical thinking skills were largely defined in a subject-specific manner. The subject-specific assessments also situated critical thinking within a broad framework of higher-order skills. While it is perhaps understandable that the language used to describe critical thinking skills and the extent to which these skills are distinguishable from related concepts is subject dependent, the use of different vocabulary to define and capture these constructs may make it somewhat difficult for students to generalize and transfer their critical thinking skills (or see a need to do so). However, this risk is somewhat mitigated by the guidance within the documents for teachers and students defining and conceptualizing the subject-specific aspects of the assessment criteria.

6.2 Does participating in the Diploma Programme predict higher levels of critical thinking in students?

Section 4 presented the findings from a quantitative comparison of critical thinking skills between IB and non-IB students. The findings suggested that IB students displayed higher levels of critical thinking skills and this was largely consistent across Australian and Norwegian students. The effect suggested that the benefit to critical thinking of IB participation is moderate and is mostly displayed in students nearing the end of the Diploma Programme (i.e., Grade 12 students). The findings also suggested that while some of the benefit in critical thinking was attributable to pre-existing differences between IB students and non-IB students, such as general cognitive abilities and personality, there remained a significant advantage of IB participation on critical thinking over and above these pre-existing differences that we were able to account for. Of course, there remains a possibility that the observed differences are attributable to pre-existing differences between IB and non-IB students that were not captured by the current project's range of covariates.

The results of this study align with previous findings suggesting that critical thinking is positively associated with other cognitive constructs, as well as the personality construct openness to experience (e.g. Clifford, Boufal & Kurtz, 2004; Macpherson & Stanovich, 2007), both of which were also associated with IB participation. This suggests that students with a propensity to score higher on critical thinking are likely to select into the Diploma Programme, but the combined quantitative and qualitative findings of this study provide promising initial evidence that the Diploma Programme can capitalise on and further develop students' critical thinking skills.

6.3 In what ways do Diploma Programme students and teachers encounter, experience and develop critical thinking skills?

The qualitative data from Australia and England provided rich and varied perspectives from teachers and students on the issues such as the teaching of critical thinking, particularly in relation to the Theory of Knowledge course and Extended Essay, the integration of assessment in learning, and students' reflections on being IB students. For example, teachers in both England and Australia believed that the Diploma Programme offered students an advantage over non-IB students with respect to developing critical thinking and in preparation for future university studies. Students believed that they have further advantages compared to non-IB students, as they experienced the IB programme as particularly challenging to their thinking.

Moreover, teachers further suggested they were able to see how their students were developing critical thinking over the course of IB and provided examples of students they had supervised through work on Extended Essay and Theory of Knowledge tasks. Teachers particularly emphasised the importance of teaching students to consider issues from multiple perspectives and understand concepts in relation to their historical and contextual place. Such findings were confirmed by students who emphasised the need for looking at concepts from different perspectives when they debated a case, wrote their Extended Essay or conducted their Theory of Knowledge assessments. Teachers also concluded that it was important to teach critical thinking *within subjects* as well as *independently*, but agreed it was not always easy to collaboratively plan how to best do so.

As such, the findings suggest that there is the potential for more knowledge sharing between teachers on best practices of teaching for critical thinking. All teachers argued that successful teaching strategies for critical thinking would include the use of debates, and the integration of critical thinking in the writing of the Extended Essays and Theory of Knowledge assessments. This is consistent with the recommendations from the meta-analysis by Abrami et al. (2008), which suggested critical thinking skills must be targeted and taught using opportunities for dialogues and exposure of authentic problems and examples. Similarly, students spoke about how debates forced them to think critically and how they appreciated such tasks as part of the learning process.

Teachers further demonstrated active formative assessment practices, as oral feedback and tutorials were integrated into their teaching practices. Importantly, the practice of mentoring during the Extended Essay serves as a crucial part of developing students' critical thinking, although it also has been mentioned as an area which could be improved, based on the fact that students had varied experiences of the quality of mentoring and supervision they received. These varied experiences were mostly due to lack of subject knowledge from the allocated mentor, and teachers confirmed it was a challenge in schools that they had colleagues without the relevant IB or subject background. From teachers' perspectives, the lack of proper time for supervision was repeatedly mentioned as an obstacle, while some students accepted that they were not adequately taking advantage of the feedback and supervision offered. Some students also felt the lack of subject specialism compromised the quality of feedback they received for their work.

Other students appreciated the feedback from their supervisors and were able to act on it. These mixed results in students use of feedback confirms previous assessment studies, which have been demonstrated that students' learning is dependent on both high quality and timely feedback from their

teachers (Steen-Utheim & Hopfenbeck, 2018), students being motivated to act upon the feedback (Shute, 2008), as well as students' ability to understand the feedback they receive (Gamlem & Smith, 2013, Van der Kleij & Adie, 2020).

The interviews in England and Australia, documented that teachers and students found the official IB criteria used for assessment purposes to be too generic and not subject-specific enough. The perceived ambiguity in the criteria lead to some confusion with respect to what was expected of students. Although teachers explained that they had been provided with updated guidelines on assessment in recent years, the interviews demonstrated that both teachers and students were still unsure on how to interpret some of the criteria in assessment. Further, we found few examples on how assessment of critical thinking was conducted, and the lack of clarity around the concept of critical thinking left us with questions on how it is assessed. External assessment of some of the IB examinations further confirmed the lack of clarity around assessment criteria for the interviewed teachers and students, as marks were changed for students without teachers or students fully understanding the reason for which they were changed.

Based on both teacher and student interviews, we conclude that there is the potential for improving feedback processes with respect to enhancing students' development in critical thinking in both Australia and England, as well as clarifying the concept of critical thinking with both generic and subject specific examples.

The IB programme has placed strong emphasis on outcomes and values such as developing a strong and robust knowledge base in the IB subjects, as well as becoming an independent critical thinker. These values were evident in interviews of both students and teachers, who appreciated them as an important outcome of the IB programme. From teachers' perspectives, it was concluded that the heterogeneity of past schooling within cohorts made it more challenging to teach some of the students how to develop their critical thinking, and students that had a non-IB background also described how challenging it had been to get into the mindset of IB thinking in the beginning.

Overall, we found that teachers enjoy teaching the IB programme. They have reported a difference in the way IB students handled complex questions when compared to non-IB peers and feel that Diploma Programme students will have an advantage later at university. Critical thinking is a difficult concept, and more guidance will be helpful to support teachers promoting critical thinking in their subjects, Theory of Knowledge and the Extended Essay.

Teacher interviews suggested that teachers experience within the different IB schools varied. While some teachers pointed to the opportunities for sharing more knowledge within their schools, they also found it challenging to fully embrace all the suggestions the IB documents outlined. While some teachers explained challenges related to having non-IB colleagues, other teachers mentioned the lack of time to engage in depth with concepts such as critical thinking when supervising their students. Most teachers appreciated the resources offered from the IB and mentioned how these documents have improved in recent years. These IB resources tended to be online, or accessible through workshops that teachers could attend which focused on enhancing teachers' pedagogical approach to critical thinking instruction. These resources may play a valuable role in helping teachers provide better critical thinking instruction because critical thinking instruction is not necessarily intuitive or addressed within traditional teacher training programmes (Abrami et al., 2008). It is, however, worth considering that the value of

these development opportunities also depends on schools' managerial support to provide time for teachers to undertake this training.

Teachers also shared varied experiences with respect to collaboration. While teachers in Australia seem to have been successful in planning lessons collaboratively, teachers in England expressed how this has been challenging for them despite their intention to do so over the years because of time and workload constraints. There seems to be a potential for strengthening the teaching of critical thinking across schools by facilitating more collaboration and knowledge sharing between teachers within and across subjects.

Both teachers and students agreed that some research topics (e.g. science) did not lend themselves to critical thinking, and therefore found it more challenging to include it in certain subjects. From the interview data, this finding has been the most surprising one, as it would be expected that science, would be a subject you would expect the need for critical thinking skills. Considering also the example used from biology in section 3.2.1, where assessment objective focuses on students' ability to "formulate, analyse and evaluate hypotheses, research questions, predictions, methodologies and techniques, primary and secondary data, scientific explanations" (IBO, 2014b, p.19), it seems like there is a potential for future work on how to better enhance critical thinking in subjects such as science and mathematics.

6.4 Limitations

While the quantitative results suggest that the IB may foster critical thinking it is important to keep in mind that there are likely to be complex and varied reasons that student self-select into the IB programme and these may contribute to the observed differences. While, our analyses were able to control for a range of cognitive, personality, and socioeconomic variables it is simply impractical for any study to conclusively rule out all alternatively causal explanations for the observed critical thinking differences.

Another consideration is the extent to which the observed critical thinking differences have practical implications within classroom and workplace contexts. IB students, unlike most students in non-IB programmes, study critical thinking in the abstract domain-general sense. It is therefore somewhat unsurprising that they perform better on an abstract test of critical thinking skills. The most pertinent question, however, remains largely unanswered – do these critical thinking skills generalise and transfer between subjects/domains in a way that improves educational and vocational performance?

We further acknowledge what might be a strong self-selection effect in the student sample, as students opted into the interviews and therefore the interview sample might be comprised of particularly motivated and high achieving students. Furthermore, the interviewed students were only drawn from the IB sample, and many of the positive things they reported about the approaches to teaching in learning in the IB may be equally true of non-IB programmes.

Finally, the outbreak of COVID19 made it impossible to conduct the planned interviews in Norwegian schools, as well as three additional schools in England, leaving us with less interviews than initially intended in the research design. Despite these limitations, this report's findings provide encouraging initial evidence that the approach adopted by the IB to teaching and assessing critical thinking may have demonstrable effect on their students' critical thinking skills.

6.5 Conclusions

Based on the quantitative findings, there is evidence that IB Diploma Programme students display higher critical thinking skills than non-IB students. This effect is more pronounced in students nearing the end of the Diploma Programme (i.e., Grade 12 students) and remains after a range of personality, cognitive, and socioeconomic variables are controlled for.

Findings from the qualitative interviews suggest teachers in both England and Australia believe that the Diploma Programme offers students an advantage over non-IB students with respect to developing critical thinking and preparing for future studies. Similarly, students believe that they have advantages compared to non-IB students, as they experienced the IB programme as challenging them to expand their thinking.

Our findings further suggest teachers and students embrace the approach IB has taken with respect to integrating critical thinking into the Diploma Programme, but both teachers and students expressed some uncertainty about how it is both defined and assessed within and across subjects in the programme.

Teachers suggest more knowledge sharing would be helpful and further professional development on how to better foster critical thinking within the different subjects and disciplines. Previous research studies have recommended training teachers in the specific instruction of critical thinking and the findings of this report provide further support for this recommendation.

The benefit of IB participation to critical thinking provides preliminary support for the efficacy of the approach taken by the IB programme. Perhaps the most obvious way an educational programme such as the IB can enhance critical thinking is through the instructional approaches it utilises. Our results suggest that the IB embraces a mixed approach to teaching critical thinking which is largely in line with the best practices established by recent meta-analyses examining pedagogical approaches to critical thinking development (Abrami et al., 2015; Abrami et al., 2008; Niu, et al., 2013). Such approach also serves to make teaching critical thinking an explicit goal within regular courses, ensuring that critical thinking instruction is not assumed to necessarily follow from other gains in knowledge, but is specifically taught within the classroom.

The approach may also represent one of the likely pathways by which IB students gain a competitive advantage in terms of critical thinking, because national programmes rarely utilise domain-general critical thinking instruction courses, as have been seen for example in England where critical thinking has recently been dropped as an A-level course (Pells, 2016).

Overall, across the document analysis, quantitative comparison, and qualitative interviews this report provides encouraging evidence that the IB programme is able to develop students' critical thinking by embracing evidence-based pedagogical approaches. This research serves not only as an important evaluation of the effectiveness of the Diploma Programme but provides vital insights into students' and teacher's perceptions of the role of pedagogy and classroom practices in facilitating and supporting critical thinking development. Given the increasing importance of critical thinking as a graduate attribute, it is vital that we continue to methodically evaluate how educators can best improve students' critical thinking through their classroom practices.

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Appendices

Appendix 1: Interview schedule for Diploma Programme teachers

Theory of Knowledge teacher + Diploma Programme coordinator

Many thanks for agreeing to participate in the interview. This will be very helpful for our research to better understand how critical thinking is taught and assessed in the Diploma Programme. The interview will be around 30 minutes and I will be interested in your experience as a Theory of Knowledge teacher and a Diploma Programme co-ordinator preparing students for the Diploma Programme examinations. All responses and personal data will be handled with strict confidentiality and will be destroyed as soon as it is no longer needed for research purposes. Your name and that of your school will not appear in any reports. Feel free to skip questions or withdraw from the interview at any time. I would like to audio-record the interview to facilitate data collection. Do you mind if I audio-record our conversation?

1. What skills do you think the Theory of Knowledge develops in students?
2. a. To what extent do you think the Theory of Knowledge helps students understand other subjects?
b. Can you give an example?
3. a. How frequently do you plan activities focused on critical thinking in your teaching?
b. To what extent do you carry out this planning with other subject teachers?
4. a. To what extent do you assess critical thinking within the Theory of Knowledge?
b. How do you assess critical thinking within the Theory of Knowledge?
5. What type of feedback do you give students on their critical thinking skills?
6. a. To what extent does the guidance you are given for teaching and assessing critical thinking in the Theory of Knowledge help you in preparing students for the Theory of Knowledge presentation and essay writing?
b. What other support would you require?
7. What skills do you think students develop through the Extended Essay?
8. a. What evidence of critical thinking do you look for in the Extended Essay?
b. To what extent are students able to demonstrate critical thinking skills in their Extended Essay?
c. To what extent the guidance you are given for supervising students helps you in encouraging them to demonstrate critical thinking skills in the Extended Essay?
d. What other support would you find helpful?

9. Thinking back on our interview conversation, is there anything else you would like to add that you believe is of importance? *Note: Questions 7 & 8 only relevant for Theory of Knowledge teachers who supervise Extended Essays.*

Subject teachers

Many thanks for agreeing to participate in the interview. This will be very helpful for our research to better understand how critical thinking is taught and assessed in the Diploma Programme. The interview will be around 30 minutes and I will be interested in your experience as subject teachers preparing students for the Diploma Programme examinations. All responses and personal data will be handled with strict confidentiality and will be destroyed as soon as it is no longer needed for research purposes. Your name and that of your school will not appear in any reports. Feel free to skip questions or withdraw from the interview at any time. I would like to audio-record the interview to facilitate data collection. Do you mind if audio-record our conversation?

1. To what extent do you think your subject challenges students' thinking?
2. a. How frequently do you plan activities focused on critical thinking in your teaching?
 - b. To what extent do you carry out this planning with other teachers (subject or Theory of Knowledge?)
3. a. To what extent do you assess critical thinking within your subject?
 - b. How do you assess critical thinking within your subject?
4. What type of feedback do you give students on their critical thinking skills?
5. What skills do you think students develop through the Extended Essay?
6. a. To what extent you do think the guidance you are given for teaching and assessing critical thinking in your subject prepares students for their Diploma Programme examination?
 - b. What other support would you require?
7. a. What evidence of critical thinking do you look for in the Extended Essay?
 - b. To what extent are students able to demonstrate critical thinking skills in their Extended Essay?
 - c. To what extent does the guidance you are given for supervising students helps you in encouraging them to demonstrate critical thinking skills in the Extended Essay?
 - d. What other support would you find helpful?
8. Thinking back on our interview conversation, is there anything else you would like to add that you believe is of importance?

Appendix 2: Interview schedule for Diploma Programme students

Many thanks for agreeing to participate in the interview. This will be very helpful for our research to better understand how critical thinking is taught and assessed in the Diploma Programme. The interview will be around 30 minutes and I will be interested in your experience as Diploma Programme students preparing for the Diploma Programme examinations. All responses and personal data will be handled with strict confidentiality and will be destroyed as soon as it is no longer needed for research purposes. Your name and that of your school will not appear in any reports. Feel free to skip questions or withdraw from the interview at any time. I would like to audio-record the interview to facilitate data collection. Do you mind if I audio-record our conversation?

1. Why did you choose to do the Diploma Programme?
2. What skills did the Theory of Knowledge help you develop?
3. How did the Theory of Knowledge challenge your thinking? Give an example.
4. How well do you think the Theory of Knowledge course prepares you for the Theory of Knowledge oral and written examination?
5. Think of an example in a subject of your choice where the teacher helped you effectively build critical thinking skills.
6. What skills did the Extended Essay help you develop?
7. To what extent was the Extended Essay helpful in building a deeper understanding of the topic you researched?
8. How did the Theory of Knowledge help you in planning, preparing and writing your Extended Essay?
9. How helpful did you find the feedback from your Extended Essay supervisor in developing and demonstrating critical thinking in your Extended Essay?
10. Can you give an example of how you demonstrated critical thinking in your Extended Essay?
11. Thinking back on our interview conversation, is there anything else you would like to add that you believe is of importance?

Note: Questions about the Extended Essay might not be relevant to Diploma Programme1 students (especially question 9).

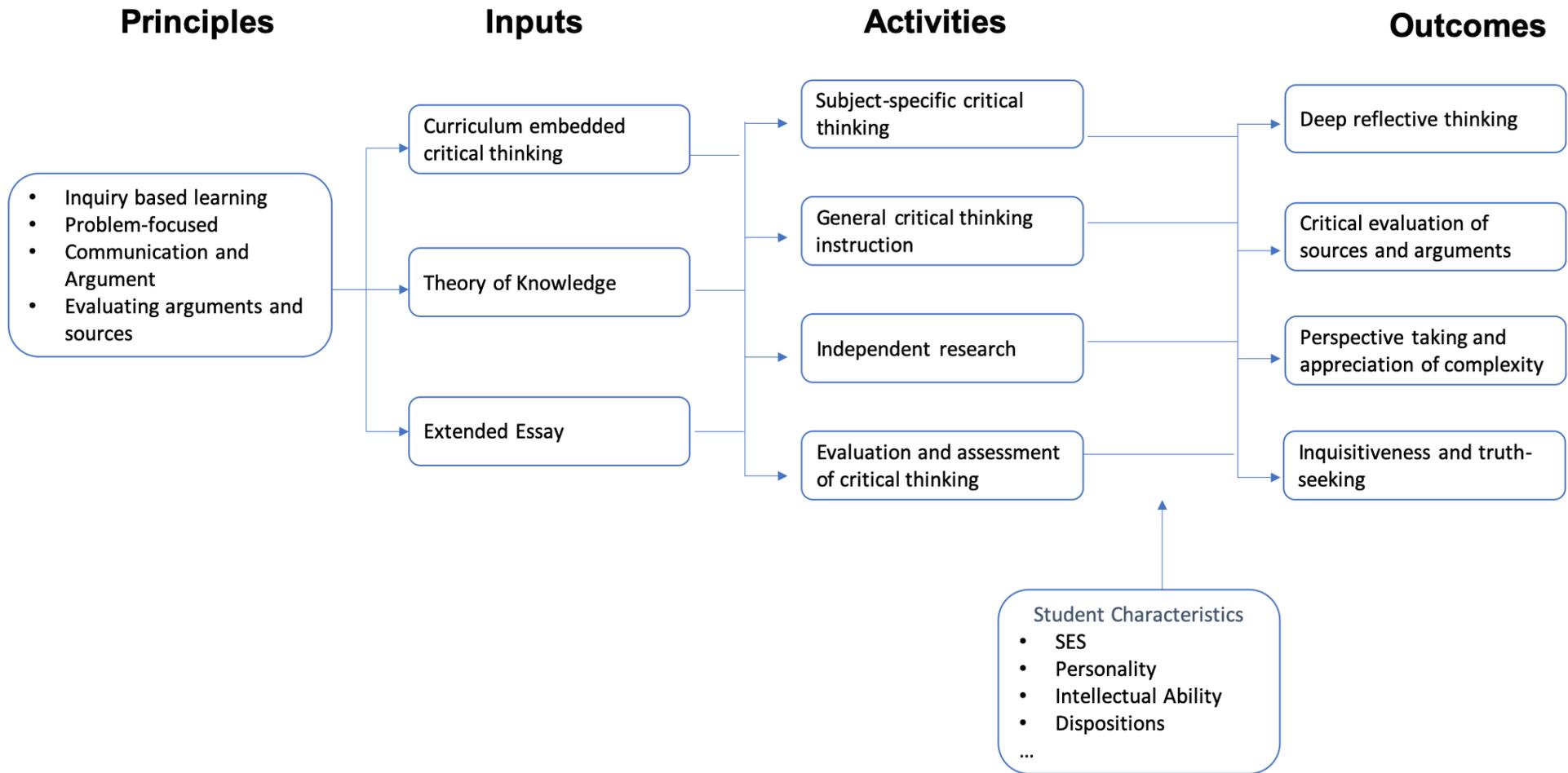
Appendix 3: Critical thinking battery of tests

The project consisted of the following battery:

- Demographics (Age, gender, grade)
- Socio-economic status
- Personality (Big-5: Openness to experience, conscientiousness, extraversion, agreeableness, neuroticism)
- Cognitive Reflection Test
- The International Cognitive Ability Resource (ICAR-16)
- Cornell Critical Thinking Test

Appendix 4: Logic Model

A logic model provides a framework for linking outcomes with inputs (Chen & Rossi, 1980). Based on the qualitative findings from the document analysis and our quantitative findings from Australian schools (Interim report), we have developed a logic model linking critical thinking outputs with processes at the student, teacher, and school levels. The following model provides a framework to evaluate the approach towards critical thinking adopted by the IB and to understand how the methods and approaches used within the IB might translate to better critical thinking.



Appendix 5: Coding guide for teacher and student interviews

Codes/themes	Explanations and Examples from interviews
Instruction and teaching	<ul style="list-style-type: none"> • Explicit teaching of critical thinking skills • Utilising both domain-specific and domain-general approaches to teaching critical thinking • Opportunities for one-on-one mentorship <p><i>I think it's very, very curriculum driven. [...] The curriculum we're teaching them, the subject contents we're teaching them, is very much designed to encourage group critical thinking</i></p>
Outcomes	<ul style="list-style-type: none"> • Critical thinking viewed as an outcome within a holistic view of student development • Critical thinking is situated within broader outcomes such as thinking skills and inquiry thinking <p><i>For anthropology they constantly have to question themselves in terms of what is normal, why are some things taboo in our culture and not in others and vice versa.</i></p>
Assessment and Evaluation	<ul style="list-style-type: none"> • Critical thinking and related skills are valued within the assessment structure • Subject-specific assessment language is utilised • The use of subject-specific language is supported by written guidance <p><i>That (the process of peer assessment) really trains them to be a lot more critical about what they're saying and the assumptions that they're making and how much how they haven't thought through necessarily their ideas and their conclusions</i></p>
Management, Policy, and Teacher Development	<ul style="list-style-type: none"> • Management support for policy changes, through leadership team and IB coordinator • Pedagogical support through examples and suggestions • Professional teacher development conferences and workshops • Building professional learning community where teachers collaborate and share good practice, focusing upon learning, rather than teaching <p><i>I very much planned to deliver some of the economic units in tandem with the geography teacher doing IB geography in that we did have a certain part of the syllabus together. It was our intention to do so. Time and pressures have not been helpful in delivering it. We do plan to do it.</i></p>