

Research summary

Exploring the learning benefits and outcomes of the IB extended essay in preparing students for university studies in Canada (two phases)

Based on research reports prepared for the IB by:

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Project overview

This summary offers an overview of a two-phase research project exploring the impact of the Diploma Programme (DP) extended essay (EE) experience on student success at university. The first phase of the research project examines the relationship between IB extended essay experiences and undergraduates' epistemic beliefs, approaches to learning, values of the importance of inquiry demands and inquiry self-efficacy. The second phase explores the learning benefits of the DP extended essay, and the extent to which the EE has helped DP graduates during their first year of university study. Additionally, Phase 2 investigates IB students' conceptions of inquiry and their inquiry self-efficacy, as measured by the McGill Self-Efficacy in Enacting Inquiry Questionnaire (MSEEIQ), in comparison to non-IB students.

Phase 1

Research design

This study uses a quasi-experimental, post-test design to explore former IB students' epistemic beliefs, approaches to learning, values surrounding inquiry and inquiry self-efficacy. Several analyses, including linear regression and multivariate analysis of variance (MANOVA), were conducted to investigate these constructs. Linear regression analysis is performed to determine which variables best explain students' overall rating of the importance of inquiry instruction and learning. MANOVA is used to compare IB and non-IB students' factor scores for each instrument. Additionally, MANOVA is used to look for an effect of one or more independent variable(s) on several dependent variables. In this case, the dependent variables are the factor scores for each instrument.

The same five instruments were used in all of the analyses

- Self-Efficacy for the Demands of Inquiry Questionnaire (SEDIQ)
- McGill Strategic Demands of Inquiry Questionnaire (MSDIQ)
- Schommer-Aikins Epistemological Beliefs Questionnaire (SEBQ)
- Learning Processes Questionnaire (LPQ)
- Views of Nature of Science form C Questionnaire (VNOS-C)

The instruments included measures of epistemic beliefs (SEBQ), conceptual knowledge of the nature of science (VNOS-C), the depth of the learner's approach to learning (LPQ), students' self-efficacy as an inquirer (SEDIQ) and student ratings of the importance of engagement in inquiry (MSDIQ). These measures were selected based on evidence of their reliability and validity but also to reflect what current research in higher education demonstrates to be important variables—variables which are likely to affect and be affected by inquiry instruction and learning.

Sample

Students who participated in the first phase were identified by the records office of McGill University, a university that emphasizes research and is ranked among the top 20 in the world. The students included in this study were former IB students and non-IB students sampled from the Faculty of Education and the Faculty of Sciences. Sample sizes vary with each research question because not all participants completed all of the surveys.

Limitations

This is a quasi-experimental, post-test only research design. Quasi-experimental research is correlational and thus is limited in determining causal relationships. Further, a post-test only design does not have the added benefit of a pre-test, which could be used as a baseline for comparisons.

Key findings

This research considers the evidence for what variables best distinguished IB from non-IB undergraduate students in terms of their inquiry self-efficacy, views on the nature of science, inquiry values, epistemic beliefs and approaches to learning. Significant differences between the two groups were found using MANOVA on three variables: inquiry values (MSDIQ), epistemic beliefs (SEBQ) and approaches to learning (LPQ).

McGill Strategic Demands of Inquiry Questionnaire (MSDIQ)

The MSDIQ (Shore, et al. 2012; Syer 2007) is a 79-item questionnaire with 3 subscales, each subscale representing a dimension of inquiry: preparation for an inquiry project, enactment of the inquiry project and reflection on the enactment. Fourteen factors were identified and organized under the three subscales. The results suggest that both former non-IB and IB students rate 10 of the factors measured by the MSDIQ in a similar manner. However, four factors were rated higher by IB students (from fairly important to very important). Each of these four factors contributes to one of the three major dimensions of inquiry, as established by the MSDIQ. Former IB students indicated higher ratings of aspects of inquiry learning that represent self-regulation of the inquiry process. Additionally, the MANOVA results show that the IB students assigned high overall ratings to the importance of instructional and learning demands of engagement in inquiry.

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Schommer-Aikins Epistemological Beliefs Questionnaire (SEBQ)

Epistemology is the branch of philosophy concerned with the nature of knowledge, its possibility, scope, general basis and the justification of belief (Honderich 1995). Evidence suggests that epistemic beliefs are related to cognition, motivation, mathematical learning (Muis 2004; K. R. Muis, Foy 2010; Muis, Franco 2009) and self-regulation (Muis 2004; Muis, Franco 2009). Epistemic beliefs affect how students approach problem solving in mathematics (Schoenfeld 1989), monitor their comprehension of what is read and directly and indirectly affect achievement (Schommer 1990, 1993). This study uses the Schommer-Aikins Epistemic Beliefs Questionnaire (SEBQ) (Schommer 1990; Schommer-Aikins, Duell, Barker 2003), which is a widely used general measure of epistemic beliefs. The SEBQ has been shown empirically to be related to reading comprehension and performance on achievement tests of college students (Schommer 1990).

A higher score on the SEBQ indicates that the student is more naive and confident in their mistaken beliefs and therefore less likely to change these beliefs. Lower scores suggest that a person is more sophisticated and flexible in their beliefs about knowledge and/or in its uses (Schommer 1990, 1993). The non-IB students had statistically significant higher mean Likert scores than IB students on the following two factors: simple knowledge and quick learning. Specifically, the non-IB students held a stronger belief that a) knowledge is certain and without ambiguity and b) that learning should be quick and easy rather than gradual and effortful.

Table 1
SEBQ results

Factor	Items
Simple knowledge	<i>Seeks single answers:</i>
	Non-IB students $M = 2.969$ ($SD = .059$)
	IB students $M = 2.706$ ($SD = .110$)
	<i>Avoids ambiguity:</i>
Non-IB students $M = 3.069$ ($SD = .076$)	
IB students $M = 2.675$ ($SD = .141$)	

Quick learning

Concentrated effort is a waste of time:

Non-IB students $M = 3.000$ ($SD = .093$)

IB students $M = 2.250$ ($SD = .173$)

Learning Processes Questionnaire (LPQ)

Research has demonstrated that undergraduate students have different motives and strategies for learning in university courses (J. Biggs, Kember, Leung 2001; John B. Biggs 1987b). Biggs' research offers empirical evidence that students' learning approaches may typically fall into surface and deep motives (Biggs, et al. 2001). Surface and deep motives are two approaches to learning explored using the LPQ. A primary distinction between surface motives and deep motives is the goal of learning. Deep learning entails comprehension and other higher order thinking goals (Biggs, et al. 2001). Virtually all kinds of inquiry processes

In this study, IB students had statistically significant lower mean scores than non-IB students indicating that, on average, IB students are less likely to view learning as primarily memorization of information.

demand understanding and utilize deep motives, while surface motives only demand recall of information and mnemonic strategies of learning. In this study, IB students had statistically significant lower mean scores ($M = 15.46$, $SD = 3.60$) than non-IB students ($M = 16.96$, $SD = 3.85$) indicating that, on average, IB students are less likely to view learning as primarily memorization of information.

Phase 2

Research design

Phase 2 of this study used a collective case study approach to develop further understanding of the learning benefits of engagement in the EE. Qualitative results of Phase 2 are based on a sample of 15 former DP students during their first year of university study. The transcripts from the 15 semi-structured, in-depth student interviews were inductively coded (Corbin, Strauss 2008), and the researchers identified patterns among the categories that emerged.

Phase 2 also compares inquiry self-efficacy, as measured by the McGill Self-Efficacy in Enacting Inquiry Questionnaire (MSEEIQ), of 207 former IB and 144 former non-IB students. The MSEEIQ is a 32-item instrument measuring "Self-Efficacy in Enacting Inquiry". Descriptive statistics were calculated for each inquiry factor on the MSEEIQ. Independent samples *t*-tests were used to test the significance of the difference between the mean Likert scale score for each inquiry task, comparing two groups of students (IB and non-IB).

Sample

Students for the interviews were recruited from a sample of IB DP students obtained from the university registrar's office by sending out a recruitment letter which offered reimbursement of \$150 for participating in a 90-minute interview and completing a survey instrument. The first 15 who responded positively to the invitation were interviewed.

The MSEEIQ was administered to students at McGill University as part of ongoing research into inquiry. For phase 2 of this study, 207 former IB student responses and 144 former non-IB student responses were analysed.

Limitations

Case studies do not aim to provide generalizable results, but instead offer in-depth description and theorizing about learning. Collective case studies sample more than one unique case to achieve better understanding through a comparison of cases within the boundary of the case.

Key findings

Qualitative

Qualitative results indicated that most IB students were very positive about the high academic work ethic and the student-centred environment afforded in the DP schools they attended. A qualitative analysis of student responses to the questions about what they learned from participation in the EE revealed a large number of learning outcomes related to inquiry tasks and foundational to reading, writing, study and search skills. A large percentage of the students who participated in the EE reported a number of academic learning outcomes, including: enhanced organization, reading, writing and reasoning skills.

Along with these skills, students almost unanimously mentioned that doing the EE had improved their confidence in their ability to accomplish the academic demands of undergraduate studies and to estimate the time needed to do an essay assignment in a course. The analysis of the interviews identified several themes related to learning outcomes of the EE.

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Table 2 lists themes related to learning outcomes and illustrative quotes from the 15 student respondents.

Table 2
Learning outcomes of the extended essay

Theme	Illustrative quote
The EE as a learning experience	<ul style="list-style-type: none"> • <i>To go search for information, to learn what is important in that information and to do something new with it...a way to generate new information</i> • <i>You have to do more than read and understand, you have to create links and make the information your own</i> • <i>I learned how to do research and the hardest part is to organize what I learned (to mix many topics and subjects together that are not normally made to go together) into categories before writing as a plan to follow as I write.</i> • <i>Learning that research can be fun rather than a chore</i>
Learning from doing the EE	<ul style="list-style-type: none"> • <i>Personally I was never very concerned about doing research later so I consider doing this [EE] as “painting by numbers”—Research methods more than any theoretical or creative aspect of EE—How to gather and build up information so that it results in a body of knowledge—Analysis of ideas—Problem solving—More a problem solving experience—I had a question to answer and a series of recommended steps to follow—Being creative—Problem solving and being creative—That in conducting research I was the main author..., I started thinking like “I want this data, I need to find it!”—What it’s like to go in depth into a subject—Doing in depth analysis of a subject.</i>
Self-regulation strategies	<ul style="list-style-type: none"> • <i>How to organize my ideas (before, during and after writing)</i> • <i>How to organize my ideas in an essay that will have some coherence</i> • <i>How to organize an argument that brings the reader to a conclusion that is not too far-fetched</i> • <i>I’m more organized regarding work...essays, exams, everything I have to do</i>

- How to organize a coherent argument
 - I learned to reach out to people [help-seeking]
 - You have to be motivated, determined...I think it's especially that and the rest are competencies
 - You really have to enjoy doing what you do to pursue a project that takes you so long and so much time [perseverance]
 - Motivation to persist
- Self-evaluation**
- I learned a lot about myself
 - I learned to use others' criticisms and complements to apply it to my work instead of being angry about it
 - To be more resourceful
 - To have a lot of patience
 - To see and accept help from others
 - To accept criticism from experts and peers

Analysis of student reports demonstrate that most of the knowledge learned through EE participation helped them to successfully cope with university academic demands

Further, analysis of student reports demonstrate that most of the knowledge learned through EE participation helped them to successfully cope with university academic demands. However, the results also show that first year students experienced research primarily through reading it, writing about it and occasionally discussing it but rarely through actually doing it as part of their coursework. These specific results replicate those reported by Inkelas, K, Swan, A, Pretlow, J, and Jones, J. (2012) and Wray, D. (2013).

Quantitative

When the mean inquiry self-efficacy scores of 207 former IB students and 144 former non-IB students were compared using independent samples *t*-tests,¹ two of the seven inquiry task skills were significantly different.

A *t*-test revealed a statistically significant difference between the mean factor scores of former IB students and non-IB students on the following two factors.

Table 3
MSEIIQ significant results

1. Stating the problem and asking questions	There was a significant difference in the mean factor scores of IB students ($M = 7.89, SD = 1.60$) and non-IB students ($M = 8.37, SD = 1.43$), $t(349) = 2.901, p = .004$.
2. Hypothesizing outcomes and results	There was a significant difference in the mean factor scores of IB students ($M = 6.81, SD = 1.58$) and non-IB students ($M = 7.40, SD = 1.61$), $t(349) = 3.408, p = .001$.

A *t*-test failed to reveal a statistically significant difference between the mean factor scores of IB students and non-IB students on the following five factors.

¹ Because 7 *t*-tests were performed, there is an increased risk for Type I errors. To account for that, a Bonferroni adjustment was applied, meaning that alpha of .05 was divided by 7, yielding a value of .007 (Field 2009). Therefore only *p* values lower than .007 are considered significant.

Table 4**MSEIQ non-significant results**

1. Creating and communicating knowledge	There was not a significant difference in the mean factor scores of IB students ($M = 7.66, SD = 1.33$) and non-IB students ($M = 7.85, SD = 1.38$), $t(349) = 1.347, p = .179$.
2. Analysing and writing data	There was not a significant difference in the mean factor scores of IB students ($M = 7.93, SD = 1.32$) and non-IB students ($M = 8.06, SD = 1.33$), $t(349) = .855, p = .393$.
3. Searching for information	There was a significant difference in the mean factor scores of IB students ($M = 8.50, SD = 1.15$) and non-IB students ($M = 8.80, SD = 1.06$), $t(349) = 2.384, p = .018$.
4. Verifying data and testing ideas	There was a significant difference in the mean factor scores of IB students ($M = 8.01, SD = 1.28$) and non-IB students ($M = 8.32, SD = 1.24$), $t(349) = 2.275, p = .023$.
5. Collecting data	There was not a significant difference in the mean factor scores of IB students ($M = 7.40, SD = 1.52$) and non-IB students ($M = 7.53, SD = 1.69$), $t(349) = .852, p = .395$.

The results suggest that the groups are confident about different skills. However, the overall distribution of inquiry self-efficacy ratings is similar across the groups. The means show that on average students in both groups rate the majority of inquiry task factors between “probably can” (Likert scale value of 7) and “definitely can” (Likert scale value of 11).

Both groups rated their “searching for information” self-efficacy factor highest and “hypothesizing outcomes and results” self-efficacy as either the lowest (IB) or second lowest factor (non-IB), suggesting both groups are most comfortable with the task of searching for information and less comfortable with hypothesizing outcomes.

Conclusion

Results from this study substantiate recent research completed by Inkelas, Swan, Pretlow and Jones (2012) and Wray (2013). Similar to the findings in this study, the research done by Inkelas, Swan, Pretlow and Jones (2012) suggests that the EE 1) provides familiarity with the steps of a lengthy essay, 2) increases students’ confidence in doing research essays, 3) improves ability to gather and evaluate sources of information, 4) provides preparation for college level writing, 5) improves time management in writing projects and 6) increases basic knowledge of a formal academic style appropriate to a field of study. The results from Wray’s (2013) work are also supported by this study. Specifically, students: 1) were positive about their EE experience, 2) referenced developing study skills and knowledge about a topic of their choice, 3) were disappointed with support received at times during the EE process and 4) felt they did not have an opportunity to engage in research at university.

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This summary was developed by the IB Research Department. A copy of the full report, prepared by Mark W. Aulls and David Lemay is available at <http://www.ibo.org/research>. For more information on this study or other IB research, please email research@ibo.org.

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