A Study of Critical Thinking Skills in the International Baccalaureate Middle Years Programme

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Executive Summary

A study examining the extent that critical thinking skills are emphasized in teaching and learning in the International Baccalaureate (IB) Middle Years Programme (MYP) was conducted in a large, socioeconomically diverse district of rural, urban, and suburban communities. The study was requested by the school district office overseeing the program, in collaboration with the IB. Funding for the study was provided by the IB.

Study Design

A multi-method study examined evidence of critical thinking skills in the MYP from perspectives of both students and teachers, as well as through observations in MYP classrooms. Surveys were administered to Grades 6 and 8 students in MYP and non-MYP schools about their approaches to tasks and problems, as well as ways they are using critical thinking skills in their classes. Two groups of 11th grade students also were surveyed—one group who previously attended MYP middle schools and a comparison group who previously attended non-MYP middle schools. Finally, teachers in MYP and non-MYP schools were surveyed about the practices and strategies they are using to promote critical thinking in their classrooms. To acquire a deeper understanding of the ways that teachers translate their MYP training into classroom practice, evaluators observed 32 6th and 8th grade classes in four MYP schools.

The questions guiding the study were:

1. Do current MYP students report using critical thinking skills to a greater extent than non-MYP students?
2. Do high school students with an MYP background report greater use of critical thinking skills than their non-MYP counterparts?
3. Do MYP teachers report greater use of practices promoting critical thinking in the classroom than non-MYP middle school teachers?
4. How are MYP teachers integrating the thinking skills outlined in the Approaches to Learning (ATL) framework in the classroom instruction?

Summary of Key Findings

Survey Findings from MYP and non-MYP Respondents

High percentages of students and teachers from both MYP and non-MYP schools reported the use of many of the critical thinking skills and classroom strategies examined in this report. However, comparisons of MYP students' survey responses with those of non-MYP students did not show greater use of critical thinking or goal setting behaviors by MYP students; in the overall survey responses of middle school students, MYP was negatively related to the use of many of the critical thinking skills. Among high school students, survey respondents with MYP and non-MYP backgrounds reported using critical thinking skills at similar levels. Most comparisons of MYP and non-MYP teachers' survey responses showed similar levels of reported use of critical thinking skills by the two groups. In a subsample of mathematics teachers, however, MYP was related to higher scores on the Making Connections, Sharing and Collaborating, and Analyzing dimensions of the survey. The overall lack of a positive effect for

MYP in the student survey findings may have been influenced by several issues, including the lack of random assignment to MYP and non-MYP groups, the choice of comparison schools, professional development in critical thinking skills received by non-MYP teachers, and a systemwide emphasis on critical and creative thinking in the district.

Observations of MYP Classrooms

Inquiry questions—in the form of factual, conceptual, or debatable questions—were observed in all 32 MYP classrooms. Conceptual questions, which enable students to explore "big ideas," were observed in 97% of classrooms; debatable questions, which enable students to use facts and concepts to debate a position, were observed in 47% of the classrooms. Several of the critical thinking skills were observed in more than 70% of the classrooms—gathering information, making connections, explaining ideas, and sharing work.

Consistency of Findings from Multiple Measures

Findings from student and teacher surveys and classroom observations showed a high level of consistency across measures. Many of the skills reported by the highest percentages of students and teachers also were those observed most frequently in classrooms.

Critical Thinking Skills Used Most Frequently

The skills reported by the highest percentages of students and teachers and observed in most classrooms were:

- Gathering and organizing information
- Considering ideas from different points of view
- Making connections with learning gained in other subject areas
- Students explaining or elaborating on their thinking

Recommendations

Findings from the student and teacher surveys, as well as the classroom observations suggest the following recommendations.

1. Continue training and support of MYP teachers in the use of ATL skills in instruction. A number of skills were found—through surveys and observations—to be widely used in the MYP classrooms. Target the skills reported by lower percentages of teachers (e.g., ask students to develop opposing or complementary arguments; ask students to formulate relevant and provocative questions) for additional support. Within the new ATL framework, these are skills that require higher levels of critical thinking; teachers may need additional support and time to practice the use of these high-level critical thinking skills in the classroom. It may be useful to examine curriculum documents to identify areas where critical thinking is incorporated and where critical thinking skills may be strengthened.

2. Provide additional support for learning the use of the Statement of Inquiry. Classroom observations revealed that teachers are using inquiry questions in their classrooms,

including the use of conceptual questions in almost all classrooms and debatable questions in nearly half. Help teachers use these skills to formulate and regularly refer to (with displays and reiterations) the Statement of Inquiry.

3. Explore ways to help teachers increase the amount of student-to-student interaction in classroom instructional activities. In most classrooms observed, the largest amount of time was spent with teachers talking to students. In addition, relatively small percentages of students (less than half) reported that they collaborate with others to get ideas, although about three quarters reported that they are encouraged to collaborate in classes.

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Background

The International Baccalaureate (IB) organization offers four challenging and innovative programs to students: the IB Primary Years Programme (PYP); Middle Years Programme (MYP); Diploma Programme (DP); and the IB Career-related Programme (CP). In the district conducting the study, 19 IB programs have been authorized and established: one PYP, five MYPs in middle schools, eight DPs and two CPs in high schools. Three of the high schools with DPs also have the MYP for students in Grades 9 and 10. All PYPs and MYPs in the district employ a whole-school model. The focus of this study was on the IB MYP—specifically, its emphasis on critical thinking skills.

Critical thinking has been a key and overarching feature of the MYP since the program began, but the recent restructuring of the MYP brought a new emphasis to thinking and learning skills with the introduction of the Approaches to Learning (ATL) skills framework (IB, 2014a). The ATL framework includes five broad skills organizers—Thinking Skills, Social Skills, Communication Skills, Self-management Skills, and Research Skills. Central to the ATL framework is "learning how to learn" and helping students develop awareness of how they learn best, and of thought processes and learning strategies. Starting in fall 2013, IB, MYP, and PYP teachers in the district received additional training and support to incorporate the ATL skills framework into their everyday classroom instruction. The skills within the Thinking Skills area of the ATL framework are the focus of the current study.

The district's program evaluation unit conducted this study of the IB MYP. The study was requested by the office overseeing the program in collaboration with the IB. Funding for the study was provided by the IB. The broad objective of the study was to examine the extent that critical thinking skills are emphasized in teaching and learning in the MYP. The study compared self-reported critical thinking skills of current MYP students and non-MYP students, and of Grade 11 students who attended MYP schools and those who attended non-MYP schools. In addition, the study examined how MYP teachers were incorporating the skills taught in the ATL Thinking Skills area in their classrooms. This report is the first of two reports on the findings of the Year 3 Continuation Study of the IB MYP in the district.

Program Description

Founded in 1968, the IB currently works with more than 4,000 schools in 145 countries to develop and offer four programs to over 1,080,000 students aged 3 to 19 years (IB, 2014b). The IB PYP, MYP, DP, and the CP offer challenging curricula with rigorous assessment; each program encourages students to become lifelong learners and active citizens with a global perspective.

The MYP, for students aged 11 to 16, provides "a framework of academic challenge that encourages students to embrace and understand the connections between traditional subjects and the real world, and become critical and reflective thinkers" (IB, 2014c). The MYP provides a coherent and comprehensive curriculum that merges a framework of academic challenges and life skills with the district's instructional guides. The program is intended to promote the education of the whole person, emphasizing the importance of a broad and balanced education. Teachers focus on the inclusion of skills and processes built around a framework of concepts; the aim is to teach not only content knowledge but also to help students develop a genuine understanding of the underlying principles in each discipline and apply these in a new context in preparation for further learning.

Literature Review

When students are thinking critically, they are intellectually engaged (Gini-Newman, 2007; Elder & Paul, 2010). Critical thinking, as defined by a panel of 46 experts from philosophy and education, is "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the…considerations upon which that judgment is based." (American Philosophical Association, 1990, p. 2). During the past quarter century, educators and researchers have recognized that critical thinking is a crucial component in the education of our children, and developing critical thinking skills is a central educational goal and outcome (Giancarlo, Blohm, & Urdan, 2004). Studies by national and international organizations, including the National Research Council and the Organization for Economic Cooperation and Development (OECD), an organization of 30 industrialized nations, have shown that complex thinking and analytic skills are key components of learning at all stages of development (OECD, 2008; Silva, 2008).

As recognition of the importance of critical thinking skills has grown, so has the interest in teaching and measuring those skills, and understanding their relationship to other educational outcomes (Ennis, 1993; Paul and Elder, 2007; Silva, 2008; Spicer and Hanks, 1995; U.S. Department of Education, 2000). Cotter and Tally (2009) point out that defining and developing ways to measure critical thinking is necessary for a full understanding of these skills and how to improve them.

Abrami and colleagues (2009) conducted a meta-analytic examination of the impact of instruction on the development and enhancement of critical thinking skills and dispositions. Their analysis included 117 studies; 27 of them were experimental in design. They point out that the wide range of assessment tools and research designs make evaluating critical thinking challenging. For example, they classified assessment tools into the following categories:

standardized tests (i.e., Watson-Glaser Critical Thinking Appraisal, Cornell Critical Thinking Test, etc.); tests developed and evaluations conducted by a teacher (i.e., student responses to interview questions, essays and open ended questions); tests developed by researchers (i.e., instruments adopted from other sources, with or without modifications). Furthermore, the authors note that not all researchers define critical thinking the same way.

An important finding from the study was that the way critical thinking is taught matters, as does pedagogy (Abrami et al., 2009). Among the types of critical thinking interventions examined, the mixed instructional approaches that combine both content and critical thinking skills had the largest effect. The least effective technique was the immersion method, in which critical thinking is indirect and not an independent objective of the course. The other two methods, where critical thinking skills are a course objective (i.e., general approach) and where critical thinking skills are a course objective and are combined with content (i.e., infusion approach), were found to have moderate effects. In addition, when instructors received special advanced training in preparation for teaching critical thinking skills, the impacts of the instruction were greatest. Conversely, when critical thinking was stated as a course objective, but no professional development was provided, results were smallest. While not as substantial as the other findings, the authors also found that collaboration among students while developing critical thinking skills provided some advantage.

Within IB, and MYP in particular, developing critical thinking or higher-order thinking skills is recognized as central to the program (Green, 2012; Lineham, 2013; Nicholson, 2013). Culross and Tarver (2011) surveyed students and interviewed teachers about their experience in the IB DP. Both groups reported benefits of the IB classes on thinking and study skills; teachers perceived IB as "…requiring higher level thinking skills, applying learning, developing links between concepts, and covering a broader spectrum of topics…." The authors also surveyed students who had graduated four or five years earlier from an IB DP; students were asked their perceptions of the program several years out. Although only 28 students responded (50% of students contacted), their responses were consistent with those of the currently enrolled students and those of DP teachers. "…Overall, they perceived they had a greater breadth and depth of knowledge, improved creative and critical thinking skills, and improved oral and written communication skills." (Culross & Tarver, 2011, p. 236).

Although critical thinking is central to the MYP, little has been reported about how teachers are using critical thinking skills within their lessons, and to what extent students are demonstrating these thinking skills. A recent study by Alford, Rollins, Stillisano, and Waxman (2013) conducted observations of 85 classrooms from eight PYP and MYP schools to examine instruction from multiple perspectives (teacher, student, and classroom). Although the focus of their study was not on critical thinking specifically, many of the IB programme items included in their observation protocol were strategies that support critical thinking skills (e.g., "allowed students to develop concepts or procedures;" "assisted students to organize thinking"). Their study revealed that instruction in most of the schools was active, with teachers often engaging students, exploring new skills and key concepts, explaining, elaborating, and evaluating. Most of the IB programme features targeted for the observations, however, were evident only to a limited extent in the classrooms.

Scope of the Study

This study examined evidence of critical thinking skills in MYP from perspectives of both teachers and students, as well as through observations in the classrooms. To understand the possible impact of MYP on students' critical thinking skills, we surveyed 6th and 8th grade students in MYP and non-MYP schools about their approaches to tasks and problems, as well as ways they are using critical thinking skills in their classes. In addition, we surveyed 11th grade students who previously attended MYP or non-MYP middle schools about their approaches to tasks and problems. Finally, teachers in MYP and non-MYP schools were surveyed about the practices and strategies they are using to promote critical thinking in their classrooms. To acquire a deeper understanding of the ways that teachers translate their MYP training into classroom practice, we observed 32 6th and 8th grade classes in four MYP schools.

The questions guiding this study were:

1. Do current MYP students report using critical thinking skills to a greater extent than non-MYP students?
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Methodology

Selection of Schools

Four MYP middle schools and two non-MYP middle schools were chosen for the 6th and 8th grade student and teacher survey components of the study, and three high schools that receive students from both MYP and non-MYP middle schools were chosen for the Grade 11 survey component of the study.

MYP Schools

The four MYP middle schools were selected from among seven in the district using the following criteria:

- Teachers completed MYP training in the ATL skills framework.
- School feeds into high school with local IB program (not countywide magnet program).
- School administrators agreed to the administration of student and teacher surveys, and class observations.

One MYP school that did not participate in study data collection served as a pilot for surveys and the observation protocol.

Non-MYP Comparison Schools

The two comparison schools in the study were MYP candidate schools. That is, they were "next in-line" to begin implementation of MYP, and in fact the candidate schools had an MYP coordinator who could work with evaluators to manage data collection activities. According to local program staff, teachers in these comparison schools had started using the learning profile, which is not an aspect related to this study, but had not received ATL training and were not implementing the MYP curriculum or conducting instructional planning using MYP's ATL.

It was believed that selecting schools that were in consideration for MYP would result in schools more similar to MYP schools, particularly in terms of intangible aspects, like openness to implementing a rigorous schoolwide program. Two other potential comparison schools that were in consideration for MYP at the time of the study were invited to participate; one declined, and one agreed to participate but did not complete the surveys.

The two participating non-MYP schools were compared to the MYP study schools on a composite of demographic variables: percentage of students enrolled in English for Speakers of Other Languages (ESOL) classes; percentage of students receiving Free or Reduced-price Meals System (FARMS) services; percentage of students identified as Asian, Black or African American, Hispanic/Latino, or White; percentage of students receiving special education services; and previous year's mean state assessment Reading scale score. Differences in demographic and academic characteristics of the two groups were found, and statistical procedures (i.e., selection of matched groups using propensity score matching and use of propensity score as a control variable) were put in place to control for differences between the two initial groups.

High Schools

Among the eight IB DP programs in the district, the three selected for the study enroll students from both MYP and non-MYP middle schools. The design allowed concurrent survey participation of former MYP students and non-MYP students attending the same high schools.

Student Sample and Survey Administration

Prior to administering the survey, teachers sent home a permission form to parents describing the study and the survey, and any student whose parent withheld permission was not surveyed. The link to the online survey was sent to the MYP coordinator at each of the four MYP schools and two comparison middle schools, and to the IB coordinator at the three high schools. The coordinators were asked to have all students in the selected grades (6^{th} and 8^{th} in middle school and 11^{th} in high school) complete the survey during the students' English classes. The survey was administered during the spring 2014 semester.

Middle School Students. An initial total of 2,729 middle school students completed the survey. Of these, 767 surveys could not be used because they did not include a student ID number that was needed for analysis,[1] and 65 were not included in the analysis because they were completed

[1] Student ID was required to append student demographic data.

by students not in Grades 6 or 8. Thus, surveys from 1,279 6th and 8th grade students from the four MYP schools and 618 6th and 8th grade students from two comparison schools were included in this study.

It is not possible to calculate precise response rates for the student surveys because scheduling challenges in some schools and absences from class meant that not all students in the relevant grades were given the survey. However, of all 3,487 Grade 6 and 8 students in the four MYP schools and two non-MYP middle schools, 2,729 (78%) of them completed a survey. The percentage of students who completed surveys with ID numbers and in the correct grade was 54% (1,897 of 3,487).

High School Students. An initial total of 790 high school students completed the survey; 128 surveys could not be used because they did not include student ID numbers that were needed for analysis,[2] and 90 surveys were not included in the analysis because they were from students not in Grade 11. Thus, surveys from 572 Grade 11 high school students from the three high schools were included in the study. The estimated response rate for the high school survey, based on all 1,095 Grade 11 students in the three high schools, and all surveys completed, was 72%. The percentage of students who completed surveys with IDs and correct grade level was 52% (572 of 1,095).

Table 1 shows the number of students in each grade who had previously attended MYP middle schools and non-MYP middle schools in the survey response groups.

Table 1
Number of Students Responding to Surveys with Data Required for Study Inclusion by Grade Level

	MYP respondents	Non-MYP respondents
Grade	*N*	*N*
6	615	265
8	664	353
11	167	405

Student Survey

The online student surveys were developed by district researchers in collaboration with IB program staff. Both middle and high school surveys included questions about the student's use of skills or approaches associated with critical thinking and goal setting: gathering information; supporting a position; organizing information; analysis/information processing; openness and flexibility; and Goal Setting. The survey questions were adapted from two sections of the *Youth Life Skills Survey*—Critical Thinking (17 items) and Goal Setting (4 items)—created by Mincemoyer, Perkins, and Numyua (2001) at Penn State University. In addition, eight questions about classroom practices, aligned with the ATL thinking skills, were developed by district

[2] Student ID was required to append student demographic data and to identify MYP or non-MYP middle school attended.

researchers for the middle school student survey. Copies of the middle school and high school student surveys are presented in Appendix A.

The *Youth Life Skills Survey* was developed for use with youth between the ages of 8 and 18. For the current study, the survey was pilot tested with a small number of middle school students, and their feedback resulted in minor wording changes to some of the original *Youth Life Skills Survey* questions, as well as exclusion of three of the original Critical Thinking questions that were not clear to the pilot-tested students. The changes were made in order to make the survey more understandable and relevant to the school experience of middle and high school students.

Mincemoyer and Perkins (2005) have provided information describing the development of the *Youth Life Skills Survey* and reliability of subsets of questions, including Critical Thinking and Goal Setting. Cronbach's alpha for the Critical Thinking questions was .72, and for Goal Setting was .73 (Mincemover & Perkins, 2005). In this study the survey responses are presented for individual items in order to provide maximum feedback to program administrators. However, in the interest of describing the internal consistency of the particular sets of survey questions used in this study with the responses from the current study sample, we conducted a reliability analysis of the 17 Critical Thinking questions, 4 Goal Setting questions, and 8 Classroom Practice questions (middle school survey only). All middle and high school students who completed surveys were included in the analysis (N = 3,258). Chronbach's alpha was .90 for the Critical Thinking items; .79 for the Goal Setting items; and .83 for the Classroom Practice questions, indicating relatively high internal consistency for each section of the survey.

To examine the underlying dimensions in the three subsets of survey items, factor analysis, using Principal Component extraction with varimax rotation, was conducted on each of the subsets (Critical Thinking, Goal Setting, and Classroom Practices). For the Goal Setting and Classroom Practices scales, the factor analyses produced one component. For Critical Thinking, the final solution produced three factors, which may be described as: 1) gathering information and supporting a position; 2) planning and organizing; and 3) having an open mind, being flexible. A detailed description of the factor analysis is included in Appendix B. A test of the internal consistency of each of the three factors yielded acceptable measures of reliability: Cronbach's alpha was .83 for Gathering information and supporting a position; .75 for Planning and organizing; and .76 for Open mindedness and flexibility.

Teacher Sample and Survey Administration

All teachers in the four MYP schools and the two non-MYP comparison schools were invited to complete an online survey. An online survey link was provided to each school's MYP coordinator who then made it available to all teachers in the school during spring 2014.

A total of 223 teachers completed surveys, 114 from MYP schools and 109 from non-MYP schools. Because we did not contact teachers directly, we do not have an exact number of teachers who received the survey, so a response rate can only be estimated. Basing a response rate on the total number of teachers in the six schools where teachers were surveyed (total = 363), the overall response rate was 61%. The response rate for the MYP teachers was 48% and for non-MYP teachers was 86%.

Teacher Survey

The online teacher survey was developed by district researchers in collaboration with IB program staff. The survey questions were written to reflect skills outlined in the ATL framework, particularly those in the Thinking Skills category (which includes Critical Thinking, Creative Thinking, and Transfer) and the Social (Collaboration) category. The survey presented 20 teaching practices (e.g., use brainstorming to generate new ideas), and teachers were asked to indicate how often they used the practice, using a 5-point scale: Daily (every class day); Frequently (most class days); Sometimes (about half of class days); Occasionally (a few class days); and Not at all. A copy of the teacher survey is included in Appendix A.

To examine the internal consistency of the teacher survey, we conducted a reliability analysis of the 20 survey questions with the responses of the 223 teachers. All teachers, MYP and non-MYP, who completed surveys were included in the analysis. Cronbach's alpha was .90 for the survey, indicating high internal consistency of the items.

Factor analysis was conducted to examine whether subsets of questions representing different types of skills and practices would emerge as components of the survey. Results of a principal components extraction with varimax rotation revealed four components; they may be described as: 1) asking and developing questions; 2) making connections; 3) sharing, collaborating; and 4) analyzing. Results of the factor analysis are presented in Appendix B. The internal consistency of each of the components was assessed with Cronbach's alpha, yielding acceptable reliability: Cronbach's Alpha was .85 for Asking and developing questions; .79 for Making connections; .68 for Sharing and collaborating; and .74 for Analyzing.

In order to provide the most detailed feedback to program administrators, results for individual survey items are presented in this report; items are grouped by the factor components. In addition, scores were computed for each dimension (or factor component) using responses on the 5-point scale averaged across items in each of the four factors identified in the analysis.

MYP Classroom Observations

In each of the four participating MYP schools, eight classes were observed. At each school, one Grade 6 class and one Grade 8 class were randomly selected in each of the following four subjects: science, mathematics, humanities, and English. Classes of teachers who were in their first year and classes with substitute teachers were not considered for selection. Observations were conducted in February 2014.

Observation Protocol. A structured observation protocol was developed by district evaluators in consultation with IB program staff. Each observation was conducted for a full 45-minute class period. The "look fors" were closely aligned with the skills outlined in the ATL framework (e.g., "Consider multiple alternatives") and with teacher training materials relating to the use of inquiry questions (IB, 2013). Observers worked together with program staff to clearly and specifically define the observable actions and behaviors that would be counted as evidence in the observation protocol. Before observational data were collected for the study, researchers

observed several classes together, then compared ratings and discussed inconsistencies, and clarified or adjusted the protocol as needed. For each rating, observers indicated the extent of evidence for the skill/practice. A copy of the observation protocol is included in Appendix C.

Student Demographic and Performance Data

For each student who completed a survey, data on race/ethnicity, gender, previous school, receipt of services (FARMS, ESOL, and special education), and previous state assessment Reading scale score were obtained from district student records. The state assessment in reading and math was given annually to all students in Grades 3–8 in the state as a way to measure academic progress. These demographic and academic variables were appended to the survey file (using the student ID) in order to conduct analyses comparing survey responses of MYP middle school students with responses from non-MYP middle school students and high school students with MYP or non-MYP backgrounds, controlling for demographic and academic differences.

Procedures for Analysis

Different analytic procedures were used to address the evaluation questions.

Analytic Procedures for Question 1

Do current MYP students report using critical thinking skills to a greater extent than non-MYP students?

Because the groups of current MYP and non-MYP students differed both in size and on several of the demographic characteristics, statistical methods were used to reduce the potential effect of those differences. Propensity score matching was used to identify two groups of students in each grade (6 and 8)—students enrolled in MYP middle schools and students enrolled in non-MYP middle schools—who were similar in composition by race/ethnicity, receipt of FARMS, ESOL, and special education services, gender, and previous year state assessment Reading scale score.[3] These matched groups were used to examine the responses to survey items, and analyze the effect of MYP enrollment on survey scale scores. Responses of Grade 6 and Grade 8 students were analyzed separately.

For descriptive analyses, percentages of students responding "Always" or "Often" are presented for each of the items on the Critical Thinking and Goal Setting sections for students in MYP schools and students in non-MYP schools for Grade 6 and Grade 8 separately. On the survey items about classroom practices, the percentage of students in each group who responded "Strongly Agree" or "Agree" are shown.

Analysis of the effect of MYP enrollment was conducted for each of the survey dimensions (three Critical Thinking dimensions, Goal Setting, and Classroom Practices) using regression analyses, controlling for students' race/ethnicity; receipt of FARMS, ESOL, and special

[3] Propensity score matching is a method of identifying two groups of subjects who would have similar chances (based on selected variables) of being in the "treatment" group; in this study, "treatment" group refers to enrollment in an MYP middle school. Nearest neighbor matching technique was used to identify the two groups for this study.

education services; gender; and previous year state assessment Reading scale score. Dimension scale scores were computed using an average of the ratings (1 through 5) on each of the survey items in the dimension. Analyses were conducted for each grade separately.

Analytic Procedures for Question 2

Do high school students with an MYP background report greater use of critical thinking skills than their non-MYP counterparts?

Analytic procedures were similar to Question 1. Propensity score matching was used to identify two groups of students—students previously enrolled in MYP middle schools and students previously enrolled in non-MYP middle schools—who were similar in composition by race/ethnicity; receipt of FARMS, ESOL, and special education services; grade; gender; and Grade 8 state assessment Reading scale score. These matched groups were used to examine the Grade 11 students' responses to survey items, and analyze the effect of previous MYP enrollment on survey scale scores.

For descriptive analyses, percentages of students responding "Always" or "Often" are presented for each of the items on the Critical Thinking and Goal Setting sections for students who previously attended MYP schools and students who previously attended non-MYP schools.

Analysis of the effect of MYP enrollment was conducted for each of the survey dimensions (three Critical Thinking dimensions and Goal Setting) using regression analyses, controlling for students' race/ethnicity; receipt of FARMS, ESOL, and special education services; gender; and Grade 8 state assessment Reading scale score. Dimension scale scores were computed using an average of the ratings (1 through 5) on each of the survey items in the dimension. In addition, since one of the three high schools has an MYP in which all Grade 9 and Grade 10 students participate, enrollment at that high school (with MYP) was included in the analyses to control for the potential effect of MYP in Grades 9 and 10 in high school.

Analytic Procedures for Question 3

Do MYP teachers report greater use of practices promoting critical thinking in the classroom than non-MYP middle school teachers?

The survey responses of teachers in MYP schools and non-MYP schools were examined by presenting the percentage of teachers responding "Daily" or "Frequently" to each survey item. Since the focus of the survey was teachers' use of strategies that may promote critical thinking, professional development (PD) in critical thinking skills was a relevant variable. Therefore, the responses of teachers in non-MYP schools were examined separately for those who reported they had participated in critical thinking PD and those who reported they did not have critical thinking PD experience. In addition, separate analyses were conducted for teachers of English/reading and mathematics; only those two subjects had large enough samples of teachers in MYP and non-MYP schools to present responses separately.

To examine the effect of MYP on teachers' survey responses, regression analyses were conducted with each of the dimension scale scores, controlling for the number of years taught and critical thinking training received.

Analytic Procedures for Question 4

How are MYP teachers integrating the thinking skills outlined in the Approaches to Learning framework in the classroom instruction?

Findings from the 32 classroom observations were summarized descriptively. Examples from classroom observations were used to illustrate the findings.

Findings

Question 1: Do current MYP students report using critical thinking skills to a greater extent than non-MYP students?

Characteristics of Middle School Survey Respondents

Demographic and academic characteristics of the respondents from MYP and non-MYP schools were compared. The two groups of initial survey respondents differed on several of the demographic characteristics examined. Among Grade 6 students, significantly larger percentages of students from MYP schools than from non-MYP schools were Black or African American or Hispanic/Latino, and received FARMS, ESOL, or special education services (Fisher's Exact Test, $p < .05$). A significantly smaller percentage of students from MYP schools than from non-MYP schools were Asian ($p < .05$). Among Grade 8 students, significantly larger percentages of students from MYP schools were Hispanic/Latino, or received FARMS or ESOL (Fisher's Exact Test, $p < .01$). Significantly smaller percentages of students from MYP schools than from non-MYP schools were Asian or White ($p < .01$). Comparisons of the previous year's mean state assessment Reading scale score revealed that at both grade levels, the non-MYP group had significantly higher state assessment Reading scale scores than the MYP group ($p < .001$; Grade 6: mean difference = -22, effect size d = -.59; Grade 8: mean difference = -17, effect size d = -.49). The demographic and academic characteristics of the initial Grade 6 and Grade 8 survey respondents are shown in Appendix D, Table D-1.

To compare and analyze the survey responses of the two groups—MYP students and non-MYP students—and reduce the potential influence of differences in demographic or academic characteristics, we identified "analytic subsamples" of the two groups for each grade, using propensity scores to match them on gender; race/ethnicity; receipt of FARMS, ESOL, special education services; and previous state assessment Reading scale score. There were 201 matched students in each of the 6th grade groups, and 281 matched students in each of the 8th grade groups. The characteristics of the matched analytic groups in each grade are shown in Table 2.

Table 2
Characteristics of Analytic Subsamples of Grade 6 and Grade 8 Survey Respondents:
MYP and Non-MYP Students Matched on Demographic Characteristics and State Assessment Reading

	Grade 6				Grade 8			
	Students enrolled in MYP Schools (*N* = 201)		Students enrolled in non-MYP Schools (*N* = 201)		Students enrolled in MYP Schools (*N* = 281)		Students enrolled in non-MYP Schools (*N* = 281)	
Characteristics	*n*	%	*n*	%	*n*	%	*n*	%
Gender								
Male	110	54.7	92	45.8	139	49.5	133	47.3
Female	91	45.3	109	54.2	142	50.5	148	52.7
Race/Ethnicity								
Black or African American	72	35.8	56	27.9	102	36.3	88	31.3
Asian or Pacific Islander	28	13.9	33	16.4	46	16.4	51	18.2
Hispanic/Latino	66	32.8	66	32.8	63	22.4	63	22.4
White	29	14.4	35	17.4	51	18.1	63	22.4
Two or More Races	6	3.0	11	5.5	19	6.8	16	5.7
FARMS (current or previous)	131	65.2	121	60.2	158	56.2	155	55.2
ESOL (current or previous)	76	37.8	70	34.8	85	30.2	75	26.7
Special education (current)	12	6.0	14	7.0	25	8.9	23	8.2
	Mean	*(SD)*	*Mean*	*(SD)*	*Mean*	*(SD)*	*Mean*	*(SD)*
State Assessment Reading scale score (previous year)	434	(35.6)	435	(31.7)	434	(32.7)	433	(33.5)

Note. FARMS = Free and Reduced-price Meals System; ESOL = English for Speakers of Other Languages; SD = standard deviation.

Among both Grade 6 and Grade 8 students, the matched analytic groups of MYP and non-MYP students were similar on demographic characteristics and on the previous year state assessment Reading scale score. Chi square tests revealed no statistically significant differences between the analytic groups (analyzed separately for each grade) on any of the demographic characteristics reported, and ANOVA revealed the state assessment Reading scale scores of the two groups in each grade were not significantly different. These analyses confirm that the matching procedures were successful.

Survey Responses of MYP and non-MYP Students

The responses of the analytic subsamples of MYP students and students from non-MYP schools are summarized in the tables that follow. Tables 3a through 3d show the percentage of students in each group who responded “Always” or “Often” to statements on the Critical Thinking and Goal Setting dimensions of the survey; Table 3e shows the percentage of students in each group who responded “Strongly Agree” or “Agree” to the Classroom Practices dimension of the survey.

The effect of MYP was tested by analyzing the scale scores for each of the dimensions—i.e., students' averaged responses on a 1 to 5 scale to the group of items included in each dimension—using regression analyses, controlling for gender; race/ethnicity; receipt of FARMS, ESOL, special education services; and state assessment Reading Scale scores. Results of the regression analyses for each grade on each of the survey dimensions are shown in Appendix E.

Gathering information, supporting a position. Table 3a presents students' responses to survey items relating to gathering information and supporting a position. On all but one of the survey items, for both Grades 6 and 8 students, more than 60% of the respondents indicated that the statement was true for them "Always" or "Often." The regression analyses examining the effect of MYP on students' overall response to the Gathering Information dimension revealed that in Grade 6, MYP was significantly and negatively related to students' scale score on the Gathering Information dimension (β = -.113, $t(391)$ = -2.34, $p < .05$); in Grade 8 MYP was not significantly related to students' dimension scale scores. The results of the regression analyses are shown in Table E-3a in Appendix E.

Table 3a
Percentage of Respondents Responding "Always" or "Often" to Survey Statements:
MYP and Non-MYP Students Matched on Demographic Characteristics and State Assessment

Critical Thinking Dimension: Gathering information, supporting position	Grade 6				Grade 8			
	Students in MYP Schools (N = 201)		Students in Non-MYP Schools (N = 201)		Students in MYP Schools (N = 281)		Students in Non-MYP Schools (N = 281)	
Survey Items	*n*	%	*n*	%	*n*	%	*n*	%
It is important for me to get information to support my opinion.	142	71.0	151	76.6	191	69.0	204	72.9
I am able to give reasons for my opinions.	153	76.5	155	78.7	202	73.7	223	81.1
I support my decisions with the information I get.	137	70.6	146	75.3	194	70.3	216	76.9
I usually have more than one source of information before making a decision.	122	61.0	126	64.0	163	58.8	185	65.8
I make sure the information I use is correct.	152	78.4	157	79.7	200	72.2	208	74.8
I develop my ideas by gathering information.	124	62.9	140	70.4	171	61.1	200	71.7
When facing a problem, I identify options to solve it.	118	60.2	152	75.6	176	63.1	189	67.3
I think of possible results before I take action.	124	61.7	147	73.1	193	68.9	199	71.1

Planning, organizing information. Table 3b shows students' responses to survey items relating to planning and organizing information. About half of the students reported that they "Always" or "Often" use three of these skills and about a quarter of the students reported developing a checklist. The regression analyses examining the effect of MYP on students' overall response to the Planning dimension revealed that in Grade 6, MYP was significantly and negatively related to students' scale score on the Planning dimension (β = -.128, $t(391)$ = -2.55, $p < .05$); in Grade 8 MYP was not significantly related to students' scale scores. The results of the regression analyses are shown in Table E-3b in Appendix E.

Table 3b
Percentage of Respondents Responding "Always" or "Often" to Survey Statements:
MYP and Non-MYP Students Matched on Demographic Characteristics and State Assessment

Critical Thinking Dimension: Planning, organizing information	Grade 6				Grade 8			
	Students in MYP Schools (*N* = 201)		Students in Non-MYP Schools (*N* = 201)		Students in MYP Schools (*N* = 281)		Students in Non-MYP Schools (*N* = 281)	
Survey Items	*n*	%	*n*	%	*n*	%	*n*	%
I plan where to get information on a topic.	86	43.2	104	52.5	126	46.0	113	41.4
I plan how to get information on a topic.	98	49.7	123	64.1	143	52.0	143	51.6
I develop a checklist to help me think about an issue.	41	21.1	52	27.1	54	19.6	59	21.6
I put my ideas in order of importance.	99	50.8	109	55.9	138	50.2	140	50.5

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Openness to different ideas. Table 3c presents students' responses to survey items relating to being open to different ideas. On four of the skills, between 55% and 69% of the Grade 6 MYP students responded "Always" or "Often;" 42% responded always/often to the item about collaborating with others to get ideas. Among Grade 8 students, percentages of MYP and non-MYP students responding "Always" or "Often" ranged from 64% to 75% on questions about openness to other ideas, and lower percentages (49% and 56%) responded "Always" or "Often" to the collaboration item. The regression analyses examining the effect of MYP on students' overall response to the Openness dimension revealed that in both Grade 6 (β = -.181, $t(391) = -3.75$, $p < .01$) and Grade 8 (β = -.098, $t(550) = -2.40$, $p < .05$), MYP was significantly and negatively related to students' scale score on the Openness dimension. The results of the regression analyses are shown in Table E-3c in Appendix E.

Table 3c
Percentage of Respondents Responding "Always" or "Often" to Survey Statements:
MYP and Non-MYP Students Matched on Demographic Characteristics and State Assessment

Critical Thinking Dimension: Openness to different ideas	Grade 6				Grade 8			
	Students in MYP Schools (*N* = 201)		Students in Non-MYP Schools (*N* = 201)		Students in MYP Schools (*N* = 281)		Students in Non-MYP Schools (*N* = 281)	
Survey Items	*n*	%	*n*	%	*n*	%	*n*	%
I listen to the ideas of others even if I disagree with them.	135	68.5	157	79.7	179	63.9	203	73.3
I keep an open mind to different ideas when making a decision.	113	58.2	140	72.2	197	71.1	197	71.9
I compare ideas when thinking about a topic.	107	55.2	128	66.7	178	64.3	188	69.1
I am aware that sometimes there are no right or wrong answers to a question.	135	68.9	150	77.3	188	67.4	206	74.9
When I have a task to do, I collaborate with other people to get ideas.	84	41.8	108	53.7	138	49.1	157	55.9

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Goal Setting. Table 3d presents students' responses to survey items relating to setting goals. Among Grade 6 students, percentages of students in both groups who responded "Always" or "Often" was greater than 50% on all four skills; on "I think about how and when I want to reach a goal," more than three quarters of the students in MYP and non-MYP schools responded "Always" or "Often." Among Grade 8 students, smaller percentages of students in both groups responded "Always" or "Often" on three of the four skills, compared with the Grade 6 students. Only one item—"Both positive and negative feedback help me work toward my goal"—produced percentages at a level similar to that of the Grade 6 students. The regression analyses examining the effect of MYP on students' overall response to the Goal Setting dimension yielded no statistically significant effects. The results of the regression analyses are shown in Table E-3d in Appendix E.

Table 3d
Percentage of Respondents Responding "Always" or "Often" to Survey Statements:
MYP and Non-MYP Students Matched on Demographic Characteristics and State Assessment

Goal Setting Dimension	Grade 6				Grade 8			
	Students in MYP Schools (*N* = 201)		Students in Non-MYP Schools (*N* = 201)		Students in MYP Schools (*N* = 281)		Students in Non-MYP Schools (*N* = 281)	
Survey Items	*n*	%	*n*	%	*n*	%	*n*	%
I look at the steps needed to reach a goal.	139	71.6	143	71.9	170	61.2	174	63.0
I think about how and when I want to reach a goal.	144	75.4	154	77.8	193	62.0	173	69.9
After setting a goal, I break the goal down into steps so I can check my progress.	107	55.2	122	61.6	112	40.6	130	47.1
Both positive and negative feedback help me work toward my goal.	132	68.0	141	71.2	195	69.6	200	72.5

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Students' perceptions of classroom practices. Table 3e presents students' responses to survey items relating to classroom practices that may promote critical thinking. On all eight of the practices presented in the survey, 70% or more of students in both MYP and non-MYP schools agreed (i.e., responded "Strongly Agree" or "Agree") that the practice was used in their classes. The practice with the largest percentage of students agreeing was, "My teachers often ask me to explain my answers" (between 88% and 97% of the students agreed). The regression analyses examining the effect of MYP on students' overall response to the Classroom Practices dimension revealed that in both Grade 6 (β = -.242, $t(391)$ = -4.90, $p < .01$) and Grade 8 (β = -.100, $t(550)$ = -2.37, $p < .05$), MYP had a significant, and negative effect on students' overall response the Classroom Practices dimension. The results of the regression analyses are shown in Table E-3e in Appendix E.

Table 3e
Percentage of Respondents Responding "Strongly Agree" or "Agree" to Survey Statements:
MYP and Non-MYP Students Matched on Demographic Characteristics and State Assessment

Classroom Practices	Grade 6				Grade 8			
	Students in MYP Schools (N = 201)		Students in Non-MYP Schools (N = 201)		Students in MYP Schools (N = 281)		Students in Non-MYP Schools (N = 281)	
Survey Items	*n*	%	*n*	%	*n*	%	*n*	%
My teachers often ask me to explain my answers.	181	92.8	192	96.5	245	88.4	264	95.3
In my classes, students are encouraged to share their ideas.	148	75.5	173	87.4	197	71.1	197	71.9
In my classes, we are encouraged to 'brainstorm' ideas and questions.	160	82.1	180	90.5	219	79.3	231	83.7
In my classes, we sometimes evaluate our own learning.	135	70.7	175	88.4	199	71.8	212	77.7
In my classes, students are encouraged to think about ideas and problems from different points of view.	159	80.7	176	88.0	213	77.2	237	85.3
For some of our classwork, we use what we have learned in more than one subject.	159	80.7	175	87.5	216	78.0	230	83.6
In my classes, we are encouraged to collaborate and think through problems together.	149	74.9	183	92.0	207	75.8	224	81.8
In my classes, students often are asked to identify trends or make predictions.	147	75.0	169	84.9	193	70.2	198	72.8

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Survey Responses of MYP Students: Critical Thinking Strategies and Practices Reported by Largest and Smallest Percentages of Respondents

To understand which of the critical thinking strategies MYP students currently report using most frequently and least frequently, survey responses were examined across all strategies to identify those with the largest and smallest percentages of MYP students reporting that they use the strategy "Always" or "Often."

Critical thinking and goal setting. The percentage of MYP students responding "Always" or "Often" to the use of strategies for critical thinking and goal setting ranged from 20% to 78%, as shown in Tables 3a through 3d. Table 4 shows survey items with the largest percentages of MYP students responding "Always" or "Often" and items with the smallest percentages of MYP students responding at that level. Classroom practices are listed separately in Table 5.

Table 4
Survey Items with Largest and Smallest Percentages of MYP Students Responding "Always" or "Often"—Critical Thinking and Goal Setting Dimensions

	Students in MYP Schools			
	Grade 6 (N = 201)		Grade 8 (N = 281)	
Survey Items with *Largest* Percentages of Students Responding "Always" or "Often"	*n*	%	*n*	%
I make sure the information I use is correct.	152	78.4	200	72.2
I am able to give reasons for my opinions.	153	76.5	202	73.7
I support my decisions with the information I get.	137	70.6	194	70.3
It is important for me to get information to support my opinion.	142	71.0	191	69.0
Survey Items with *Smallest* Percentages of Students Responding "Always" or "Often"				
When I have a task to do, I collaborate with other people to get ideas.	84	41.8	138	49.1
I plan where to get information on a topic.	86	43.2	126	46.0
I develop a checklist to help me think about an issue.	41	21.1	54	19.6

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Four skills used by the largest percentage of MYP students were in the Gathering Information, Supporting Position area. Over 75% of Grade 6 students responded "Always" or "Often" to "I make sure the information I use is correct," and "I am able to give reasons for my opinions;" 72% and 74% of the Grade 8 students responded at this level to the two items, respectively. Approximately 70% of both the Grades 6 and 8 MYP students responded "Always" or "Often" to "It is important for me to get information to support my opinion," and "I support my decisions with the information I get."

The items with the lowest percentage of students responding "Always" or "Often" were, for the most part, items in the Planning and Organizing Information area. Most of the survey items in the planning and organizing group had responses of "Always" or "Often" by 50% or less of the 6th and 8th grade MYP students. In addition, an item relating to collaboration—"When I have a task to do, I collaborate with other people to get ideas"—had relatively low percentages of students responding "Always" or "Often" for one or both of the grades.

Perceptions of classroom practices. MYP students' responses to survey items about classroom practices ranged from 70% to 93% responding "Strongly Agree" or "Agree." Table 5 shows the practices with highest and lowest percentages of agreement.

Table 5
Survey Items with Largest and Smallest Percentages of MYP Students Responding "Strongly Agree" or "Agree"—Classroom Practices

	Students in MYP Schools			
	Grade 6 (*N* = 201)		Grade 8 (*N* = 281)	
Survey Items with *Largest* Percentages of Students Responding "Strongly Agree" or "Agree"	*n*	%	*n*	%
My teachers often ask me to explain my answers.	181	92.8	245	88.4
In my classes we are encouraged to 'brainstorm' ideas and questions.	160	82.1	219	79.3
For some of our classwork, we use what we have learned in more than one subject.	159	80.7	216	78.0
In my classes, students are encouraged to think about ideas and problems from different points of view.	159	80.7	213	77.2
Survey Items with *Smallest* Percentages of Students Responding "Strongly Agree" or "Agree"				
In my classes, we sometimes evaluate our own learning.	135	70.7	199	71.8
In my classes, students often are asked to identify trends or make predictions.	147	75.0	193	70.2

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

The item with the highest percentage of agreement by MYP students was, "My teachers often ask me to explain my answers" (93% of Grade 6 students and 88% of Grade 8 students responded "Strongly Agree" or "Agree"). Also showing a high percentage of agreement was, "In my classes we are encouraged to 'brainstorm' ideas and questions" (82% of Grade 6 and 79% of Grade 8 students agreed), as well as an item about thinking about problems from different points of view, and an item about using what has been learned in other subjects.

No survey items had levels of agreement lower than 70%. The items at that lower level of agreement (70–75%) were: "In my classes, we sometimes evaluate our own learning" (71% of Grade 6 and 72% of Grade 8 students agreed); and "In my classes, students often are asked to identify trends or make predictions" (75% of Grade 6 and 70% of Grade 8 students agreed).

Question 2: Do high school students with an MYP background report greater use of critical thinking skills than their non-MYP counterparts?

Characteristics of High School Survey Respondents

Characteristics of the two groups of high school survey respondents—those who previously attended MYP schools and those who attended non-MYP schools—were examined. Differences between the two groups of high school students were evident on several of the demographic

characteristics. Significantly smaller percentages of students from MYP schools than from non-MYP schools were Black or African American, and a significantly larger percentage of students from MYP schools than from non-MYP schools were White or received ESOL services (Fisher's Exact Test, $p < .05$). The demographic and academic characteristics of the initial Grade 11 survey respondents are shown in Appendix D, Table D-2.

To compare and analyze the two groups' survey responses without the potential influence of differences in demographic characteristics, we identified analytic subsamples of the two groups, using propensity scores to match them on gender; race/ethnicity; and receipt of FARMS, ESOL, and special education services; and Grade 8 state assessment Reading scale score. There were 151 students in each of the Grade 11 matched samples. The characteristics of the two matched analytic groups are shown in Table 6.

Table 6
Characteristics of Analytic Subsamples of Grade 11 Survey Respondents: Previous MYP and Non-MYP Students Matched on Demographic Characteristics and State Assessment Reading

		Students previously enrolled in MYP Schools (N = 151)		Students previously enrolled in non-MYP Schools (N = 151)	
Characteristics		*n*	%	*n*	%
Gender	Male	76	50.3	75	49.7
	Female	75	49.7	76	50.3
Race/ ethnicity	Black or African American	38	25.2	38	25.2
	Asian	21	13.9	20	13.2
	Hispanic/Latino	61	40.4	62	41.1
	White	30	19.9	30	19.9
	Two or More Races	1	0.7	1	0.7
FARMS (current or previous)		92	60.9	91	60.3
ESOL (current or previous)		55	36.4	55	36.4
Special education (current)		8	5.3	8	5.3
		Mean	*(SD)*	*Mean*	*(SD)*
State Assessment Reading scale score (Grade 8)		422	(42.3)	423	(42.1)

Note. FARMS = Free and Reduced-price Meals System; ESOL = English for Speakers of Other Languages; SD = Standard Deviation.

The matched analytic groups of high school students were similar on the specified demographic characteristics and the Grade 8 state assessment Reading scale score. Chi square tests revealed no statistically significant differences between the analytic groups on their demographic characteristics, and ANOVA revealed no significant difference between the groups on their Grade 8 state assessment Reading scores, indicating a successful matching procedure.

Survey Responses of High School Students Previously Enrolled in MYP and non-MYP Schools

The responses of the matched analytic groups of high school students—those previously enrolled in MYP and those from non-MYP schools—are summarized in the tables that follow. Tables 7a through 7d show the percentage of students in each group who responded "Always" or "Often" to statements on the Critical Thinking and Goal Setting dimensions of the survey. The effect of

MYP was tested by analyzing the mean scale scores for each of the dimensions—i.e., students' averaged responses on a 1 to 5 scale to the group of items included in each dimension—using regression analyses, controlling for gender; race/ethnicity; receipt of FARMS, ESOL, and special education services; and Grade 8 state assessment Reading Scale score.

Gathering information, supporting a position. Table 7a presents high school students' responses to survey items relating to gathering information and supporting a position. On all but one of the survey items, two thirds or more of the students in both groups responded that the statement was true for them "Always" or "Often." The item with the highest percentage of students responding "Always" or "Often" was, "I am able to give reasons for my opinions," endorsed by 81% of the students in each group. The regression analysis revealed no statistically significant relationship between previous MYP enrollment and students' overall response on the Gathering Information dimension ($\beta = .016$, $t(291) = .281$, $p > .05$).

Table 7a
Percentage of High School Students Responding "Always" or "Often" to Survey Statements: by Previous MYP or Non-MYP Enrollment, Matched on Demographic Characteristics and State Assessment

Critical Thinking Dimension: Gathering information, supporting position	Previous Enrollment in MYP School (N = 151)		Previous Enrollment in Non-MYP Schools (N = 151)	
Survey Items	*n*	%	*n*	%
It is important for me to get information to support my opinion.	103	68.7	115	76.7
I am able to give reasons for my opinions.	120	80.5	120	80.8
I support my decisions with the information I get.	111	74.0	108	73.5
I usually have more than one source of information before making a decision.	77	52.4	96	63.6
I make sure the information I use is correct.	113	74.8	110	72.8
I develop my ideas by gathering information.	108	71.5	98	64.9
When facing a problem, I identify options to solve it.	108	71.5	116	77.3
I think of possible results before I take action.	112	74.2	112	74.2

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Planning, organizing information. Table 7b shows students' responses to survey items relating to planning and organizing information. Similar to the responses of the middle school students, the percentage of students reporting that they "Always" or "Often" use these skills was about half on three of the items and about a quarter on the items about developing a checklist. The regression analysis revealed no statistically significant relationship between previous MYP enrollment and students' overall response to the Planning dimension ($\beta = .028$, $t(291) = .475$, $p > .05$).

Table 7b
Percentage of High School Students Responding "Always" or "Often" to Survey Statements: by Previous MYP or Non-MYP Enrollment, Matched on Demographic Characteristics and State Assessment

Critical Thinking Dimension: Planning, organizing information	Previous Enrollment in MYP Schools (N = 151)		Previous Enrollment in Non-MYP Schools (N = 151)	
Survey Items	*n*	%	*n*	%
I plan where to get information on a topic.	69	46.0	69	45.7
I plan how to get information on a topic.	71	47.7	83	55.0
I develop a checklist to help me think about an issue.	45	30.0	33	22.1
I put my ideas in order of importance.	82	54.7	85	57.0

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Openness to different ideas. Table 7c presents high school students' responses to survey items relating to being open to different ideas. On four of the skills, around 70% of students in both groups responded "Always" or "Often;" about half of the students responded always/often to the collaboration item. The regression analysis revealed no statistically significant relationship between previous MYP enrollment and students' overall response to the Openness to Ideas dimension (β = .015, t(291) = .260, p > .05).

Table 7c
Percentage of High School Students Responding "Always" or "Often" to Survey Statements: by Previous MYP or Non-MYP Enrollment, Matched on Demographic Characteristics and State Assessment

Critical Thinking Dimension: Openness to different ideas	Previous Enrollment in MYP Schools (N = 151)		Previous Enrollment in Non-MYP Schools (N = 151)	
Survey Items	*n*	%	*n*	%
I listen to the ideas of others even if I disagree with them.	113	74.8	110	72.8
I keep an open mind to different ideas when making a decision.	108	71.5	111	74.5
I compare ideas when thinking about a topic.	108	71.5	103	68.2
I am aware that sometimes there are no right or wrong answers to a question.	109	73.2	110	73.8
When I have a task to do, I collaborate with other people to get ideas.	74	49.0	76	51.0

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Goal Setting. Table 7d presents students' responses to survey items relating to setting goals. Percentages of students who responded "Always" or "Often" were greatest in both groups for, "Both positive and negative feedback help me work toward my goal"—more than three quarters of the students responded "Always" or "Often." The lowest percentage for each group (49% for former MYP students and 53% for non-MYP students) was in response to, "After setting a goal, I break the goal down into steps so I can check my progress." The regression analysis revealed no statistically significant relationship between previous MYP enrollment and students' overall response to the Goal Setting dimension (β = -.020, t(291) = -.337, p > .05).

Table 7d

Percentage of High School Students Responding "Always" or "Often" to Survey Statements: by Previous MYP or Non-MYP Enrollment, Matched on Demographic Characteristics and State Assessment

Goal Setting Dimension	Previous Enrollment in MYP Schools (N = 151)		Previous Enrollment in Non-MYP Schools (N = 151)	
Survey Items	*n*	%	*n*	%
I look at the steps needed to reach a goal.	97	64.2	105	69.5
I think about how and when I want to reach a goal.	103	68.7	102	68.0
After setting a goal, I break the goal down into steps so I can check my progress.	74	49.3	78	52.7
Both positive and negative feedback help me work toward my goal.	116	77.9	114	76.5

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Survey Responses of High School Students Previously Enrolled in MYP: Strategies Used by Largest and Smallest Percentages of Respondents

To understand which of the critical thinking strategies high school students with an MYP background currently report using most frequently and least frequently, survey responses were examined across all strategies to identify those with the largest and smallest percentages of students reporting that they use the strategy "Always" or "Often."

Critical Thinking and Goal Setting. The responses of high school students with previous MYP enrollment varied across the different Critical Thinking and Goal Setting strategies. Table 8 lists the survey items with the largest percentages of students responding "Always" or "Often" and items with the smallest percentages of students responding at that level.

Table 8

Survey Items with Largest and Smallest Percentages of High School Students Responding "Always" or "Often"—Critical Thinking and Goal Setting

	High School Students Previously Enrolled in MYP (N = 201)	
Survey Items with *Largest* Percentages of Students Responding "Always" or "Often"	*n*	%
I am able to give reasons for my opinions.	120	80.5
Both positive and negative feedback help me work toward my goal.	116	77.9
I listen to the ideas of others even if I disagree with them.	113	74.8
I make sure the information I use is correct.	113	74.8
I think of possible results before I take action.	112	74.2
I support my decisions with the information I get.	111	74.0

Table 8 (continued)
Survey Items with Largest and Smallest Percentages of High School Students Responding "Always" or "Often"—Critical Thinking and Goal Setting

Survey Items with *Smallest* Percentages of Students Responding "Always" or "Often"	*n*	%
After setting a goal, I break the goal down into steps so I can check my progress.	74	49.3
When I have a task to do, I collaborate with other people to get ideas.	74	49.0
I plan how to get information on a topic.	71	47.7
I plan where to get information on a topic.	69	46.0
I develop a checklist to help me think about an issue.	45	30.0

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Survey items with the highest percentage of "Always" or "Often" responses by high school students previously enrolled in MYP showed some similarities to the items reported by the highest percentages of MYP middle school students. Similar to responses of middle school students, the largest number of items—four—were in the Gathering Information, Supporting Position area. Three quarters or more of the students responded "Always" or "Often" to, "I am able to give reasons for my opinions," and "I make sure the information I use is correct." More than 70% of students responded "Always" or "Often" to, "I support my decisions with the information I get," and "I think of possible results before I take action." One item in the Goal Setting dimension had high percentages of students responding "Always" or "Often:" "Both positive and negative feedback help me work toward my goal" was endorsed by 78% of the high school students. The item in the Openness to Different Ideas dimension with the highest reported use was, "I listen to the ideas of others even if I disagree with them" (75% of high school students responded "Always" or "Often").

The items with the lowest percentage of students responding "Always" or "Often" were, for the most part, items in the Planning and Organizing Information area. Similar to the responses of the middle school MYP students, most of the survey items in the planning and organizing group had 50% or less of the high school students responding "Always" or "Often." In addition, two other items—"When I have a task to do, I collaborate with other people to get ideas," and "After setting a goal, I break the goal down into steps so I can check my progress"—had less than half of the students responding "Always" or "Often."

Question 3: Do MYP teachers report greater use of practices promoting critical thinking in the classroom than non-MYP middle school teachers?

Characteristics of Teacher Survey Respondents

Characteristics of the two groups of teachers who completed surveys—those who taught at MYP schools and those who taught at non-MYP schools—were examined. For each of the two groups of respondents, Table 9 shows the numbers of years taught in the district, the grade level and subject taught, and whether the teacher reported participating in PD focused on critical thinking.

Overall, the responding teachers were an experienced group; almost two thirds had taught in the district for six years or more. The non-MYP teachers were slightly more likely to have taught 10 years or more than the MYP teachers (52% compared with 41%).

Most of the responding teachers taught more than one grade (57% of MYP teachers and 53% of non-MYP teachers). Percentages of respondents teaching Grade 6 and Grade 7 were similar between the MYP and non-MYP teachers; a slightly higher percentage of non-MYP teachers taught Grade 8 students than MYP teachers (17% compared with 10%).

The largest percentages of teachers from both groups taught English or reading, or mathematics. Table 9 shows the number of teachers completing the survey who taught each subject.

Table 9
Characteristics of Survey Respondents:
Teachers in MYP Schools and Teachers in Non-MYP Middle Schools

Characteristics		Teachers in MYP schools (*N* = 114)		Teachers in non-MYP schools (*N* = 109)		Total (*N* = 223)	
		n	%	*n*	%	*n*	%
Number of years taught in the district[a]	1 (first year)	14	12.7	9	8.4	23	10.6
	2–5 years	27	24.5	25	23.4	52	24.0
	6–9 years	24	21.8	17	15.9	41	18.9
	10 or more	45	40.8	56	52.3	101	46.5
Grades taught[b]	6	21	19.3	18	17.3	39	18.3
	7	15	13.8	13	12.5	28	13.1
	8	11	10.1	19	17.3	29	13.6
	More than one grade	62	56.9	55	52.9	117	54.9
Subject taught	English or reading	26	22.8	26	23.9	52	23.3
	Mathematics	20	17.5	18	16.5	38	17.0
	Science	10	8.8	11	10.1	21	9.4
	Social studies	13	11.4	12	11.0	25	11.2
	Foreign language	9	7.9	5	4.6	14	6.3
	ESOL	8	7.0	3	2.8	11	4.9
	Art, music, computer science	3	2.6	9	8.3	12	5.3
	Physical education or health	3	2.6	9	8.3	12	5.4
	Other or no answer	22	19.3	16	14.7	38	17.1
Has participated in PD focused on critical thinking (including MYP training)		92	80.7	62	56.9	154	69.1

[a] Answered by 110 MYP teachers and 107 non-MYP teachers.
[b] Answered by 109 MYP teachers and 104 non-MYP teachers.

MYP teachers were asked about their participation in IB/MYP PD opportunities; both MYP and non-MYP teachers were asked about attendance at PD focused on critical thinking. Table 9 shows the percentage of teachers in each group who reported attending PD that focused on critical thinking (including, among MYP respondents, official IB/MYP PD that addressed the

Approaches to Learning). Among responding teachers, 81% of MYP teachers[4] and 57% of non-MYP teachers reported attending PD focused on critical thinking. Since the study focused on the use of strategies that are frequently used to promote critical thinking, the survey responses of teachers in non-MYP schools who reported participation in critical thinking PD were examined separately from those non-MYP teachers who did not report critical thinking PD experience.

Survey Responses of MYP and non-MYP Teachers

Tables 10a through 10d show the percentage of teachers who responded "Daily" (every class day) or "Frequently" (most class days) to each of the survey items, which are organized into four dimensions based on the factor analysis: 1) Asking and Developing Questions; 2) Making Connections; 3) Sharing and Collaborating; and 4) Analyzing. Responses are shown for three groups of teachers: MYP teachers; teachers in non-MYP schools who reported participating in PD focused on critical thinking; teachers in non-MYP schools who did not report participating in critical thinking PD. The effect of MYP was tested by analyzing the scores for each of the dimensions—i.e., teachers' averaged responses on a 1 to 5 scale to the group of items included in each dimension—using regression analyses, controlling for number of years taught, grade taught, and receipt of critical thinking training. Results of the regression analyses for each of the survey dimensions are shown in Appendix F.

Asking and developing questions. Overall, compared with other items on the survey, the survey items in this group had lower percentages of teachers in all groups—MYP, non-MYP with critical thinking PD, and non-MYP with no critical thinking PD—responding that they use the practice "Daily" or "Frequently" (Table 10a). An exception to the lower percentages was on the practice of brainstorming—73% of the MYP teachers reported that they use brainstorming, as a class or in groups, "Daily" or "Frequently;" 66% of the non-MYP teachers with critical thinking PD, and 60% of the non-MYP teachers without PD reported using brainstorming "Daily" or "Frequently." The practices with the lowest percentage of teachers responding "Daily" or "Frequently" referred to asking students to develop arguments or questions. Analysis of teachers' overall response to items in the Asking and Developing Questions dimension revealed no statistically significant effect for MYP. Results of the regression analysis are shown in Appendix F, Table F-10a.

[4] Although not all of the MYP teachers reported attending PD focused on critical thinking, the program staff were confident that all MYP teachers receive ongoing PD related to critical thinking, specifically training on the Approaches to Learning.

Table 10a
Percentage of Teachers Responding "Daily" or "Frequently" to Survey Statements: MYP Teachers, Non-MYP Teachers with Critical Thinking PD, and Non-MYP Teachers Without Critical Thinking PD

Asking and developing questions	Teachers in MYP Schools (N = 114)		Teachers in Non-MYP Schools			
			With Critical Thinking Training (N = 62)		Without Critical Thinking Training (N = 47)	
Survey Items	*n*	%	*n*	%	*n*	%
Asks students to develop opposing or complementary arguments.	30	26.5	24	39.3	10	21.3
Encourages students to guess or ask "what if" questions.	55	48.2	41	66.1	28	59.6
Presents questions for discussion that have no clear right or wrong answers.	61	53.5	42	67.7	26	56.5
Helps students evaluate evidence and arguments.	60	53.6	36	59.0	21	46.7
Ask students to formulate relevant and provocative questions.	35	31.3	23	38.3	19	41.3
Use brainstorming as a class or among groups of students, to generate new ideas.	83	72.8	41	66.1	28	59.6
Helps students identify trends or make predictions.	60	53.6	35	57.4	17	37.0

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Making connections. Responses to survey items in this group were in the midrange among all the survey items—most of the items had between 51% and 79% of the responding teachers indicating that they use the practice "Daily" or "Frequently" (Table 10b). Among MYP teachers, the item with the highest percentage of teachers responding at that level was "Discuss a real-world problem" (74%). No statistically significant effect for MYP was found in the analysis of the overall scale scores for the Making Connections dimension. Results of the regression analysis are shown in Appendix F, Table F-10b.

Table 10b
Percentage of Teachers Responding "Daily" or "Frequently" to Survey Statements: MYP Teachers, Non-MYP Teachers with Critical Thinking PD, and Non-MYP Teachers Without Critical Thinking PD

Making connections	Teachers in MYP Schools (N = 114)		Teachers in Non-MYP Schools			
			With Critical Thinking Training (N = 62)		Without Critical Thinking Training (N = 47)	
Survey Items	*n*	%	*n*	%	*n*	%
Discuss significance of the lesson—personally, locally, nationally, or globally.	78	69.0	47	75.8	37	78.7
Solicit multiple and diverse points of view about a question or issue.	68	60.7	39	62.9	27	57.4
Discuss a real-world problem.	84	73.7	42	67.7	29	61.7
Make connections between learning gained in different subject areas.	62	54.9	35	56.5	24	51.1
Direct students to gather and organize information to formulate a position or perspective.	70	61.4	37	59.7	28	59.6

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Sharing and collaborating. Responses to three of the four survey items in this group were greater than 75% of the responding MYP teachers indicating that they use the practice "Daily" or "Frequently" (Table 10c). The item with the highest percentage of teachers responding at that level was, "Ask students to explain their answers" (90% of MYP teachers; 95% of non-MYP teachers with PD; 92% of non-MYP teachers without PD). Two other survey items were endorsed by more than 75% of MYP teachers: "Ask students to share their work with the class," and "Ask students to work together to think through problems, questions, or issues." No statistically significant effect for MYP was found in the analysis of the overall scale scores for the Sharing and Collaborating dimension. Results of the regression analysis are shown in Appendix F, Table F-10c.

Table 10c
Percentage of Teachers Responding "Daily" or "Frequently" to Survey Statements: MYP Teachers, Non-MYP Teachers with Critical Thinking PD, and Non-MYP Teachers Without Critical Thinking PD

Sharing and collaborating	Teachers in MYP Schools (N = 114)		Teachers in Non-MYP Schools: With Critical Thinking Training (N = 62)		Teachers in Non-MYP Schools: Without Critical Thinking Training (N = 47)	
Survey Items	*n*	%	*n*	%	*n*	%
Ask students to share their work with the class.	85	75.9	43	70.5	28	60.9
Ask students to share their work with others for reflection and refinement.	69	61.6	43	69.4	29	61.7
Ask students to work together to think through problems, questions, or issues.	95	83.3	54	87.1	35	74.5
Ask students to explain their answers.	103	90.4	59	95.2	43	91.5

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Analyzing. Overall, the practices included in this group of survey items had the highest levels of reported use by the three groups of teachers (Table 10d). Each of the three survey items in the Analyzing dimension had greater than 75% of each of the groups indicating that they use the practice "Daily" or "Frequently." The items referred to breaking down concepts, using models, and encouraging students to use existing knowledge. No statistically significant effect for MYP was found in the analysis of the overall scale scores for the Analyzing dimension. Results of the regression analysis are shown in Appendix F, Table F-10d.

Table 10d
Percentage of Teachers Responding "Daily" or "Frequently" to Survey Statements: MYP Teachers, Non-MYP Teachers with Critical Thinking PD, and Non-MYP Teachers Without Critical Thinking PD

Analyzing	Teachers in MYP Schools (N = 114)		Teachers in Non-MYP Schools: With Critical Thinking Training (N = 62)		Teachers in Non-MYP Schools: Without Critical Thinking Training (N = 47)	
Survey Items	*n*	%	*n*	%	*n*	%
Help students break down complex concepts or problems into their component parts.	89	78.1	53	85.5	39	83.0
Use models or visuals to represent complex ideas.	88	77.9	54	88.5	41	87.2
Encourage students to use existing knowledge to generate new ideas or solve an unfamiliar problem.	89	78.8	53	86.9	39	83.0

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Teachers' Responses by Subject Area

Given the range of subjects taught by the responding teachers, it was of interest to examine the use of the practices in different subject areas. Two subjects had a large enough group of teachers in both the MYP schools and non-MYP schools—English or reading, and mathematics. Tables 11a through 11d summarize the responses of the English and mathematics teachers' from MYP and non-MYP schools.[5]

Asking and developing questions. Similar to the responses for all MYP and non-MYP teachers, the practice with the highest percentage of English or reading teachers responding "Daily" or "Frequently" was brainstorming; 92% of the MYP English/reading teachers reported using brainstorming daily or frequently. Among mathematics teachers in MYP schools, the practices with the largest percentage of teachers reporting daily or frequent use were: "Helps students evaluate evidence and arguments," and "Helps students identify trends or make predictions" (65% reporting daily/frequently for each practice). Analysis of the effect of MYP on the overall scale scores for the Asking and Developing Questions dimension (separately for English/reading and mathematics) revealed no statistically significant MYP effect for either English/reading teachers or mathematics teachers. Results of the regression analyses are shown in Appendix F, Table F-11a.

[5] Because the numbers of teachers within subject areas were smaller, the non-MYP teachers were not divided into groups according to critical thinking training received.

Table 11a
Percentage of Teachers Responding "Daily" or "Frequently" to Survey Statements:
MYP Teachers and Non-MYP Teachers of English/Reading or Mathematics

Asking and developing questions	English or Reading				Mathematics			
	Teachers in MYP Schools (*N* = 26)		Teachers in Non-MYP Schools (*N* = 26)		Teachers in MYP Schools, (*N* = 20)		Teachers in Non-MYP Schools (*N* = 18)	
Survey Items	*n*	%	*n*	%	*n*	%	*n*	%
Ask students to develop opposing or complementary arguments.	9	34.6	10	38.5	5	25.0	3	16.7
Encourage students to guess or ask "what if" questions.	18	69.2	16	61.5	7	35.0	8	44.4
Present questions for discussion that have no clear right or wrong answers.	18	69.2	21	80.8	9	45.0	7	38.9
Help students evaluate evidence and arguments.	17	65.4	16	64.0	13	65.0	7	38.9
Ask students to formulate relevant and provocative questions.	13	50.0	13	52.0	5	25.0	4	22.2
Use brainstorming as a class or among groups of students, to generate new ideas.	24	92.3	19	73.1	12	60.0	8	44.4
Help students identify trends or make predictions.	17	65.4	14	56.0	13	65.0	8	44.4

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Making connections. In both English/reading and mathematics, the practice with the highest percentage of teachers reporting daily or frequent use was "Discuss a real-world problem." Analyses of the effect of MYP on the overall scale scores for the Making Connections dimension comparing responses of MYP and non-MYP teachers (separately for English/reading and mathematics) revealed that, among mathematics teachers, MYP was statistically significantly related to the scale score for this dimension ($\beta = .515$, $t(35) = 2.85$, $p < .01$). MYP was not significantly related to the Making Connections dimension for English/reading teachers. Results of the regression analyses are shown in Appendix F, Table F-11b.

Table 11b
Percentage of Teachers Responding "Daily" or "Frequently" to Survey Statements:
MYP Teachers and Non-MYP Teachers of English/Reading or Mathematics

Making connections	English or Reading				Mathematics			
	Teachers in MYP Schools (N = 26)		Teachers in Non-MYP Schools (N = 26)		Teachers in MYP Schools, (N = 20)		Teachers in Non-MYP Schools (N = 18)	
Survey Items	*n*	%	*n*	%	*n*	%	*n*	%
Discuss significance of the lesson—personally, locally, nationally, or globally.	23	88.5	23	88.5	11	55.0	8	44.4
Solicit multiple and diverse points of view about a question or issue.	22	84.6	20	76.9	12	63.2	5	27.8
Discuss a real-world problem.	23	88.5	21	80.8	19	95.0	13	72.2
Make connections between learning gained in different subject areas.	18	72.0	19	73.1	9	45.0	4	22.2
Direct students to gather and organize information to formulate a position or perspective.	21	80.8	18	69.2	12	60.0	8	44.4

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Sharing and collaborating. High percentages of English/reading and mathematics teachers in MYP schools and in non-MYP schools reported daily or frequent use of these practices (Table 11c). Mathematics teachers in MYP schools in particular reported high levels of use: 100% of them indicated that they, "Ask students to work together to think through problems, questions, or issues" daily or frequently, and 95% of reported that they "Ask students to share their work with the class" daily or frequently. Nearly all teachers in both groups reported that they ask students to explain their answers. Analyses of the effect of MYP on the overall scale scores for the Sharing and Collaborating dimension (separately for English/reading and mathematics) revealed that, among mathematics teachers, MYP was statistically significantly related to the scale score for this dimension ($\beta = .436$, $t(35) = 2.32$, $p < .05$). MYP was not significantly related to the Making Connections dimension for English/reading teachers. Results of the regression analyses are shown in Appendix F, Table F-11c.

Table 11c
Percentage of Teachers Responding "Daily" or "Frequently" to Survey Statements:
MYP Teachers and Non-MYP Teachers of English/Reading or Mathematics

Sharing and collaborating	English or Reading				Mathematics			
	Teachers in MYP Schools (N = 26)		Teachers in Non-MYP Schools (N = 26)		Teachers in MYP Schools, (N = 20)		Teachers in Non-MYP Schools (N = 18)	
Survey Items	*n*	%	*n*	%	*n*	%	*n*	%
Ask students to share their work with the class.	21	80.8	19	76.0	19	95.0	13	72.2
Ask students to share their work with others for reflection/refinement.	18	72.0	19	73.1	15	75.0	12	66.7
Ask students to work together to think through problems, questions, or issues.	22	84.6	22	84.6	20	100.0	15	83.3
Ask students to explain their answers.	25	96.2	26	100.0	20	100.0	18	100.0

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Analyzing. High percentages of MYP and non-MYP teachers in both English/reading and mathematics reported daily or frequent use of the practices in this area (Table 11d). Among the MYP group, 80% or more of the teachers in both English/reading and mathematics reported daily or frequent use of each of the practices. Analyses of the effect of MYP on overall scale scores for the Analyzing dimension (separately for English/reading and mathematics) revealed that, among mathematics teachers, MYP was statistically significantly related to the scale score for this dimension ($\beta = .459$, $t(35) = 2.48$, $p < .05$). MYP was not significantly related to the Making Connections dimension for English/reading teachers. Results of the regression analyses are shown in Appendix F, Table F-11d.

Table 11d
Percentage of Teachers Responding "Daily" or "Frequently" to Survey Statements:
MYP Teachers and Non-MYP Teachers of English/Reading or Mathematics

Analyzing	English or Reading				Mathematics			
	Teachers in MYP Schools (*N* = 26)		Teachers in Non-MYP Schools (*N* = 26)		Teachers in MYP Schools, (*N* = 20)		Teachers in Non-MYP Schools (N = 18)	
Survey item	*n*	%	*n*	%	*n*	%	*n*	%
Helps students break down complex concepts or problems into their component parts.	23	88.5	22	84.6	20	100.0	15	83.3
Use models or visuals to represent complex ideas.	21	80.8	25	96.2	16	80.0	13	76.5
Encourage students to use existing knowledge to generate new ideas or solve an unfamiliar problem.	22	88.6	22	88.0	18	90.0	15	83.3

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Survey Responses of MYP Teachers: Practices Used Daily or Frequently by Largest and Smallest Percentages of Respondents

The responses of MYP teachers varied across the practices presented in the survey. Table 12 lists the survey items with the largest percentages of teachers responding, "Daily" or "Frequently (most days)," and items with the smallest percentages of teachers responding at that level.

The practice with the largest percentage of teachers reporting daily or frequent use was, "Ask students to explain their answers," consistent with the responses from middle and high school students, whose survey item with the highest endorsement was, "I am able to give reasons for my opinions," as well as the middle school students' response to classroom practices, in which 93% of the Grade 6 respondents indicated agreement that, "My teachers often ask me to explain my answers." All but two of the practices with the highest percentages of daily or frequent use were in the Analyzing and Sharing and Collaborating dimensions of the teacher survey. The three practices with the lowest response were from the Asking and Developing Questions dimension of the survey. Less than half of the responding MYP teachers reported that they: "Ask students to develop opposing or complementary arguments," "Ask students to formulate relevant and provocative questions," or "Encourage students to guess or ask 'what if' questions" on a daily or frequent basis.

Table 12
Survey Items with Largest and Smallest Percentages of MYP Teachers Responding "Daily" or "Frequently"

Survey Items with Largest Percentages of Teachers Responding "Daily" or "Frequently"	Teachers from 4 MYP Schools (N = 114)	
	n	%
Ask students to explain their answers.	103	90.4
Ask students to work together to think through problems, questions, or issues.	95	83.3
Encourage students to use existing knowledge to generate new ideas or solve an unfamiliar problem.	89	78.8
Help students break down complex concepts or problems into their component parts.	89	78.1
Use models or visuals to represent complex ideas.	88	77.9
Ask students to share their work with the class.	85	75.9
Discuss a real-world problem.	84	73.4
Use brainstorming as a class or among groups of students, to generate new ideas.	83	72.8
Survey Items with Smallest Percentages of Teachers Responding "Daily" or "Frequently"		
Encourage students to guess or ask "what if" questions.	55	48.2
Ask students to formulate relevant and provocative questions.	35	31.3
Ask students to develop opposing or complementary arguments.	30	26.5

Note. Not all survey respondents answered all questions. Percentages are based on number of respondents answering question.

Findings from MYP Classroom Observations

A description of subjects and grades of the 32 classrooms where observations were conducted is presented in Table 13. At each of the four MYP schools, one Grade 6 class and one Grade 8 class were randomly selected in each of the following four subjects: science, mathematics, humanities, and English. Classes of teachers who were in their first year and classes with substitute teachers were not considered for selection.

Observations were conducted in February 2014; each classroom observation was 45 minutes long. The mean number of students in the observed classes was 24; class size ranged from 15 to 34 students.

Table 13
Number of Classes for Observations in MYP Schools

Subject	Number of Grade 6 Classes (N = 16)	Number of Grade 8 Classes (N = 16)	Total Number of Classes (N = 32)
English	4	4	8
Mathematics	4	4	8
Humanities	4	4	8
Science	4	4	8

Physical evidence of critical thinking skills in the classroom. While observing the class session, researchers also scanned the classroom for physical evidence of the use of critical thinking skills. Physical evidence was observed in 6 of the 32 classrooms. Examples of the evidence noted were:

- Premade posters on: Analyze, Categorize, Compare, Clarify, Compile, Conclude, Contrast, Formulate, Examine, Explain, Evaluate, Describe, Elaborate, etc.
- Easel paper on the wall with plus and delta sides to it—ready to use
- Posters: "What comparisons can you make between motion and force;" "What evidence can be observed;" and others
- Graphic organizers (e.g., webs) created by students

Classroom arrangement. Observers also recorded the arrangements of desks in the classroom. Most classrooms (23) were set up with clusters or groups of desks. Four were arranged in rows, and five used other arrangements (e.g., rows facing middle, rows of pairs).

Statement of inquiry. A key component of an MYP learning unit is the statement of inquiry, described in the MYP Unit planner notes (IB, 2013) as setting "conceptual understanding in a global context in order to frame classroom inquiry and direct purposeful learning." A statement of inquiry was observed in only 3 of the 32 classrooms. All three were displayed (on poster or board), and one also was stated by the teacher. For example, one classroom displayed this statement of inquiry: "Global interactions (relationships between individuals, communities, and nature) are influenced by resources and perspective."

Overarching or focus question. Observers looked for evidence of an overarching question that the lesson was focused on or organized around. An overarching or focus question was noted in 19 of the 32 classrooms. Science and social studies classes were more likely than English or mathematics classes to have an overarching question; seven science classes and six social studies classes were observed to have an overarching question. Three English classes and three mathematics classes had overarching questions. Examples of overarching or focus questions are listed below.

- What was a major result of the Industrial Revolution?
- What effect can one person or character have on the outcome of a society?
- What conclusions can you draw about cause and effect relationships based on your reading of a nonfiction text, fictional text, and personal experience?
- What are costs and benefits of (1) highway system, and (2) great wall. Was it worth it?
- What is the connection between distance formula and Pythagorean theorem?
- How does global warming impact sea level? Communities?
- How do authors vary narrative elements to serve their purposes?
- How do economic and political systems influence each other?
- How do we classify angles and why do we classify angles before we measure them?

Inquiry questions. In addition to the focus question, observers listened throughout the class session for inquiry questions—factual, conceptual, and debatable—and recorded the level of prominence of the inquiry questions within the lesson. MYP materials (IB, 2013) define the three types of inquiry questions in this way:

- Factual—concrete questions that have right and wrong answers (who, why, what, when, where); often focusing on recall
- Conceptual—more abstract questions that explore broader meanings, deeper understanding and transferrable knowledge; often involving analysis and synthesis
- Debatable—questions that generate disagreement, engage multiple perspectives, and promote critical and creative thinking; often involving the creation and exploration of competing values, theories and rationales

In each classroom, observers made an overall judgment—were inquiry questions: 1) prominent or the focus of the lesson; 2) evident, but not prominent or the focus of the lesson; or 3) no inquiry questions were heard.

Evidence of inquiry questions was observed in all 32 classroom observations.

- Inquiry questions were prominent or the focus of the lesson in 21 classrooms.
- Inquiry questions were evident (but not prominent) in 11 classrooms.
- No classrooms had ratings of "Not heard or observed."

The types of inquiry questions heard most frequently were factual and conceptual. Table 14 shows the extent of the inquiry questions reported in the 32 classroom observations.

Table 14
Ratings of Extent of Inquiry Questions in 32 Classroom Observations

Type of inquiry question	None	Up to a few	Many
Factual	0	14	18
Conceptual	1	17	14
Debatable	17	13	2

Factual and conceptual questions were heard in almost all of the classrooms. Debatable questions were observed in fewer classrooms, although almost half (15, or 47%) of the classes did include one or more debatable question. Table 15 lists examples from the observations of each of the types of inquiry questions.

Table 15
Examples of Inquiry Questions from 32 Classroom Observations

Factual
Dividing by 2 is the same as multiplying by what?
What fraction French am I if my grandmother is 1/2 French? What do you multiply by?
What is compost made of?
What is the Silk Road?
What does materialistic mean?
What does "sound" mean here?
What is the missing variable?
Do sea turtles pull into their shells like land turtles?
Conceptual
What do you think most Americans felt about westward expansion in the 1800s?
How can we use graham cracker, frosting, fruit roll-up to represent plate boundaries?
How can this item be used when it is recycled?
Why would silk be a wanted fabric?
What are other metaphors of death?
Why are there environmental problems with farming?
Why did the author choose the title …?
How does area and perimeter apply to life?
Debatable
Which of the following had the most impact on humanity?
Which type of economic system (market, mixed market, command) would be the best to live in?
Do you think the picture shows he will be good or bad for the nation?
Does everyone get treated fairly under law?
Which way of learning about plate techtonics is best? (Dance, snack, diagrams)
Is social networking good or bad?
Was the cost of human suffering worth the benefit of economic and geographic expansion?
Was the Great Wall worth it?

Critical and creative thinking skills. Observers recorded occurrences of 18 separate indicators of thinking skills. The indicators were drawn from the ATL skill categories, specifically, Critical Thinking and Creative Thinking (IB, 2013). Table 16 lists the indicators and the percentage of classrooms where the skill was observed; findings are organized with the most frequently observed indicators listed first. It should be remembered that each observation was conducted for only one class period, providing a brief snapshot of the strategies used in the classroom. It must not be concluded that the percentage of classrooms where the skill was observed represents the percentage of classrooms ever using the skill. In the summary of observations (Table 16), the use of the skills should be viewed comparatively, rather than absolutely. The skills that were observed in a larger percentage of the classes are likely skills that are used more frequently, and were more likely to occur during the observation. Similarly, the skills observed in fewer classrooms are probably used less frequently overall and thus were less likely to be evident during the observation.

Table 16
Evidence of Critical and Creative Thinking Skills Recorded in 32 Classroom Observations

	Skill Observed	
	Number of classrooms	% of classrooms
Make logical connections, as appropriate (e.g., with subjects, self, text).	25	78.1
Gather and organize relevant information to formulate a perspective or gain knowledge.	23	71.9
Explain, elaborate on, or justify thinking to peers or teacher, in writing or orally.	23	71.9
Consider multiple alternatives, even unlikely ones, and ideas from multiple perspectives, diverse thoughts and points of view.	20	62.5
Break down large ideas or concepts for analysis (*explicitly* breaking down into component parts).	20	62.5
Practice visible thinking strategies and techniques. (e.g., graphic organizers, Venn diagrams, "I used to think, now I think").	19	59.4
Use models and simulations to explore complex systems and issues. (e.g., scenarios, acting out, video clip, science demo/experiment).	17	53.1
Draw conclusions and generalizations.	16	50.0
Apply existing knowledge to generate new ideas, solutions, products, or processes.	13	40.6
Evaluate evidence and arguments. Recognize / discuss assumptions and bias.	11	34.4
Students formulate provocative and relevant questions (going beyond who/what/where). –why? --how? --to what extent?	10	31.2
Brainstorming.	9	28.1
Ask "what if" questions and/or generate testable hypotheses (might be guess).	7	21.9
Synthesize ideas from smaller components to build new understanding or knowledge.	7	21.9
Test generalizations and conclusions.	7	21.9
Make predictions; identify trends and forecast possibilities.	6	18.7
Identify obstacles, challenges, problems.	4	12.5
Revise understanding based on new information and evidence (beyond simply solidifying understanding).	2	6.2

Eight of the indicators were observed in at least half of the classrooms. The indicators observed in the highest percentage of classrooms were: "Make logical connections…" (78% of the classrooms); "Gather and organize relevant information…" (72%); and "Explain, elaborate on, or justify thinking…" (72%). Ten indicators were observed in fewer than half of the classrooms. The indicator observed with the lowest frequency (in two classrooms) was "Revise understanding based on new information and evidence…."

Type of interactions. Students are expected to be active learners in the MYP classroom, so a measure of their interaction during class was included in the observation protocol. Observers recorded the amount of time in each of the classrooms spent in different types of interactions (e.g., teacher talking to students, students talking to class or to teacher, or students talking to students). Table 17 shows the percentage of time in the 32 classrooms spent in different types of interactions.

Table 17
Number and Percent of Classrooms Observed Spending Different Portions of Class Time in Three Types of Interactions (*N* = 32 Classrooms)

	Not observed		Up to ¼ (and more than 0) of class time		More than ¼ up to ¾ of class time		¾ or more of class time	
Type of Interaction	*n*	%	*n*	%	*n*	%	*n*	%
Teacher to all students	1	3.1	7	21.9	10	31.2	14	43.7
Student to teacher and class	5	15.6	24	75.0	2	6.2	1	3.1
Student to student	12	37.5	17	53.1	3	9.4	0	0.0

The 32 classes varied in the amount of class time spent with the teacher talking to all students; in 25% of the classrooms the teacher was talking one fourth or less of the time (3% not at all plus 22% less than one fourth); in 31% the teacher was talking between one and three fourths of the class time, and in 44% of the classes the teacher was talking three fourths of the class time or more. Students talking to the teacher or class were in most cases occurring as a smaller portion of the class time—91% of the interactions were one fourth or less of the class time. Students talking to students were observed in 63% of the classrooms; most of those interactions occurred in one fourth of the class time or less.

Critical and Creative Thinking Skills: Congruence of Findings by Multiple Measures

A number of the thinking skills were assessed through multiple means—student surveys, teacher surveys, and classroom observations. Although the sources used different measurements and the protocols were not identical, the findings were consistent for many of the skills. For most of the skills where more than one assessment was available, the relative level of occurrence was consistent. An examination of the skills across multiple study measures revealed some overall findings:

Moderate to high ratings on all measures—Four skills had moderate to high ratings (i.e., over 50%) on all measures (middle school student surveys, teacher surveys, and classroom observations):

- Gathering and organizing information
- Considering ideas from different points of view
- Making connections
- Students explaining or elaborating on their thinking

Moderate ratings on teacher survey and observations—Two skills were reported by a moderate to high percentage (over 50%) of surveyed teachers, and were observed in a moderate percentage (over 50%) of the classrooms:

- Breaking down complex concepts
- Using models or visuals to represent complex ideas

Low ratings on teacher survey and observations—Two skills were reported by relatively small percentages of surveyed teachers (less than 50%), and they were observed in a relatively small percentage (less than 50%) of classrooms:

- Students formulating relevant and provocative questions
- Students asking "what if" questions

Moderate to high ratings on surveys, low in observations— Finally, two skills were reported as occurring with moderate to high frequency by student and teacher surveys (over 50%), but were observed as occurring in relatively low percentages (less than 50%) of the classrooms:

- Brainstorming
- Identifying trends, making predictions

Summary of Findings

Survey Findings from MYP and non-MYP Students

Comparisons of MYP students' survey responses with those of non-MYP students (using dimension scale scores) did not show greater use of critical thinking or goal setting behaviors by MYP students. Analysis of survey findings indicated that for some critical thinking dimensions, middle school students in non-MYP schools reported more frequent use of the behaviors than students in MYP. Among high school students, responses of students previously enrolled in MYP and those previously enrolled in non-MYP schools were similar.

Survey Findings from MYP and non-MYP Teachers

More than half (57%) of the non-MYP teachers reported that they had participated in professional development focused on critical thinking, so responses to survey items were examined separately for non-MYP teachers with critical thinking PD and those who reported no critical thinking PD, and analyses of the effect of MYP controlled for receipt of training. Analyses of teachers' overall responses to survey dimensions revealed no significant effect for MYP among teachers in all subjects.

Further examination of teachers' responses was conducted by subject area; English/reading and Mathematics teachers had large enough groups for analysis. In a subsample of mathematics teachers, MYP was significantly and positively related to overall responses within the Making Connections, Analyzing, and Sharing and Collaborating dimensions.

Observations of MYP Classrooms

Inquiry questions—in the form of factual, conceptual, or debatable questions—were observed in all 32 classrooms. Conceptual questions, which enable students to explore "big ideas," were observed in 97% of classrooms; debatable questions, which enable students to use facts and concepts to debate a position, were observed in 47% of the classrooms. Several of the critical thinking skills were observed in more than 70% of the classrooms: gathering information, making connections, and explaining ideas.

Critical Thinking Skills Used Most Frequently in MYP Classrooms

Student and teacher surveys, and classroom observations, showed a high level of consistency. The skills reported by the highest percentages of students and teachers and observed in most classrooms were:

- Gathering and organizing information
- Considering ideas from different points of view
- Making connections
- Students explaining or elaborating on their thinking

Strengths and Limitations

The use of a mixed-method design, using reliable and valid measures, is a strength of the study. Surveys were used to elicit data from multiple sources, and the use of structured classroom observations added rigor to the study, generating data that are not self-reported.

Findings from multiple study measures produced consistent results in this study. A high level of agreement was seen among the survey responses of MYP students, high school students previously enrolled in MYP, and teachers in MYP schools, and observation findings from 32 MYP classrooms. The consistency across measures provides some evidence of the concurrent validity of the surveys and observations.

The comparison of survey responses of MYP students and teachers with those of non-MYP students and teachers may have been influenced by the lack of random assignment and the choice of comparison schools. The selection of comparison schools that were candidates for MYP offered some control over factors that are not measured, such as administrative and staff "readiness" for a schoolwide program, as well as survey administration through a school-based coordinator. However, one of the comparison schools contains a districtwide magnet program, which might be associated with some differences in student populations and teacher training. Although the study analyzed survey responses from samples of students matched on demographic and academic characteristics in order to mitigate the effects of differences in student populations, it is possible that there are other characteristics that the analyses were not able to statistically control. For example, it is possible that students who have applied for and have been selected for a specialized magnet program have some different traits that were not measured in this study, such as in motivation levels or organizational skills. Consequently, the comparison of survey responses from MYP and non-MYP middle school students should be

viewed with caution, as there may have been unmeasured differences in the two groups of middle school students.

In addition, although all schools were asked to administer the surveys in English class, nearly all of the students in the non-MYP schools took the survey in other classes; the largest number took the survey in mathematics class (40%). It is not known whether completing the survey in different subject classes might influence students' responses, but it must be considered. In addition, a large number of students did not provide a student ID on their survey so their surveys could not be included in the analysis; this reduction brought the response rate of useable surveys down from 78% to 54% for middle school students and from 72% to 52% for Grade 11 students.

Analysis of the teachers' survey responses also may have been confounded by the choice of comparison schools. Although it was believed that having teachers from MYP candidate schools would provide a suitable comparison, it is possible that anticipation of the start of MYP may have introduced more than the usual amount of social desirability bias for the comparison group teachers. In addition, even though the comparison group teachers had not received training with the ATL framework from the IB, a large percentage of these non-MYP teachers had received PD related to critical thinking. Their training may have influenced their own responses to the teacher survey, and it also may have had an effect on the responses of their students, since the PD may have impacted their classroom practices.

Finally, the specific skills that were examined in the study were based on the Approaches to Learning Skills Framework. The ATL framework was introduced in the district at the start of the 2013–2014 school year, when teachers in IB, MYP, and PYP schools received additional training and support to incorporate the skills into their everyday classroom activities. Therefore, the skills that the study assessed were newly introduced into the MYP curriculum at the beginning of the same year as the study; it is possible that more time is needed before measuring the use of these skills in classroom practice.

Discussion

High percentages of MYP students and teachers reported the use of numerous critical thinking skills and classroom strategies, and many of the skills were observed in over half of the classrooms. In both surveys and observations, *gathering information*, *explaining ideas*, *considering multiple alternatives, sharing work* and *making connections* were among the most frequently used skills.

Two skills were endorsed on surveys by high percentages of both students and teachers, but were recorded in classroom observations at relatively low frequencies—brainstorming; and identifying trends, making predictions. It is possible that these skills may occur relatively infrequently but have a high impact, so survey responses might reflect the perceived use as higher than it actually was.

The comparison of MYP students' and teachers' survey responses with those of non-MYP students and teachers did not yield, for the most part, positive effects for MYP. As pointed out in the Strengths and Limitations section, the choice of non-MYP comparison schools, as well as the

fact that over half of the non-MYP teachers had received professional development focused on critical thinking, may have influenced the survey responses of both students and teachers in the non-MYP schools. However, large percentages of MYP students did report using many of the critical thinking skills examined in this study. In their response to survey questions about the use of critical thinking strategies in their classrooms, over 70% of the MYP students agreed that each of the strategies was in use; many strategies were reported by more than 80% of the MYP students. Thus, there is evidence that strategies to support critical thinking *are* being used in MYP classrooms, and they are being used in at least some non-MYP classrooms. The study findings cannot readily be generalized to all schools in the district, since the MYP and comparison schools may not be representative of schools throughout the district. Finally, it is important to consider that the district's Strategic Planning Framework (2013) includes creative problem solving as one of three key competency areas. Critical and creative thinking is a systemwide goal, so the findings may reflect progress toward that goal.

Recommendations

Findings from the student and teacher surveys, as well as the classroom observations suggest the following recommendations.

1. Continue training and support of MYP teachers in the use of ATL skills in instruction. A number of skills were found—through surveys and observations—to be widely used in the MYP classrooms. Target the skills reported by lower percentages of teachers (e.g., "Ask students to develop opposing or complementary arguments;" "Ask students to formulate relevant and provocative questions") for additional support. Within the new ATL framework, these are skills that require higher levels of critical thinking; teachers may need additional support and time to practice the use of these high-level critical thinking skills in the classroom. It may be useful to examine curriculum documents to identify areas where critical thinking is incorporated and where critical thinking skills can be strengthened.

2. Provide additional support for learning the use of the Statement of Inquiry. Classroom observations revealed that teachers are using inquiry questions in their classrooms, including the use of conceptual questions in almost all classrooms and debatable questions in nearly half. Help teachers use these skills to formulate and regularly refer to (with displays and reiterations) the Statement of Inquiry.

3. Explore ways to help teachers increase the amount of student-to-student interaction in classroom instructional activities. In most classrooms observed, the largest amount of time was spent with teachers talking to students. In addition, relatively small percentages of students (less than half) reported that they collaborate with others to get ideas, although about three quarters reported that they are encouraged to collaborate in classes. Previous research found that collaboration among students while developing critical thinking skills helped solidify the skills (Abrami et al., 2009).

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Appendix A

2014 Middle School Survey

Please complete the following survey. Your responses will be kept confidential and will not be shared with your teachers. Your answers will be combined with answers from other students from this school and other schools to help us learn more about how students make decisions and solve problems.

Please enter your MCPS student ID:

The following statements describe how you might think about certain things in your daily life. Mark the answer that corresponds to how often you have done what is described in the last 30 days. For example, if you mark "Always" for an item, that means you always do what is described in the statement.

	Never	Rarely	Sometimes	Often	Always
1. I think of possible results before I take action.					
2. When I have a task to do, I collaborate with other people to get ideas.					
3. I develop my ideas by gathering information.					
4. When facing a problem, I identify options to solve it.					
5. I am able to give reasons for my opinions.					

	Never	Rarely	Sometimes	Often	Always
6. It is important for me to get information to support my					

	Never	Rarely	Sometimes	Often	Always
opinions.					
7. I usually have more than one source of information before making a decision.					
8. I plan where to get information on a topic.					
9. I plan how to get information on a topic.					
10. I put my ideas in order of importance.					
11. I support my decisions with the information I get.					

	Never	Rarely	Sometimes	Often	Always
12. I listen to the ideas of others even if I disagree with them.					
13. I compare ideas when thinking about a topic.					
14. I keep an open mind to different ideas when making a decision.					
15. I am aware that sometimes there are no right or wrong answers to a question.					
16. I develop a checklist to help me					

	Never	Rarely	Sometimes	Often	Always
think about an issue.					

	Never	Rarely	Sometimes	Often	Always
17. I make sure the information I use is correct.					
18. I look at the steps needed to reach a goal.					
19. I think about how and when I want to reach a goal.					
20. After setting a goal, I break the goal down into steps so I can check my progress.					
21. Both positive and negative feedback help me work toward my goal.					

For the following items, please indicate how much you agree or disagree by marking the appropriate circle. When deciding on your answer, please think about ALL of your classes and respond with an answer that indicates your opinion OVERALL.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. My teachers often ask me to explain my answers.				
2. In my classes, students are encouraged to share their ideas.				

	Strongly Disagree	Disagree	Agree	Strongly Agree
3. In my classes, we are encouraged to "brainstorm" ideas and questions.				
4. In my classes, we sometimes evaluate our own learning.				

	Strongly Disagree	Disagree	Agree	Strongly Agree
5. In my classes, students are encouraged to think about ideas and problems from different points of view.				
6. For some of our classwork, we use what we have learned in more than one subject.				
7. In my classes, we are encouraged to collaborate and think through problems together.				
8. In my classes, students often are asked to identify trends or make predictions.				

What is your current grade level?

What school do you attend?

In which class are you taking this survey?

2014 Middle School Teacher Survey

Please take a few minutes to complete the following survey. The survey does not ask for your name and your responses will be kept confidential. Your answers will be combined with answers from other teachers in this school and in other schools to help us learn more about middle school classroom teaching strategies.

Thinking about all the classes you teach, on average, over the last three weeks, how often did you.....

	Daily (every class day)	Frequently (most class days)	Sometimes (about half of class days)	Occassionally (a few class days)	Not at all
Present questions for discussion that have no clear right or wrong answers.					
Ask students to explain their answers.					
Ask students to develop opposing or complementary arguments.					
Ask students to share their work with others for reflection and refinement.					
Use brainstorming, as a class or among groups of students, to generate new ideas.					
	Daily (every class day)	Frequently (most class days)	Sometimes (about half of class days)	Occassionally (a few class days)	Not at all
Help students evaluate evidence and arguments.					

	Daily (every class day)	Frequently (most class days)	Sometimes (about half of class days)	Occassionally (a few class days)	Not at all
Help students identify trends or make predictions					
Provide direct instruction.					
Ask students to share their work with the class.					
Ask students to formulate relevant and provocative questions.					

	Daily (every class day)	Frequently (most class days)	Sometimes (about half of class days)	Occassionally (a few class days)	Not at all
Make connections between learning gained in different subject areas.					
Use models or visuals to represent complex ideas.					
Discuss signficance of the lesson - personally, locally, nationally, or globally.					
Solicit multiple and diverse points of view about a question or issue.					
Encourage students to use existing knowledge to generate new ideas or solve an					

	Daily (every class day)	Frequently (most class days)	Sometimes (about half of class days)	Occassionally (a few class days)	Not at all
unfamiliar problem.					

	Daily (every class day)	Frequently (most class days)	Sometimes (about half of class days)	Occassionally (a few class days)	Not at all
Help students break down complex concepts or problems into their component parts.					
Direct students to gather and organize information to formulate a position or perspective.					
Discuss a real-world problem.					
Ask students to work together to think through problems, questions, or issues.					
Encourage students to guess or ask "what if" questions.					

At which school do you currently teach?

- Clemente MS
- Key MS
- Martin Luther King MS
- Montgomery Village MS
- Neelsville MS
- Silver Spring International MS

- Sligo MS
- other

What subject do you teach?

If you teach more than one subject, please indicate your primary subject, or the subject you teach in the most classes.

What grade do you teach?

(check all that apply)

- 6th grade
- 7th grade
- 8th grade

How many years have you taught at MCPS?

- 1 -- this is my first year
- 2 -- this is my second year
- 3 years
- 4 years
- 5 years
- 6-7 years
- 8-9 years
- 10 years or more

How many years have you taught at an IB school (including MYP and/or PYP)?

- 1 -- this is my first year
- 2 -- this is my second year
- 3 years
- 4 years
- 5 years
- 6-7 years
- 8-9 years
- 10 years or more

Have you ever attended any of the following IB/MYP professional development opportunities?

(check all that apply)

- ☐ Official IB training (category 1, 2, or 3, three-day training)
- ☐ MCPS IB Continuing Professional Development 3-credit course
- ☐ IB Mid-Atlantic Networking Session
- ☐ In-house IB/MYP training with MYP coordinator

Apart from any IB/MYP training indicated above, have you attended any professional development focused on critical thinking skills?

- ○ yes
- ○ no

If you indicated YES, that you have attended professional development focused on critical thinking skills, please describe:

Thank you for your participation!

Appendix B

Factor Analyses of Critical Thinking Questions on Student Survey

Principal component analysis was used because the primary purpose was to identify factors underlying the Critical Thinking Questions of the Youth Life Skills Survey. Data from all survey respondents (both middle school and high school students) were included in the factor analysis (N = 3.258).

The initial solution produced two factors and explained 45% of the variance. An examination of factor loadings in the initial solution revealed that several items (5 of 17) loaded between .35 and .55 on each of the two factors, so a second analysis was conducted forcing three factors. The result produced three interpretable factors, and explained 52% of the variance. The three factors within the Critical Thinking set of survey items may be described as: 1) gathering information and supporting a position (explained 21% of the variance); 2) planning and organizing information (explained 15% of the variance); AND 3) having an open mind, being flexible (explained 15% of the variance). All items except one fit well within the factor model; the exception ("When I have a task to do, I collaborate…") loaded .41 on the third factor and had a communality of .32. Table B-1 details the factor loadings and communalities for each of the survey questions.

Table B-1

Factor Loadings and Communalities Based on Principal Components Analysis with Varimax Rotation for Critical Thinking Questions from the Youth Life Skills Survey (N = 3,258)

	Gather info, support position	Planning, organizing	Open to different ideas	Communality
It is important for me to get information to support my opinions.	.66			.51
I am able to give reasons for my opinions.	.65			.46
I support my decisions with the information I get.	.61			.52
I usually have more than one source of information before making a decision.	.59	.33		.50
I make sure the information I use is correct.	.59			.42
I develop my ideas by gathering information.	.58	.32		.48
When facing a problem, I identify options to solve it.	.57			.46
I think of possible results before I take action.	.53			.40
I plan where to get information on a topic.	.34	.75		.68
I plan how to get information on a topic.	.37	.72		.66
I develop a checklist to help me think about an issue.		.68		.55
I put my ideas in order of importance.		.64		.53
I listen to the ideas of others even if I disagree with them.			.77	.63
I keep an open mind to ideas when making a decision.	.31		.72	.63
I compare ideas when thinking about a topic.	.30		.67	.61
I am aware that sometimes there are no right or wrong answers to a question.			.56	.41
When I have a task to do, I collaborate with other people to get ideas.		.32	.41	.32

Note. Factor loadings < .3 are not shown in table.

Factor Analyses of Teacher Survey

Principal component analysis was used to identify factors underlying the questions in the teacher survey. Data from all survey respondents (both MYP and non-MYP teachers) were included in the factor analysis (N = 223).

The factor solution produced four factors and explained 58% of the variance. The factors may be described as: 1) asking and developing questions (19% of the variance); 2) making connections (14% of the variance); 3) sharing, collaborating (13% of the variance); and 4) analyzing (12% of the variance). Most items fit the factor model well, except two of the items that had cross-loadings on three of the factors with no loading greater than .43. Table B-2 details the factor loadings and communalities for each of the survey items.

Table B-2
Factor Loadings and Communalities Based on Principal Components Analysis with Varimax Rotation for Teacher Survey Questions (N = 223)

	Asking and developing questions	Making connections	Sharing and collaborating	Analyzing	Communality
Ask students to develop opposing or complementary arguments	.73				.62
Encourage students to guess or ask "what if" questions	.66				.55
Presents questions for discussion that have no clear right or wrong answers.	..64	.34			.55
Help students evaluate evidence and arguments.	.64			.37	.60
Ask students to formulate relevant and provocative questions.	.61				.53
Use brainstorming as a class or among groups of students to generate new ideas.	.58		.42		.51
Help students identify trends or make predictions.	.54		.32	.31	.51
Discuss significance of the lesson—personally, locally, nationally, or globally		.83			.77
Solicit multiple and diverse points of view about a question or issue	.42	.69			.71
Discuss a real world problem.		.62	.42		.60
Make connections between learning gained in different subject areas.		.57			.45
Direct students to gather and organize information to formulate a position or perspective.	.33	.43		.42	.50
Ask students to share their work with the class.			.76		.67
As students to share their work with others for reflection and refinement.	.38		.74		.69
Ask students to work together to think through problems, questions, or issues.	.30		.53	.31	.51
Ask students to explain their answers.	.35		.42	.32	.41
Help students break down complex concepts or problems into their component parts.				.83	.75
Use models or visuals to represent complex ideas.				.66	.56
Encourage students to use existing knowledge to generate new ideas or solve an unfamiliar problem.	.33	.36		.51	.56

Note. Factor loadings < .3 are not shown in table.

Appendix C

CLASSROOM OBSERVATION BY DISTRICT
Winter 2014

Observer	[ ] TM [ ] NW	[ ] JW	**School:**	[ ] Key [ ] SSI	[ ] Neelsville [ ] Montgomery Village
Date:			**Time/Period:**	[ ] "45"min period [ ] Block	**Room Number:**
Course:	[ ] Math [ ] Science	[ ] Social Studies [ ] English	**Number of Students today** _____		**Grade** ___
Teacher's Name:			**Other adults in room:**		
			[ ] Co-Teacher [ ] Special Ed Teacher [ ] Student teacher	[ ] Paraeducator [ ] Volunteer [ ] Other _____	

Is there physical evidence in the classroom related to critical thinking skills? E.g., posters, student work explicitly showing critical thinking techniques (models, diagrams, assembling sets of data)? Describe:

How are desks arranged? [ ] rows [ ] clusters/groups [ ] circle [ ] other _____

STATEMENT OF INQUIRY:

_____

_____ [ ] stated [ ] displayed

INQUIRY QUESTIONS used or developing:

Question	*Student Tchr, Grp*	*F,C,D**
*__Factual__ (information), __Conceptual__ (big ideas), __Debatable__ (take a stand, no right answer)		

Was there an **overarching question** that the lesson was focused on or organized around? [ ]YES [ ]NO

Question:_____

_____

Overall, through the whole class session, inquiry questions were: [ ] prominent or the focus of the lesson

[ ] evident, but not prominent or the focus of the lesson [ ] no inquiry questions heard

If inquiry questions were prominent, indicate: Factual [ ]None [ ]a couple or few [ ]many
Conceptual [ ]None [ ]a couple or few [ ]many
Debatable [ ]None [ ]a couple or few [ ]many

If inquiry questions were prominent, indicate: Student posed [ ]None [ ]a couple or few [ ]many

Teacher posed [ ]None [ ]a couple or few [ ]many

	Extent of Evidence			Indicate for MOST or check both if = mix	
Skills observed:	No Evidence	Once or Twice	Throughout	Teacher guided	Student initiated
GATHERING, GENERATING, EVALUATING INFORMATION AND IDEAS					
1. **Gather and organize** relevant information to formulate a perspective or gain knowledge.					
2. **Evaluate evidence and arguments.** Recognize / discuss assumptions and bias					
3. **Consider multiple alternatives,** even unlikely ones, and ideas from multiple perspectives, diverse thoughts and points of view.					

4. Draw **conclusions and generalizations**.					
5. **Test** generalizations and conclusions.					
6. **Revise understanding** based on new information and evidence (beyond simply solidifying understanding).					
ANALYZING, CONNECTING, SYNTHESIZING INFORMATION					
7. Make **logical connections**, as appropriate (e.g., with subjects, self, text)					
8. **Explain, elaborate on, or justify thinking** to peers or teacher, in writing or orally					
9. Make **predictions;** identify **trends and forecast** possibilities					
10. **Break down** large ideas or concepts for analysis **(*explicitly* breaking down** into component parts)					
11. Synthesize ideas from smaller components to build new understanding or knowledge.					
	Extent of Evidence			Indicate for MOST or check both if = mix	
Skills observed:	No Evidence	Once or Twice	Throughout	Teacher guided	Student initiated
12. Use **models and simulations** to explore complex systems and issues. (e.g., scenarios, acting out, video clip, science demo/experiment)					
13. Students **formulate provocative and relevant questions** (going beyond who/what/where). **–why? --how? --to what extent?**					

14. Practice **visible thinking strategies** and techniques. (e.g., graphic organizers, Venn diagrams, "I used to think, now I think")					
CREATIVE THINKING, PROBLEM-SOLVING					
15. **Ask "what if**" questions and/or generate testable hypotheses (might be guess).					
16. **Identify** obstacles, **challenges, problems**					
17. **Apply existing knowledge** to generate **new** ideas, solutions, products, or processes.					
STRATEGIES					

Was **brainstorming** used? [ ] YES [ ] NO What thinking skills was it supporting?

[ ] Gathering info [ ] Considering multiple alternatives [ ] Drawing conclusions [ ] Inquiry questions [ ] Making guesses/hypotheses [ ] Identifying challenges [ ]
Other:_____

About what portion of the total class time is each type of talk…
(record minutes or fraction of class time, in increments of ¼)

Teacher to all students_____ Student to teacher and class _____ Student to student_____

Other (describe)_____

Notes from the lesson—content, structure of the lesson, general observations.

Appendix D

Table D-1
Demographic Characteristics and MSA Reading Scores of All Grade 6 and 8 Survey Respondents Enrolled in MYP Schools or Non-MYP Schools

		Grade 6				Grade 8			
		Students enrolled in MYP Schools (*N* = 615)		Students enrolled in non-MYP Schools (*N* = 265)		Students enrolled in MYP Schools (*N* = 664)		Students enrolled in non-MYP Schools (*N* = 353)	
Characteristics		*n*	*%*	*n*	*%*	*n*	%	*n*	%
Gender	Male	276	44.9	125	47.2	308	46.4	172	48.7
	Female	339	55.1	140	52.8	356	53.6	181	51.3
Race/ ethnicity	Black or Afr. Amer	208	**33.8**	64	24.2	224	33.7	100	28.3
	Asian	51	**8.3**	77	29.1	84	**12.7**	89	25.2
	Hispanic /Latino	263	**42.8**	68	25.7	236	**35.5**	67	19.0
	White	74	12.0	44	16.6	80	**12.0**	78	22.1
	Two or More Races	19	3.1	12	4.5	39	5.9	18	5.1
FARMS (current or previous)		448	**72.8**	128	48.3	458	**69.0**	168	47.6
ESOL (current or previous)		264	**42.9**	83	31.3	275	**41.4**	86	24.4
Special education (current)		59	**9.6**	14	5.3	50	7.5	28	7.9
		Mean	*(SD)*	*Mean*	*(SD)*	*Mean*	*(SD)*	*Mean*	*(SD)*
State Assessment Reading Scale Score (previous year)		**425**	(35.5)	447	(40.7)	**425**	(32.8)	442	(38.9)

Note. Percentages in bold indicate a significant difference between MYP and non-MYP (Fisher's Exact Test, $p < .05$).

Table D-2
Demographic and Academic Characteristics of All Grade 11 Survey Respondents Previously Enrolled in MYP Schools or Non-MYP Schools

Characteristics		Students previously enrolled in MYP Schools (N = 167)		Students previously enrolled in non-MYP Schools (N = 405)	
		n	%	*n*	%
Gender	Male	86	51.5	181	44.7
	Female	81	48.5	224	55.3
Race/ ethnicity	Black or African American	42	**25.1**	156	38.5
	Asian	27	16.2	61	15.1
	Hispanic/Latino	63	37.7	125	30.9
	White	33	**19.8**	53	13.1
	Two or More Races	1	0.6	9	2.2
FARMS (current or previous)		99	59.3	251	62.0
ESOL (current or previous)		60	**35.9**	112	27.7
Special education (current)		8	4.8	32	7.9
		n	*Mean*	*n*	*Mean*
State Assessment Reading scale score (Grade 8)		163	422.6	334	415.8

Note. Percentages in bold indicate a significant difference between MYP and non-MYP (Fisher's Exact Test, $p < .05$).

Appendix E

Table E-3a
Summary of Regression Analyses for Variables Predicting Survey Scale Score for Gathering Information, Supporting Position: Middle School Students Enrolled in MYP or non-MYP

	Grade 6			Grade 8		
Variable	*B*	SE *B*	*β*	*B*	SE *B*	*β*
Gender (female is higher value)	-.120	.063	-.095	-.092	.054	-.071
FARMS (current or prior receipt)	-.052	.073	-.040	-.118	.065	-.091
ESOL (current or prior receipt)	-.041	.073	-.031	-.010	.070	-.007
Special education (current)	-.351	.132	-.137**	-.030	.100	-.013
Asian	.124	.116	.070	.095	.090	.055
African American	.015	.102	.011	-.004	.082	-.003
Hispanic	-.094	.108	-.070	.108	.092	.070
Two or more race groups	-.074	.167	-.023	-.167	.120	-.063
State Assessment Reading Scale Score	.003	.001	.154**	.005	.001	.245**
Enrolled in MYP	-.144	.061	-.113*	-.099	.052	-.077
R^2		.101			.095	
F		4.373**			5.78	

Note. Reference group for race comparisons was white.
* $p < .05$; ** $p < .01$.

Table E-3b
Summary of Regression Analyses for Variables Predicting Survey Scale Score for Planning and Organizing Information: Middle School Students Enrolled in MYP or non-MYP

	Grade 6			Grade 8		
Variable	*B*	SE *B*	*β*	*B*	SE *B*	*β*
Gender (female is higher value)	-.111	.087	-.065	-.091	.077	-.052
FARMS (current or prior receipt)	-.205	.102	-.116*	-.023	.093	-.013
ESOL (current or prior receipt)	.216	.102	.122*	.026	.101	.013
Special education (current)	-.162	.184	-.047	.177	.143	.056
Asian	.148	.162	.062	.095	.129	.040
African American	.164	.142	.089	.033	.117	.018
Hispanic	.104	.150	.057	.048	.132	.023
Two or more race groups	.001	.233	.000	-.296	.172	-.081
State Assessment Reading Scale Score	.000	.001	.005	.002	.001	.062
Enrolled in MYP	-.219	.086	-.128*	-.103	.075	-.058
R^2		.046			.019	
F		1.864*			1.048	

Note. Reference group for race comparisons was white.
* $p < .05$; ** $p < .01$.

Table E-3c
Summary of Regression Analyses for Variables Predicting Survey Scale Score for Openness to Different Ideas and Flexibility: Middle School Students Enrolled in MYP or non-MYP

	Grade 6			Grade 8		
Variable	*B*	SE *B*	*β*	*B*	SE *B*	*β*
Gender (female is higher value)	-.014	.069	-.010	-.018	.061	-.012
FARMS (current or prior receipt)	-.102	.080	-.071	-.112	.074	-.077
ESOL (current or prior receipt)	.017	.081	.012	.013	.080	.008
Special education (current)	-.399	.145	-.140**	.006	.113	.002
Asian	.090	.128	.046	.234	.102	.121*
African American	-.069	.112	-.046	.017	.093	.011
Hispanic	-.096	.118	-.065	.094	.105	.054
Two or more race groups	-.118	.184	-.034	-.313	.136	-.104*
State Assessment Reading Scale Score	.002	.001	.119*	.004	.001	.180**
Enrolled in MYP	-.253	.067	-.181**	-.143	.059	-.098*
R^2		.108			.085	
F		4.744**			5.147**	

Note. Reference group for race comparisons was white.
* $p < .05$; ** $p < .01$.

Table E-3d
Summary of Regression Analyses for Variables Predicting Survey Scale Score for Goal Setting: Middle School Students Enrolled in MYP or non-MYP

	Grade 6			Grade 8		
Variable	*B*	SE *B*	*β*	*B*	SE *B*	*β*
Gender (female is higher value)	-.054	.086	-.032	-.130	.074	-.077
FARMS (current or prior receipt)	.005	.100	.003	-.062	.089	-.037
ESOL (current or prior receipt)	.054	.100	.031	.013	.096	.007
Special education (current)	-.234	.180	-.070	-.099	.139	-.032
Asian	.064	.159	.028	.166	.123	.074
African American	.001	.139	.000	.094	.111	.053
Hispanic	-.078	.147	-.044	.098	.126	.048
Two or more race groups	-.344	.227	-.084	-.104	.164	-.030
State Assessment Reading Scale Score	.003	.001	.124*	.000	.001	.008
Enrolled in MYP	-.122	.084	-.073	-.106	.072	-.063
R^2		.041			.018	
F		1.627			.987	

Note. Reference group for race comparisons was White.
* $p < .05$; ** $p < .01$.

Table E-3e
Summary of Regression Analyses for Variables Predicting Survey Scale Score for Classroom Practices: Middle School Students Enrolled in MYP or non-MYP

	Grade 6			Grade 8		
Variable	*B*	SE *B*	*β*	*B*	SE *B*	*β*
Gender (female is higher value)	-.023	.048	-.024	.116	.046	.110*
FARMS (current or prior receipt)	.016	.056	.016	.001	.056	.001
ESOL (current or prior receipt)	.039	.057	.038	.015	.060	.013
Special education (current)	-.023	.102	-.012	.057	.085	.030
Asian	.007	.090	.005	-.061	.077	-.043
African American	-.047	.079	-.045	-.025	.070	-.022
Hispanic	-.080	.083	-.078	-.074	.079	-.059
Two or more race groups	-.225	.129	-.094	-.125	.103	-.057
State Assessment Reading Scale Score	.001	.001	.064	.001	.001	.032
Enrolled in MYP	-.233	.047	-.242**	-.106	.045	-.100*
R^2		.073			.029	
F		3.047**			1.67	

Note. Reference group for race comparisons was white.
* $p < .05$; ** $p < .01$.

Appendix F

Table F-10a
Summary of Regression Analyses for Variables Predicting Teachers' Survey Scale Score for Asking and Developing Questions

Variable	B	SE B	β
Years taught	.084	.118	.049
Received Critical Thinking training	.245	.152	.130
MYP teacher	-.181	.124	-.118
R^2		.019	
F		1.391	

* $p < .05$; ** $p < .01$.

Table F-10b
Summary of Regression Analyses for Variables Predicting Teachers' Survey Scale Score for Making Connections

Variable	B	SE B	β
Years taught	.056	.128	.031
Received Critical Thinking training	.010	.164	.005
MYP teacher	.049	.134	.030
R^2		.002	
F		.134	

* $p < .05$; ** $p < .01$.

Table F-10c
Summary of Regression Analyses for Variables Predicting Teachers' Survey Scale Score for Sharing and Collaborating

Variable	B	SE B	β
Years taught	.065	.119	.038
Received Critical Thinking training	.133	.153	.071
MYP teacher	.020	.125	.013
R^2		.008	
F		.569	

* $p < .05$; ** $p < .01$.

Table F-10d
Summary of Regression Analyses for Variables Predicting Teachers' Survey Scale Score for Analyzing

Variable	B	SE B	β
Years taught	.038	.116	.022
Received Critical Thinking training	-.050	.149	-.027
MYP teacher	-.088	.122	-.059
R^2		.007	
F		.467	

* $p < .05$; ** $p < .01$.

Table F-11a
Summary of Regression Analyses for Variables Predicting Teachers' Survey Scale Score for Asking and Developing Questions: English/Reading Teachers and Mathematics Teachers

	English/Reading			Mathematics		
Variable	*B*	SE *B*	*β*	*B*	SE *B*	*β*
Years taught	.051	.198	.038	-.213	.321	-.111
Received Critical Thinking training	.320	.239	.241	.034	.367	.018
MYP teacher	-.077	.206	-.067	.451	.291	.297
R^2		.049			.111	
F		.801			1.330	

* $p < .05$; ** $p < .01$.

Table F-11b
Summary of Regression Analyses for Variables Predicting Teachers' Survey Scale Score for Making Connections: English/Reading Teachers and Mathematics Teachers

	English/Reading			Mathematics		
Variable	*B*	SE *B*	*β*	*B*	SE *B*	*β*
Years taught	.110	.247	.065	-.154	.330	-.073
Received Critical Thinking training	.557	.299	.329	-.431	.378	-.206
MYP teacher	-.219	.257	-.149	.854	.299	.515**
R^2		.084			.212	
F		1.432			2.868*	

* $p < .05$; ** $p < .01$.

Table F-11c
Summary of Regression Analyses for Variables Predicting Teachers' Survey Scale Score for Sharing and Collaborating: English/Reading Teachers and Mathematics Teachers

	English/Reading			Mathematics		
Variable	*B*	SE *B*	*β*	*B*	SE *B*	*β*
Years taught	.158	.225	.105	-.083	.312	-.044
Received Critical Thinking training	.264	.273	.175	-.466	.358	-.244
MYP teacher	-.101	.235	-.077	.658	.283	.436*
R^2		.038			.148	
F		.618			1.855	

* $p < .05$; ** $p < .01$.

Table F-11d
Summary of Regression Analyses for Variables Predicting Teachers' Survey Scale Score for Analyzing: English/Reading Teachers and Mathematics Teachers

	English/Reading			Mathematics		
Variable	*B*	SE *B*	*β*	*B*	SE *B*	*β*
Years taught	.147	.200	.110	-.077	.267	-.046
Received Critical Thinking training	.095	.243	.071	-.533	.306	-.322
MYP teacher	-.159	.209	-.138	.601	.242	.459*
R^2		.022			.172	
F		.347			2.219	

* $p < .05$; ** $p < .01$.